

E=mc²

“ A JOURNEY TO SUCCESS”

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Class 10th Notes 2021-2022

According to the latest NCERT Syllabus....

1. CHEMICAL REACTIONS AND EQUATIONS

Quick Review

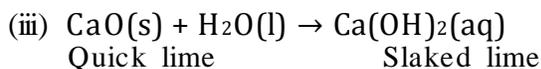
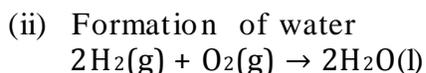
- A chemical reaction is a process in which the original substance(s) lose their nature and identity and form new substance(s) with different properties.
- Breaking of the chemical bonds and formation of the new chemical bonds is responsible for the occurrence of a chemical reaction.
- Examples: Where chemical reactions takes place:
 - (i) Digestion of food
 - (ii) Respiration
 - (iii) Rusting of iron
 - (iv) Burning of Magnesium ribbon
 - (v) Formation of curd
- A chemical reaction can be identified by either of the following observations:
 - (i) Change in state
 - (ii) Change in colour
 - (iii) Evolution of gas
 - (iv) Change in temperature
 - (v) Formation of a precipitate
- Writing a chemical equation:
 - (i) The symbols of elements and the formulae of reacting substances are written on the left hand side with a plus (+) sign between them.
 - (ii) The symbols and formulae of the substances formed are written on the right hand side with a plus sign (+) between them.
 - (iii) An arrow (→) sign is put between the reactants and the products.
 - (iv) The physical states of the reactants and products are also mentioned in a chemical equation.
- **Balanced Equations** The equations in which atoms of various elements on both sides of a chemical equation are equal in accordance with the law of conservation of mass.
- The process of making atoms of various elements equal on either side of an equation is called balancing of chemical equation. This method of balancing the equation is known as hit and trial method.
- The chemical reactions are classified into various categories depending upon the types of changes taking place.

TYPES OF CHEMICAL REACTIONS

I. COMBINATION REACTION: The reaction in which two or more reactant combine to form a single product.

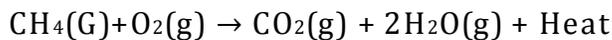
e.g., (i) Burning of coal





Exothermic Reactions: Reaction in which heat is released along with formation of products

e.g., (i) Burning of natural gas.



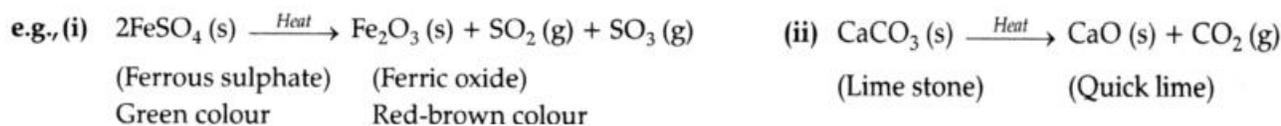
(ii) Respiration is also an exothermic reaction



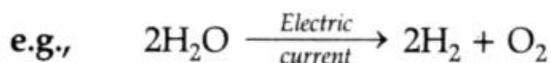
II. DECOMPOSITION REACTION: The reaction in which a compound splits into two or more simple substances is called decomposition reaction.



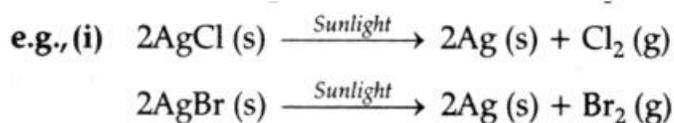
➤ **Thermal decomposition:** When decomposition is carried out by heating.



➤ **Electrolytic Decomposition:** When decomposition is carried out by passing electricity.



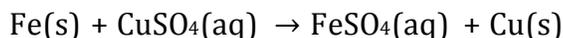
➤ **Photolytic Decomposition:** When decomposition is carried out in presence of sunlight.



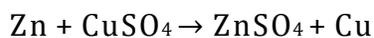
➤ Above reaction is used in black and white photography.

➤ **Endothermic Reaction:** The reactions which require energy in the form of heat, light or electricity to break reactants are called endothermic reactions.

III. DISPLACEMENT REACTION: The chemical reactions in which more reactive element displaces less reactive element from its salt solution.



The iron nail becomes brownish in colour by deposition of Cu and blue colour of CuSO_4 changes dirty green colour due to formation of FeSO_4 .



Zn is more reactive than copper.

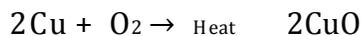
IV. DOUBLE DISPLACEMENT REACTION: A reaction in which new compounds are formed by mutual exchange of ions between two compounds.



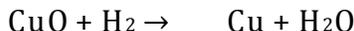
White precipitate of BaSO_4 is formed, so it is also called precipitation reaction.

V. OXIDATION AND REDUCTION:

Oxidation: It is a process of gaining oxygen during a reaction.



Reduction: Reduction is just reverse of oxidation. It is a process of losing oxygen during a reaction.

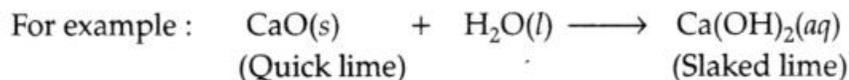


In this reaction CuO is reduced to Cu and H₂ is oxidized to H₂O. In other words, one reactant gets oxidised while the other gets reduced. Such reactions are called oxidation-reduction reactions or redox reactions.

- **Corrosion:** The surface of the reactive metals are attacked by air, water and other substances around it, and corrodes, the process is called corrosion. It is a redox reaction where metal gets oxidised to metal oxide and oxygen gets reduced to oxide ion.
- Rust is mainly hydrated iron (III) oxide Fe₂O₃.H₂O. Rusting weakens the structure of the body of vehicles, bridges, iron railing etc.
- **Prevention of Rusting:**
 - (i) The iron articles should be painted.
 - (ii) The machine parts should be oiled and greased.
 - (iii) Galvanised iron pipes are used for water supply.
 - (iv) Iron can be coated with chromium to prevent rusting.
- **Rancidity:** Rancidity is the process of slow oxidation of oil and fat present in the food materials resulting in the production of foul odour and taste in them.
- When cooked food items are placed for a long time, they become rancid and unsuitable for the consumption.
- **Methods to prevent Rancidity:**
 - (i) Packing of food materials in air tight containers.
 - (ii) Refrigeration of cooked food at low temperature.

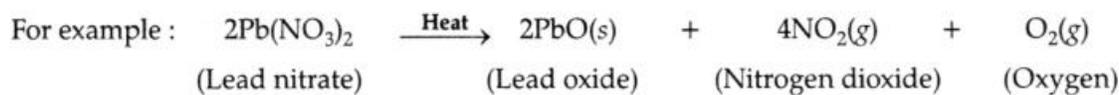
Know the Terms

- **Valency:** The number of electrons shared by an atom is called its valency. It is also called the combining capacity of an atom, e.g., chlorine atom can share one valence electron as its valency is 1, oxygen can share two valence electrons as its valency is 2.
- **Chemical equation:** It is a complete symbolic representation of a chemical reaction involving reactants and products.
- **Balanced equation:** It is the equation in which atoms of various elements on the reactants and the products side are equal. The number of atoms of elements on both the sides of a chemical equation should be equal in accordance with the law of conservation of mass.
- In a combination reaction, two or more reactants combine to give a single product.

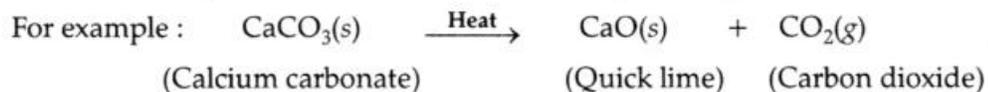


Here, two reactants (quick lime and water) combine to produce a single product (slaked lime)

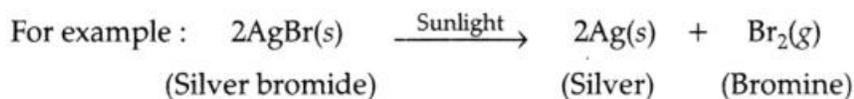
- In a **decomposition reaction**, a single reactant breaks down into two or more simpler products.



- When a decomposition reaction is carried out by heating, it is called **thermal decomposition reaction**.



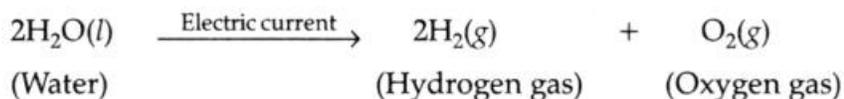
- When a decomposition reaction is carried out in the presence of sunlight, the process is called as **photochemical decomposition**.



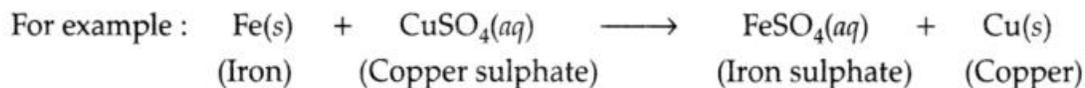
This decomposition is used in black and white photography.

- **Electrolysis:** When a decomposition reaction is carried out with the help of electric current, the process is called electrolysis.

For example: When an electric current is passed through acidified water, it decomposes into hydrogen and oxygen gas.

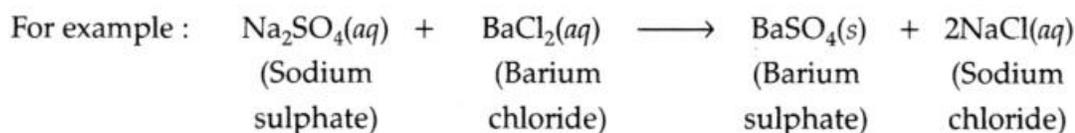


- In a displacement reaction, a more reactive element displaces a less reactive element from a compound.

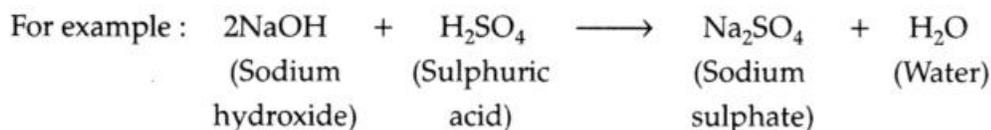


Here, more reactive element (Iron) displaces the less reactive element (Copper) from the salt of copper.

- The reactions in which the different atoms or group of atoms are displaced by other atoms or group of atoms, i.e. two compounds exchange their ions and one of the products formed is insoluble, are said to be **double displacement reactions**.

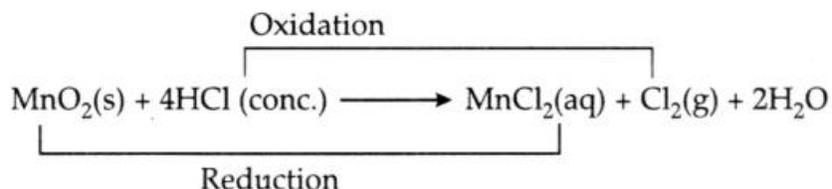


- The reactions in which acid or acidic oxide reacts with base or basic oxide to form salt and water are called **neutralization reactions**.



- Oxidation is a process in which oxygen or an electronegative element is added. It can also be defined as a process in which hydrogen or an electropositive element is removed. In terms of electronic concept, oxidation is a process in which loss of electrons takes place.

- Reduction is a process in which addition of hydrogen or an electropositive element takes place. It is also defined as a process in which oxygen or an electronegative element is removed. In electronic concept, reduction process involves the gain of electrons.
- Those reactions in which oxidation and reduction take place simultaneously are called redox reactions. For example:



- Oxidising agent is a substance which can add oxygen or an electronegative element to other materials. It can also remove hydrogen or an electropositive element from other materials.
- Reducing agent is a substance which can add hydrogen or an electropositive element to other materials. It can also remove oxygen or an electronegative element from other materials.

Questions:

1. What is chemical combination reaction? [SSLC July, 2018]

Ans: When two or more substances combine to form a single product, the reactions are called combination reactions.

2. Is burning of a candle, a physical change or a chemical change? [NCERT Exemplar]

Ans: Both, chemical change and physical change.

3. Write a balanced chemical equation for the following reaction.

Ethanol is warmed with ethanoic acid to form ethyl acetate in the presence of concentrated H_2SO_4 . [NCERT Exemplar]



4. In test-tubes A and B, zinc sulphate solution and silver nitrate solution are taken respectively. Copper turnings are added to both test-tubes. In which of the two test-tubes do you observe the reaction. Justify your answer with scientific reason. [SSLC June, 2018]

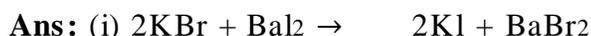
Ans: Test-tube B containing silver nitrate solution. Because copper being more reactive than silver, displaces silver from silver nitrate solution.

5. Write the balanced chemical equations for the following chemical reactions.

(i) Potassium bromide reacts with Barium iodide.

(ii) Zinc carbonate is heated.

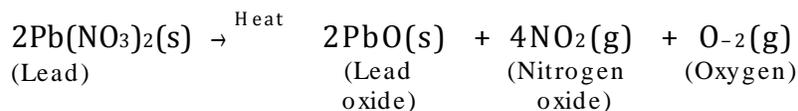
[SSLC July, 2016]



6. Which coloured fumes are obtained when lead nitrate is heated? Write the balanced chemical equation for this reaction. Name the type of this chemical reaction.

[SSLC July, 2016]

Ans: Brown coloured fumes

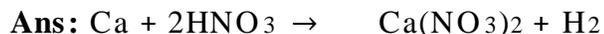


7. A copper plate was dipped into a solution of silver nitrate. After sometime, a black layer was observed on the surface of copper plate. State the reason for it and write chemical equation of the reaction involved.

Ans: Black layer was deposited due to coating of silver, because copper being more reactive than silver, displaced silver from silver nitrate solution.



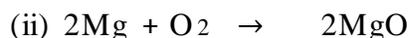
8. Give reactions of calcium and magnesium with dilute nitric acid.



9. Convert the following statements into balanced chemical equations:

(i) Zinc reacts with sulphuric acid to form zinc sulphate and hydrogen gas.

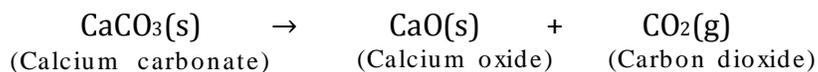
(ii) Magnesium burns in oxygen to form magnesium oxide.



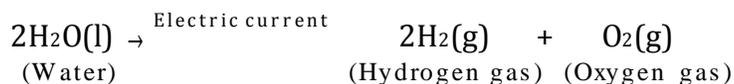
10. Define the term decomposition reaction. Give one example each of thermal decomposition and electrolytic decomposition.

Ans: In a decomposition reaction, a single reactant breaks down into two or more simpler products.

When a decomposition reaction is carried out by heating, it is called thermal decomposition reaction.



(Calcium carbonate) (Calcium oxide) (Carbon dioxide) When a decomposition reaction is carried out with the help of electric current, the process is called electrolysis.



11. Write the steps for balancing the chemical equation for the formation of ammonia by the combination of nitrogen and hydrogen.

Ans: $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$ (Unbalanced equation).

(i) Examine the number of atoms of different elements present in the unbalanced equation.

(ii) In the above reaction, N and H of both the sides are unbalanced.

(iii) To balance hydrogen, H_2 is multiplied by 3. It makes 6H – atoms on the left hand side.

(iv) Now to balance hydrogen atoms on the right hand side, NH_3 should be multiplied by 2. It makes 6H-atoms on this side.

(v) Now to balance nitrogen atoms, they are counted separately for both the sides and we will find that, nitrogen atoms are 2 on both the sides.

(vi) Balanced chemical equation will be: $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

12. (a) Mention the four informations given by an equation.

(b) State the law of conservation of mass as applicable in a chemical reaction.

Ans: (a) (i) Physical state of reactants and products.

(ii) Conditions such as temperature, pressure, heat etc.

(iii) Catalyst involved.

(iv) Change in state.

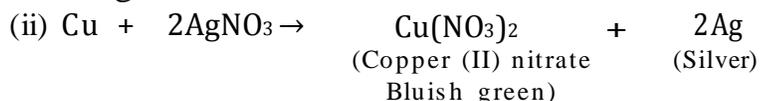
(b) Total mass of the elements present in the products in a chemical reaction has to be equal to the total mass of elements present in the reactants or Mass can neither be created nor destroyed in a chemical reaction.

13. When a copper wire was left in silver nitrate solution for sometime, it was observed that the solution turned bluish green.

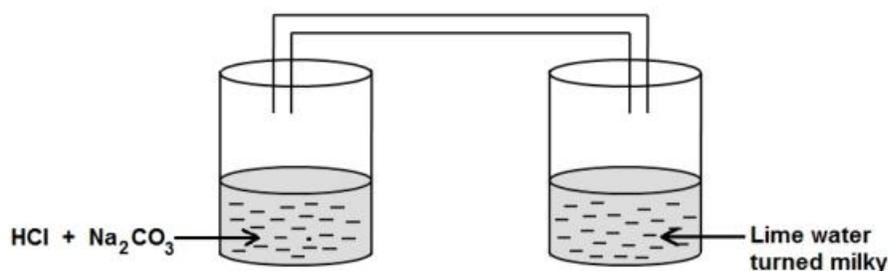
(i) Explain the observation.

(ii) Write the balanced chemical equation to represent the change taking place.

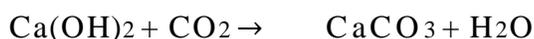
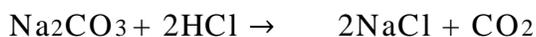
Ans: (i) Copper is more reactive than silver. Hence, when copper wire is dipped in silver nitrate solution, it displaces silver from AgNO_3 solution forming copper nitrate which is bluish green in colour.



14. What do you observe in activity given in the figure? What are the causes of these observations, explain giving reaction?



Ans: Due to reaction of sodium carbonate with dilute hydrochloric acid, carbon dioxide gas is produced. Lime water turned milky when CO_2 is passed through it, due to the formation of calcium carbonate.



15. (i) $2\text{PbO} + \text{C} \rightarrow 2\text{Pb} + \text{CO}_2$

(ii) $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$

What is redox reaction? Identify the substance oxidised and the substance reduced in the above reactions.

Ans: Those reactions in which both oxidation and reduction occur simultaneously.

(i) PbO is reduced, C is oxidised.

(ii) HCl is oxidised, MnO_2 is reduced.

16. Identify the type of reaction from the following equation and define it.



Ans: Exothermic reaction: It is a reaction in which heat energy is released along with the formation of products.

17. Write the balanced chemical equation for the following reaction and identify the type of reaction and define it. Iron III oxide reacts with aluminium and gives molten iron and aluminium oxide. [Board Term-I Set -15, 2012]



Displacement reaction is the reaction in which one element displaces another element.

18. A silver article generally turns black when kept in the open for a few days. The articles when rubbed with toothpaste again starts shining.

(i) Why do they turn black? Name the phenomenon involved.

(ii) Name the black substance formed and write its formula. [NCERT Exemplar]

Ans: (i) Silver article reacts with sulphur compounds such as H_2S present in air. The phenomenon called corrosion. For silver particularly, it is called tarnishing of silver.

(ii) The black substance is silver sulphide (Ag_2S).

19. What is rancidity? 'Mention any two ways by which rancidity can be prevented.

Ans: The oxidation of oils or fats in a food resulting into bad smell and bad taste is called rancidity. It can be prevented by —

(i) Adding anti-oxidants. (ii) Flushing with nitrogen gas.

20. Name the term used to indicate the development of unpleasant smell and taste in fat and oil containing food due to oxidation. What are anti-oxidants? Why are they added to fat and oil containing food.

Ans: Rancidity.

Antioxidants are substances that inhibit oxidation, especially one used to counter act the deterioration of stored food products.

Antioxidants are added to the food materials containing fats and oils to prevent their oxidation. Oxidation of food materials containing fats and oils is known as rancidity because of which the food becomes unfit for consumption and develop bad odour.

21. Name two metals which do not corrode easily. Give an example in each of the following case to support that:

(i) Corrosion of some metals is an advantage.

(ii) Corrosion of a metal is a serious problem.

Ans: Gold and platinum.

(i) Corrosion of aluminium is useful. A protective layer of aluminium oxide is formed on the surface of the metal which renders the metal passive and prevents it from further corrosion.

(ii) Corrosion of iron is a serious problem. Every year large amount of money is spent to replace damaged iron and steel structures. Here corrosion is a serious problem.

22. The following diagram displays a chemical reaction. Observe carefully and answer the following questions:



(i) Identify the type of chemical reaction that will take place and define it. How will the colour of the salt change?

(ii) Write the chemical equation of the reaction that takes place.

(iii) Mention one commercial use of this salt.

Ans: (i) Photochemical decomposition: A single reactant breaks down to give simpler products. White silver chloride changes to grey, as it decomposes to silver and chlorine in presence of sunlight.

(ii) $2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$

(iii) Black and white photography

23. (i) Define corrosion.
 (ii) What is corrosion of iron called?
 (iii) How will you recognise the corrosion of silver?
 (iv) Why corrosion of iron is a serious problem?

Ans: (i) Corrosion is a process in which metals are deteriorated by action of air, moisture, chemicals, etc.

(ii) Corrosion of iron is called Rusting.

(iii) Silver turns black as it reacts with H₂S present in air and form a layer of Ag₂S.

(iv) Corrosion of iron is a serious problem because it leads to wastage of tonnes of iron every year and lot of money is spent to repair or replace it:

24. (i) Account for the following:

(a) White silver chloride turns grey in sunlight.

(b) Brown coloured copper powder on heating in air turns into black coloured substance

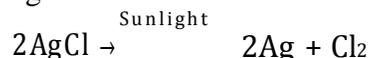
- (ii) What do you mean by:

(a) Displacement reaction

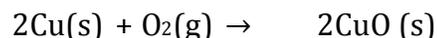
(b) Reduction reaction

Write balanced chemical equation.

Ans: (i) (a) Due to the decomposition of silver chloride into silver and chlorine by sunlight.



(b) Due to the oxidation of copper powder to copper oxide, brown colour turns into black



- (ii) (a) A chemical reaction in which the more reactive element displaces the less reactive element from its compound is called displacement reaction.



(b) A chemical reaction in which hydrogen is added or oxygen is removed is called reduction reaction.



25. (i) Balance the following chemical equation



- (ii) What is decomposition reaction? Explain it with suitable example.

Ans: (i) $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$

(ii) A simple reactant breaks down to give simpler products and the process is known as decomposition reaction.

Example: $\text{CaCO}_3(\text{s}) \xrightarrow{\text{Heat}} \text{CaO(s)} + \text{CO}_2(\text{g})$
 (Quicklime)

TEXTBOOK EXERCISES:

1. Which of the statements about the reaction below are incorrect?



(a) Lead is getting reduced.

(b) Carbon dioxide is getting oxidised.

(c) Carbon is getting oxidised.

(d) Lead oxide is getting reduced

(i) (a) and (b) (ii) (a) and (c)

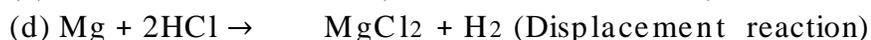
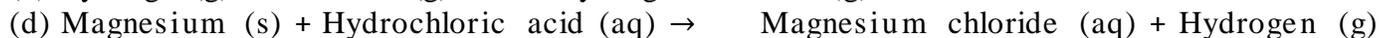
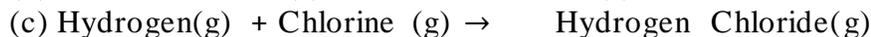
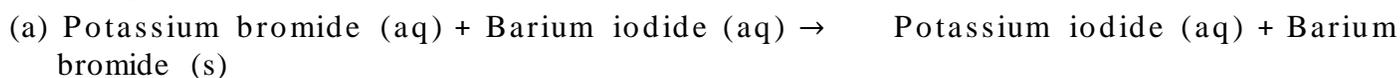
(iii) (a), (b) and (c)

(iv) All

Ans: (i) (a) and (b) are correct.

2. $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$ The reaction is an example of:
- (a) Combination reaction. (b) Double displacement reaction.
 (c) Decomposition reaction. (d) Displacement reaction.
- Ans:** (d) Displacement reaction.
3. What happens when dilute hydrochloric acid is added to iron fillings? Tick the correct answer.
- (a) Hydrogen gas and iron chloride are produced.
 (b) Chlorine gas and iron hydroxide are produced.
 (c) No reaction takes place.
 (d) Iron salt and water are produced.
- Ans:** The reaction can be written as $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$
 \therefore The correct option is (a)
4. What is a balanced chemical equation? Why should chemical equations be balanced?
- Ans:** Balanced chemical equation is that equation in which
 (a) Number of different atoms in reactants and products are equal.
 (b) The mass of the reactants and products is equal.
- The chemical equation should be balanced to follow the law of conservation of mass.
5. Translate the following statements into chemical equations and then balance them.
- (a) Hydrogen gas combines with nitrogen to form ammonia.
 (b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.
 (c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.
 (d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.
- Ans:** (a) $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$
 (b) $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{SO}_2$
 (c) $3\text{BaCl}_2 + \text{Al}_2(\text{SO}_4)_3 \rightarrow 3\text{BaSO}_4 + 2\text{AlCl}_3$
 (d) $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$
6. Balance the following chemical equation.
- (a) $\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$
 (b) $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$
 (c) $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
 (d) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{HCl}$
- Ans:** (a) $2\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$
 (b) $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$
 (c) $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
 (d) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$
7. Write the balanced chemical equations for the following reactions.
- (a) Calcium hydroxide + Carbon dioxide \rightarrow Calcium carbonate + Water
 (b) Zinc + Silver nitrate \rightarrow Zinc nitrate + Silver
 (c) Aluminium + Copper chloride \rightarrow Aluminium chloride + Copper
 (d) Barium chloride + Potassium sulphate \rightarrow Barium sulphate + Potassium chloride
- Ans:** (a) $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
 (b) $\text{Zn} + 2\text{AgNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{Ag}$
 (c) $2\text{Al} + 3\text{CuCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Cu}$
 (d) $\text{BaCl}_2 + \text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{KCl}$

8. Write the balanced chemical equation for the following and identify the type of reaction in each case.

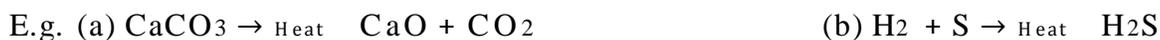


9. What does one mean by exothermic and endothermic reactions? Give examples.

Ans: Exothermic reactions are those reactions during which heat energy is released.



Those chemical reactions in which heat energy is required to carry out the reactions are called endothermic reactions.



10. Why is respiration considered an exothermic reaction? Explain.

Ans: Heat released during the process of respiration therefore, respiration is considered as an exothermic reaction.



11. Why are decomposition reactions called opposite of combination reactions? Write equations for these reactions.

Ans: In decomposition reactions, larger molecules break to give smaller molecules while in combination reactions, two or smaller units combine to give larger molecules.

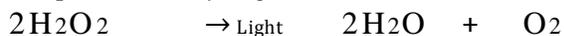
12. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

Ans: *Decomposition by heat:*



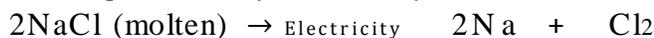
Methane Carbon Hydrogen

Decomposition by light:



Hydrogen peroxide Water Oxygen

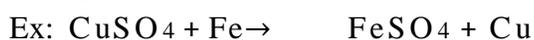
Decomposition by electricity:



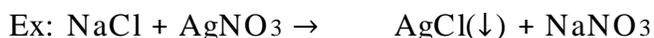
Sodium chloride Sodium Chlorine

13. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Ans: In displacement reactions, more reactive metal displaces less reactive metal from its aqueous salt solutions.



In double displacement reactions, exchange of ions takes place when the aqueous solutions of two salts get mixed together.



14. In the refining of silver, the recovery of silver from silver nitrate solution involves displacement by copper metal. Write down the reaction involved.



15. What do you mean by precipitation reaction? Explain by giving examples.

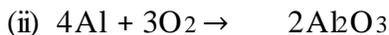
Ans: The chemical reactions in which a solid product or precipitate is formed are called precipitation reactions. Examples are.



16. Explain the following in terms of gain or loss of oxygen with two examples each.

(a) Oxidation (b) Reduction

Ans: (a) Oxidation: The gain of oxygen is called oxidation.

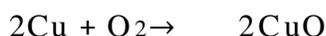


(b) Reduction The loss of oxygen is called reduction.



17. A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Ans: Element 'X' is copper and black coloured compound is copper oxide.



18. Why do we apply paint on iron articles?

Ans: To prevent the exposure of iron articles to air and moisture, thereby preventing corrosion.

19. Oil and fat containing food items are flushed with nitrogen. Why?

Ans: As nitrogen is inert in nature and checks the growth of decomposing microbes and also protect from oxygen, so oil and fat containing food items are flushed with nitrogen.

20. Explain the following terms with one example each.

(a) Corrosion (b) Rancidity

Ans: (a) *Corrosion*: The slow eating up of metals by the reaction of some atmospheric gases like oxygen, carbon-dioxide or water vapour is known as corrosion.

E.g.: The copper articles get coated with green colour which is due to the formation of basic copper carbonate.

(b) *Rancidity*: Rancidity may be defined as the natural oxidation of the oils and fats, which are present in food items, giving bad smell and taste.

E.g.: Food items, containing fats and oils, give bad smell when they exposed to air for a long time.

2. ACIDS, BASES AND SALTS

Quick Review

- Acids are sour in taste. They turn blue litmus red. Acids are the substances that furnish H ions in aqueous solution.
- If in an aqueous solution, concentration of acid is low, it is called dilute solution and if concentration of acid is high, it is called concentrated solution.
- Hydrochloric acid is released in stomach to make medium acidic in nature. It leads to coagulation of protein and helps in their digestion. HCl kills bacteria coming to the stomach along with the food.
- When a burning matchstick is brought near the hydrogen gas, it burns with a pop sound.
- When CO₂ gas is passed through lime water, it turns milky. If CO₂ is passed in excess, milkiness disappears.
- There are many natural substances like red onion peels, red cabbage leaves, beetroot extract, coloured petals of some flowers. They are called indicators because they indicate the presence of acid or base by showing the change in colour.
- Acids react with certain metal oxides to form salt and water. Acids react with metal carbonates and hydrogen carbonates to produce carbon dioxide gas.
- Strong bases react with active metals to produce hydrogen gas. Bases react with non-metallic oxides to produce salt and water.
- Both acids and bases conduct free electric current in their aqueous solution due to the presence of free ions.
- Strength of an acid or base depends on the number of H⁺ ions or OH⁻ ions produced by them respectively. More the H⁺ ions produced by an acid, stronger is the acid. More the OH⁻ ions produced by a base, stronger is the base.

Indicators:

These are the substances which change their colour / smell in different types of substances.

Types of Indicators

Natural indicators

Found in nature in plants.

Litmus, red cabbage leaves extract, flowers of hydrangea plant, turmeric

Synthetic indicators

These are chemical substances.

Methyl orange, phenolphthalein

Olfactory indicators

These substances have different odour in acid and bases.

	S.No.	Indicator	Smell/Colour in acidic solution	Smell/Colour in basic solution
Natural Indicator	1.	Litmus	Red	Blue
	2.	Red cabbage leaf extract	Red	Green
	3.	Flower of hydrangea plant	Blue	Pink
	4.	Turmeric	No change	Red

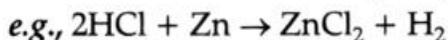
Synthetic Indicator	[1.	Phenolphthalein	Colourless	Pink
		2.	Methyl orange	Red	Yellow
Olfactory Indicator	[1.	Onion	Characteristic smell	No smell
		2.	Vanilla essence	Retains smell	No smell
		3.	Clove oil	Retains smell	Loses smell

Chemical Properties of Acids and Bases

Reaction of Metals with

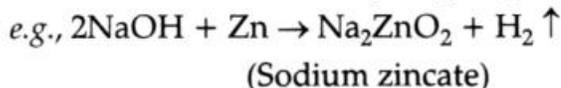
Acids

Acid + Metal → Salt + Hydrogen gas



Bases

Base + Metal → Salt + Hydrogen gas



Hydrogen gas released can be tested by ringing burning candle near gas bubbles, it burst with pop sound.

Reaction of Metal Carbonates/Metal Hydrogen Carbonates with

Acids

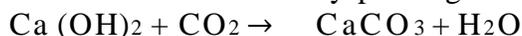
Bases

Add + Metal Carbonate / Metal hydrogen Carbonate → Base + Metal Carbonate / Metal Hydrogen Carbonate.

Salt + CO₂ + H₂O

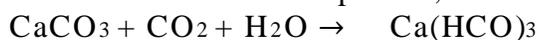


- CO₂ can be tested by passing it through lime water.



(Lime water turns milky.)

- When excess CO₂ is passed,



(Milkyness disappears.)

Reaction of Acids and Bases With Each Other

Acid + Base → Salt + H₂O

Neutralisation Reaction: Reaction of acid with base is called as neutralization reaction.



IF:

Strong Add + Weak Base → Acidic salt + H₂O

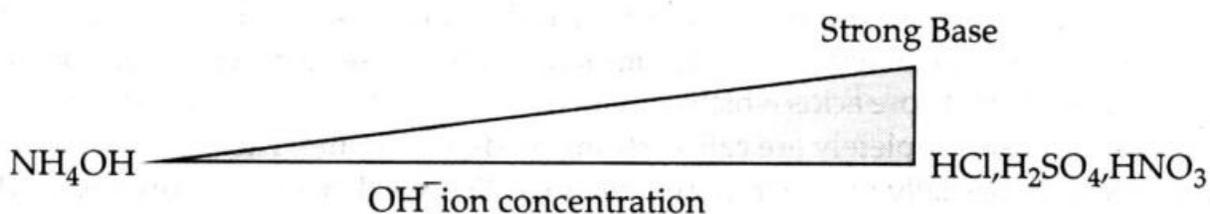
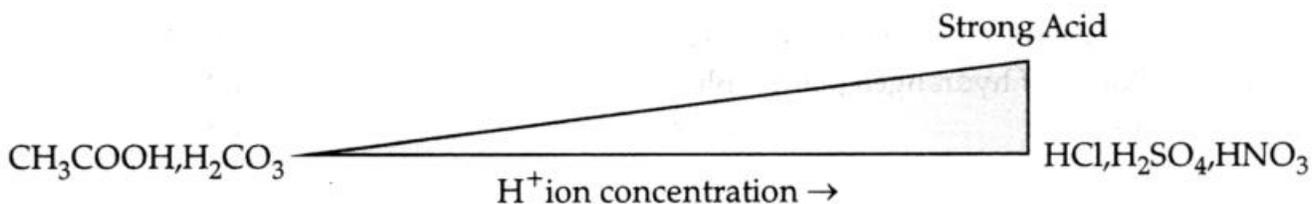
Weak Add + Strong Base → Basic salt + H₂O

Strong Add + Strong Base → Neutral salt + H₂O

Weak Acid + Weak Base → Neutral salt + H₂O

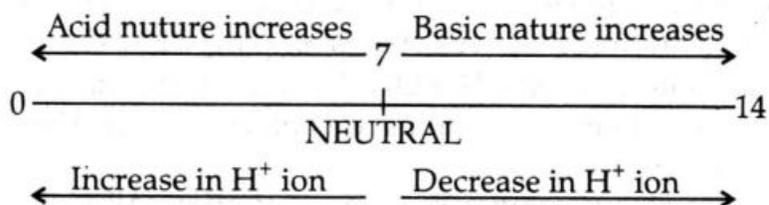
- pH of stomach is 1.5 – 3.0 due to secretion of HCl. In case of indigestion, acidity increases which can be neutralized by antacids like milk of magnesia.
- Cold drinks, chocolates and sweets are most harmful for health as well as tooth. They produce acids in mouth which are responsible for tooth decay.
- Salts of a strong add and a strong base are neutral with pH value of 7.

- Salts have various uses in everyday life and in industries.
- A salt is soluble if it dissolves in water to give a solution with a concentration of at least 0.1 moles per litre at room temperature.
- **pH Scale:** A scale for measuring H⁺ ion concentration in a solution. p in pH stands for 'potenz' a German word which means power.
 - pH = 7 → neutral solution
 - pH less than 7 → acidic solution
 - pH more than 7 → basic solution



On diluting an acid pH increases ↑

On diluting a base : pH decreases ↓

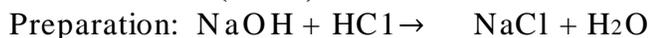


Importance of pH in everyday life

- Plants and animals are pH sensitive
 - Our body works within the pH range of 7—7.8.
 - When pH of rain water is less than 5.6, it is called acid rain.
- pH of the soil
 - Plants require a specific pH range for their healthy growth.

➤ Salts: Salts are formed when an acid and base reacts with each other Types of Salts:

1. Common Sal (NaCl):



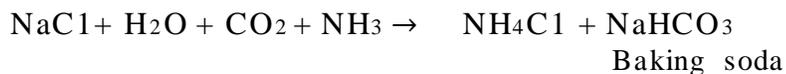
2. Bleaching Powder (CaOCl₂): It is produced by the action of chlorine on dry slaked lime.



Uses:

- | | |
|--|---|
| (a) Bleaching cotton and linen in textile industry | (b) Bleaching wood pulp in paper factories. |
| (c) Oxidizing agent in chemical industries. | (d) Disinfecting drinking water. |

3. Baking Soda (Sodium Hydrogen Carbonate) (NaHCO_3):



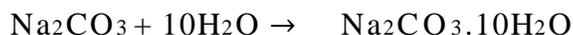
- It is mild non-corrosive base.
- When it is heated during cooking:
 $2\text{NaHCO}_3 \xrightarrow{\Delta} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

Uses:

- (a) For making baking powder (mixture of baking soda and tartaric acid). When baking powder is heated or mixed with water, CO_2 is produced which causes bread and cake to rise making them soft and spongy.
- (b) An ingredient in antacid.
- (c) Used in soda acids, fire extinguishers.

4. Washing Soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$):

Recrystallization of sodium carbonate gives washing soda. It is a basic salt.

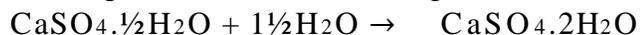


Uses:

- (a) In glass, soap and paper industry.
- (b) Manufacture of borax.

5. Plaster of Paris (Calcium sulphate hemihydrates) ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$):

On heating gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) at 373K, it loses water molecules and becomes Plaster of Paris (POP). It is white powder and on mixing with water it changes to gypsum.



Uses:

- (a) Doctors use POP for supporting fractured bones.
- (b) For making toys, material for decoration.

Know the Terms

- Those substances which turn blue litmus solution red are called acidic. The term 'acid' has been derived from the Latin word 'acidus' which means sour. Acids are sour in taste. They give H^+ ions in aqueous solution.
Example: HCl , H_2SO_4 , HNO_3 , CH_3COOH .
- These substances which change their colour (or odour) in acidic or basic solutions are called **indicators**.
- The acids which are obtained from minerals are called **mineral acids**. Those acids which are obtained from plants and animals are called organic acids. Those acids which contain minimum amount of water are called **concentrated acids**.
- The acids which ionise almost completely are called **strong acids**, e.g., mineral acids.
- The acids which ionise only partially or to a lesser extent are called **weak acids**, e.g., organic acids.
- Substances that furnish hydroxide ions (OH^-) in aqueous solution are called bases. Bases have bitter taste and produce blue colour in litmus solution.
- The substances / bases which ionise completely to furnish OH^- ions are called **strong bases**, e.g., KOH , NaOH etc. The bases which ionise only partially are called **weak bases** e.g., $\text{Mg}(\text{OH})_2$, $\text{Cu}(\text{OH})_2$ etc.

- Water soluble bases are called **alkalies**, e.g., NaOH, KOH. Thus, all alkalies are bases but all bases are not alkali.
- When a concentrated acid or base is diluted, a vigorous reaction takes place. The process is called **dilution**. It is an exothermic process as a lot of heat is produced.
- The process of forming ions in aqueous solution is called **ionisation**. All ionic compounds like NaCl, NaNO₃, Na₂SO₄ form ions in aqueous solution.
- A **universal indicator** is a mixture of many different indicators which shows a gradual but well marked series of colour changes over a very wide range of change in concentration of H⁺ ions.
- **pH** is the scale for measuring hydrogen ion concentration. The concentrations of H⁺ are generally small, therefore concentrations of H⁺ are expressed in terms of pH. pH is defined as negative logarithm of H⁺ concentration or H₃O⁺ concentration.

$$\text{pH} = -\log [\text{H}^+] \text{ or } \text{pH} = -\log[\text{H}_3\text{O}^+]$$
- The reaction in which base or basic oxide reacts with acid or acidic oxide is called **neutralisation reaction**.
 Example: $\text{NaOH}_{(\text{aq})} + \text{HCl}_{(\text{aq})} \rightarrow \text{NaCl}_{(\text{aq})} + \text{H}_2\text{O}$
- A salt is an ionic compound that results from the neutralization reaction of an acid and a base. Salts are composed of related numbers of cations and anions, so that, the product is electrically neutral.

Questions:

1. The group of compounds that will dissociate partially in aqueous solution is
 - (a) Hydrochloric acid, Nitric acid
 - (b) Carbonic acid, phosphoric acid
 - (c) Hydrochloric acid, phosphoric acid
 - (d) Copper sulphate solution, sugar solution

[SSLC April, 2018]

Ans: (b) Carbonic acid, phosphoric acid.
2. How is the concentration of hydronium ions (H₃O⁺) affected, when a solution of an acid is diluted?

[NCERT Exemplar]

Ans: When a solution of an acid is diluted i.e., water is added to it, the concentration of H₃O⁺ ions per unit volume decreases.
3. What is meant by the term pH of a solution? The pH of rain water collected from two cities A and B was found to be 6 and 5 respectively. The water of which city is more acidic?

Ans: pH of a solution is a measure of the H⁺ concentration in a solution. Lesser the pH, more acidic is the solution. Thus, rain water of city B is more acidic.
4. Explain why, an aqueous solution of sodium sulphate is neutral while an aqueous solution of sodium carbonate is basic in nature.

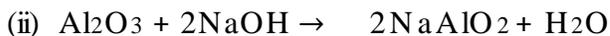
Ans: Sodium sulphate is a neutral salt because it is made from strong acid and strong base. Sodium carbonate is a basic salt because it is made from strong base and weak acid.
5. What is the change in pH values of milk when it changes into curd? Explain.

Ans: pH decreases.
 It is due to the formation of lactic acid in curd. Since, acids generally have a low pH value, so, when milk changes to curd its pH will decrease.

6. Dry HCl gas does not change the colour of dry blue litmus paper. Give reasons.

Ans: In dry state, HCl gas does not give any H⁺ ions. It does not behave as an acid. That is why the colour of litmus paper does not change.

7. Write chemical equations that shows aluminium oxide reacts with acid as well as base.



8. Though the compounds such as glucose and alcohol have, hydrogen atoms in their molecules yet they are not categorised as acids. Why?

Ans: Glucose and alcohol do not produce H⁺ ions, when dissolved in water. The acids contain hydrogen. When acid is dissolved in water, it produces H⁺ ions.

9. (a) What is the action of litmus on: [SSLC July, 2018]

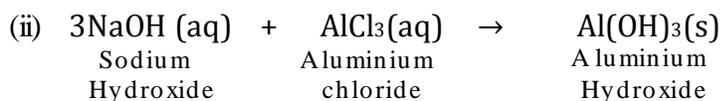
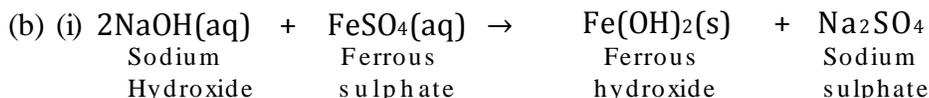
- (i) Dry ammonia gas (ii) Solution of ammonia gas in water

(b) State the observations you would make on adding sodium hydroxide to aqueous solution of:

- (i) Ferrous sulphate (ii) Aluminium chloride.

Give balanced chemical equations.

Ans: (a) (i) No change in colour. (ii) Red litmus turns blue.



10. Name the acid present in the following:

- (i) Tomato, (ii) Vinegar, (iii) Tamarind

Ans: (i) Tomato: Malic acid and citric acid

(ii) Vinegar: Acetic acid

(iii) Tamarind: Tartaric acid and citric acid.

11. To the three solutions listed below, a few drops of phenolphthalein and blue litmus were added separately. Specify the colour change in each case, if any:

- (i) Sodium carbonate (ii) Hydrochloric acid (iii) Sodium chloride

Ans:

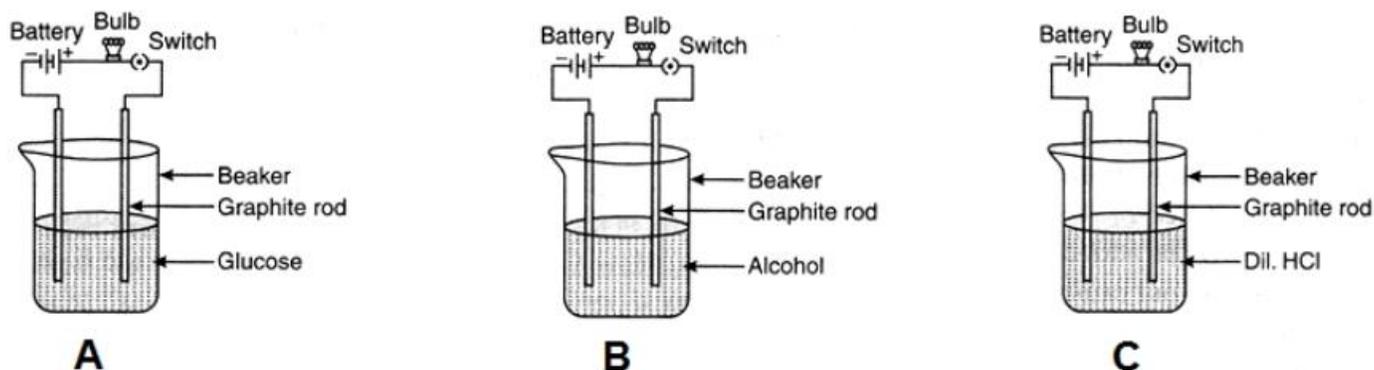
	Name of the solution	Colour change phenolphthalein	Colour change with blue litmus
(i)	Sodium carbonate	Turns pink	no change
(ii)	Hydrochloric acid	no change	Turns red
(iii)	Sodium chloride	no change	no change

12. A student takes three beakers A, B and C filled with aqueous solution of glucose, alcohol and hydrochloric acid respectively as shown in the following figure:

(i) State your observation in terms of glowing of bulb when the switch is on.

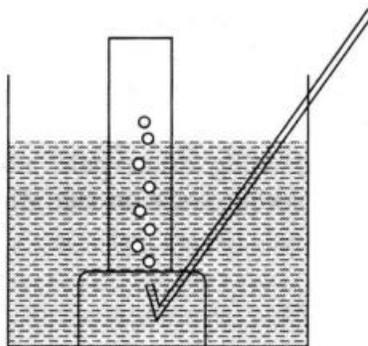
(ii) Justify your observations by giving reason in each case.

(iii) Mention the change noticed with appropriate reason if the content of beaker B is replaced by sodium hydroxide solution.



- Ans:** (i) Bulb A and B do not glow but bulb C glows.
(ii) Glucose and alcohol solutions do not conduct electricity as they do not have ions. Dil. HCl contains ions so the flow of ions is responsible for the flow of current.
(iii) After replacement, bulb glows in B as NaOH solution contains ions (Na^+ and OH^- ions)

13. A metal is treated with dilute sulphuric acid. The gas evolved is collected by the method shown in the figure:



- Name the gas.
- Is the gas soluble or insoluble in water?
- Is the gas lighter or heavier than air?
- How will you test the gas?
- If the metal used above is zinc then write the chemical equation for the evolution of gas.
- Write one industrial use of the gas evolved.

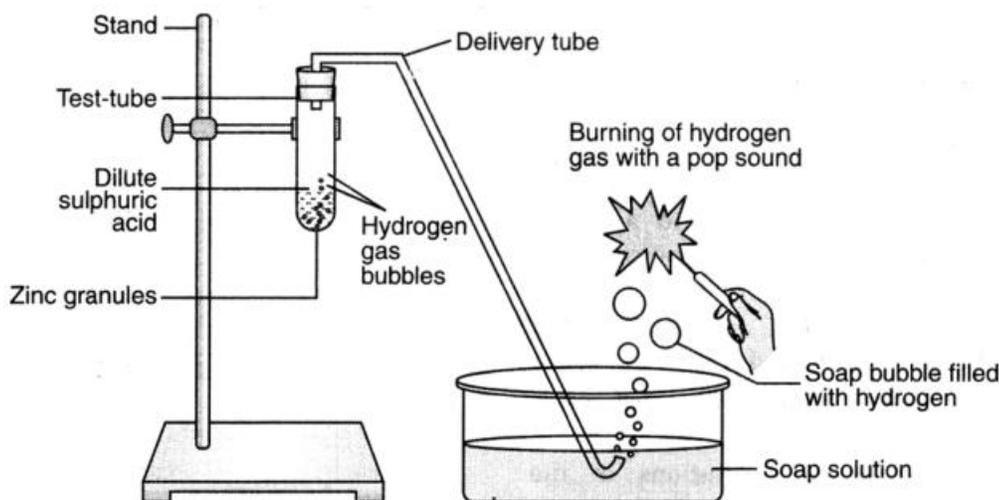
- Ans:** (i) Hydrogen gas.
(ii) Is soluble in water.
(iii) Gas is lighter than air.
(iv) Test for H_2 Gas: Bring a burning matchstick near the gas jar. It burns with a pop sound.
(v) $\text{Zn(s)} + \text{H}_2\text{SO}_4(\text{dil}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{H}_2(\text{g}) \uparrow \frac{1}{2} \times 6$
(vi) Liquid hydrogen is used as a fuel in rockets.

14. While eating food, you happen to spill some curry on your white shirt. You immediately scrub it with soap. What happens to its yellow colour on scrubbing with soap? Why? What happens to this stain when the shirt is washed with plenty of water?

Ans: The colour changes from yellow to reddish brown. Soap is basic in nature and the colour of turmeric changes from yellow to reddish brown in basic medium. The stain turns yellow again.

15. In the following schematic diagram for the preparation of hydrogen gas as shown in figure, what would happen if the following changes are made? [SSLC April, 2018]

- (a) In place of zinc granules, same amount of zinc dust is taken in the test tube.
- (b) Instead of dilute sulphuric acid, dilute hydrochloric acid is taken.
- (c) In place of zinc, copper turnings are taken.
- (d) Sodium hydroxide is taken in place of dilute sulphuric acid and the test tube is heated.



- Ans:** (a) Rate of reaction will be faster as surface area increases. -
 (b) No net effect will be there as both are the strong acids.
 (c) No reaction will take place as copper is less reactive than hydrogen.
 (d) Zinc can also react with NaOH to give hydrogen gas.



16. (i) Define universal indicator. For what purpose it is used?
 (ii) Two solutions A and B have pH values of 3.0 and 9.5 respectively. Which of these will turn litmus solution from blue to red and which will turn phenolphthalein from colourless to pink?
 (iii) Water is a neutral substance. What colour will you get when you add a few drops of universal indicator to a test tube containing distilled water?

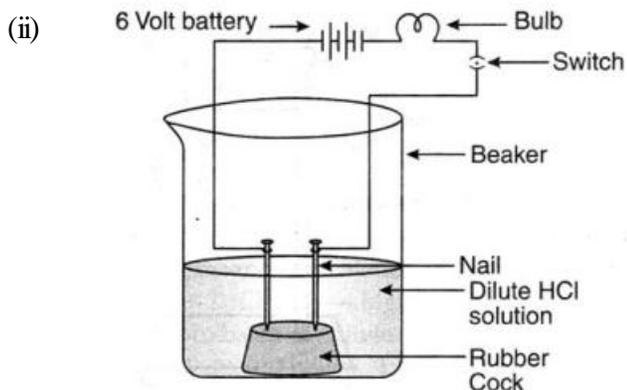
Ans: (i) Universal indicator is a mixture of many different indication (or dyes) which give different colours at different pH values of the entire pH scale. The colour produced by universal indicator is used to find the pH value of acid or base by matching the colour with the colours on pH colour chart.

(ii) Solution A is acidic and will turn litmus solution from blue to red. Solution B is basic and will turn phenolphthalein from colourless to pink.

(iii) Green colour will be obtained.

17. (i) A local magician was showing magic in a village street. He took egg shell and poured a solution over it. As a result, effervescences were formed. When he took a burning matchstick over it, it went off.
- (a) Identify the solution poured and the substance present in egg shell.
 - (b) What is the reason behind effervescences?
 - (c) Write its balanced chemical equation.
 - (d) Give the common name of the substance present in the egg shell.
- (ii) Draw a labelled diagram to show that acid solution in water conducts electricity.

- Ans:** (i) (a) Solution is an acid. Substance in egg shell is calcium carbonate.
 (b) Effervescence is due to the evolution of CO₂ gas.
 (c) $2\text{HNO}_3 + \text{CaCO}_3 \rightarrow 2\text{Ca(NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$
 (d) Lime stone.



18. The pH values of four solutions F, Q, R and S are 7.8, 1.0, 13.0 and 1.4 respectively. The solution having highest hydrogen ion concentration among them is: [SSLC July 2018]

- (i) P (ii) Q (iii) R (iv) S

Ans: (ii) Q

19. In a bakery, baking powder was not added while preparing cake. The cake obtained was hard and small in size. What is the reason for this? [SSLC July 2018]

Ans: The reason for the hardness is absence of banking powder. Baking powder when added releases Carbon dioxide gas, which gets trapped in the wet dough and bubbles out slowly making the cake to rise and hence, soft and spongy.

20. Name the sodium compound which is used for softening hard water. [NCERT Exemplar]

Ans: Sodium carbonate.

21. What is the common name of the compound CaOCl_2 ? [NCERT Exemplar]

Ans: Bleaching powder.

22. Classify the following salts into acidic, basic and neutral —
Potassium sulphate, Ammonium chloride, Sodium carbonate, Sodium chloride.

Ans: *Neutral Salts:* Potassium sulphate, sodium chloride

Basic Salts: Sodium carbonate

Acidic Salts: Ammonium chloride.

23. Explain why, an aqueous solution of sodium sulphate is neutral while an aqueous solution of sodium carbonate is basic in nature.

Ans: Sodium sulphate when dissolves in water forms strong add and strong base so its aqueous solution is neutral. Sodium carbonate, on the other hand, when dissolves in water forms an alkaline solution which turns red litmus blue. Thus, its aqueous solution is basic in nature.

24. The colour of copper sulphate solution changes when an iron nail is dipped in it. State the reason .giving chemical equation for the reaction involved.

Ans: $\text{CuSO}_4 + \text{Fe} \rightarrow \text{FeSO}_4 + \text{Cu}$
(Blue) (Green)

Iron is more reactive than copper. Hence it displaces copper from copper sulphate and due to formation of FeSO_4 , the colour changes from blue to green.

25. (i) How chloride of lime chemically differs from calcium chloride?

(ii) What happens when chloride of lime reacts with sulphuric acid? Write chemical equation involved.

(iii) Mention two uses of chloride of lime.

Ans: (i) Chloride of lime is calcium hypochlorite CaOCl_2 which is alkaline while calcium chloride is CaCl_2 which is neutral.

(ii) $2\text{CaOCl}_2(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CaSO}_4(\text{aq}) + \text{CaCl}_2(\text{aq}) + 2\text{HClO}(\text{aq})$

(iii) (a) Bleaching powder is used for bleaching purposes in textile and paper industry and in laundry.

(b) It is also used as a disinfectant for water.

Textbook Exercises

1. A solution turns red litmus blue, its pH is likely to be

- (a) 1 (b) 4 (c) 5 (d) 10

Ans: (d) 10

2. A solution reacts with crushed egg shells to give a gas that turns lime-water milky. The solution contains

- (a) NaCl (b) HCl (c) LiCl (d) KCl

Ans: (b) HCl

3. 10 ml of a solution of NaOH is found to be completely neutralised by 8ml of a given solution of HCl. If we take 20 ml of the same solution of NaOH, the amount of HCl solution (the same solutions as before) required to neutralise it, will be

- (a) 4 ml (b) 8ml (c) 12ml (d) 16ml

Ans: (d) 16ml

4. Which one of the following types of medicines is used for treating indigestion?

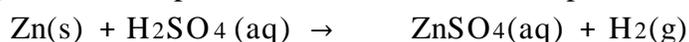
- (a) Antibiotic (b) Analgesic (c) Antacid (d) Antiseptic

Ans: (c) Antacid

5. Write word equations and then balance equations for the reaction taking place when

- (a) Dilute sulphuric acid reacts with zinc granules.
(b) Dilute hydrochloric acid reacts with magnesium ribbon.
(c) Dilute sulphuric acid reacts with aluminium powder
(d) Dilute hydrochloric acid reacts with iron fillings.

Ans: (a) Zinc + Sulphuric acid \rightarrow Zinc sulphate + Hydrogen



(b) Magnesium + Hydrochloric acid \rightarrow Magnesium Chloride + Hydrogen



(c) Aluminium + Sulphuric acid \rightarrow Aluminium sulphate + Hydrogen



(d) Iron + hydrochloric acid \rightarrow Ferrous chloride + Hydrogen



6. Compounds such as alcohols and glucose also contain hydrogen but are not categorised as acids. Describe an activity to prove it.

Ans: When electric current is passed through alcohol and glucose solution, we will observe that the current does not pass through these solutions due to lack of ions.

7. Why does distilled water not conduct electricity, whereas rain water does?

Ans: In rainwater, various acids are present which give ions by dissociating and therefore can conduct electricity whereas distilled water is salt free so it does not conduct electricity.

8. Why do acids not show acidic behaviour in the absence of water?

Ans: In the absence of water, acids cannot be dissociated to give H ions. Therefore they can't show acidic behaviour.

9. Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9 respectively. Which solution is (a) neutral (b) strongly alkaline (c) strongly acidic (d) weakly acidic (d) weakly alkaline? Arrange the pH in increasing order of W concentration.

Ans: (a) D (b) C (c) B (d) A (e) E
C (10 - 11M) < E (10 - 9M) < D (10 - 7M) < A (10 - 4M) < B (10 - 1M)

10. Equal lengths of magnesium ribbons are taken in test tube A and B. HCl is added to test tube A, while CH₃COOH is added to test tube B. Amount and concentration taken for both the acids are same. In which test tube will the fizzing occur more vigorously and why?

Ans: The fizzing will be faster in test tube A because HCl is stronger acid than acetic acid.



11. Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.

Ans: When milk is turned into curd then its pH Value will decrease due to the production of lactic acid in curd which is acidic in nature.

12. A milkman adds a very small amount of baking soda to fresh milk

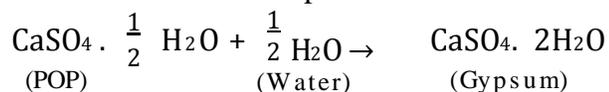
- (a) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?
(b) Why does this milk take a long time to set as curd?

Ans: (a) On addition of small amount of baking soda, the milk will be slightly alkaline to stop the curdling.

(b) This milk takes a long time to set as curd because the lactic acid produced reacts with the baking soda.

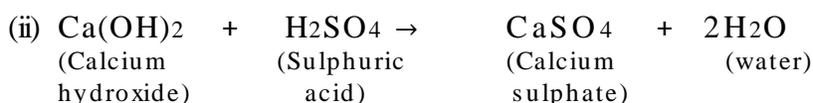
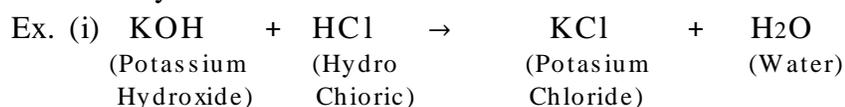
13. Plaster of Paris should be stored in a moisture proof container. Explain why?

Ans: By absorbing moisture, POP can change into hard mass (gypsum), so it should be stored in moisture proof container.



14. What is a neutralisation reaction? Give two examples.

Ans: Neutralisation reactions are those chemical reactions in which salt and water are formed by the reaction of acids and bases.



15. Give two important uses of washing soda and baking soda.

Ans: Two important uses of washing soda are:

- (i) It is used in the preparation of washing powder (ii) It is used in softening of water.

Two important uses of baking soda are:

- (i) It is used as antacid to remove the acidity of stomach.
(ii) It is used in the designing of soda acid fire extinguisher.

3. METALS AND NON – METALS

Quick Review

- Metals are mostly solids, possess high density. They have high melting and boiling points. They have lustre and they are sonorous. They are good conductors of heat and electricity.
- Most of the metals are hard. However some of the metals like sodium, potassium are soft metals and can be cut with knife.
- All metals are solids except Mercury, Cesium, Francium, Germanium and Gallium which are low melting solids. Gallium becomes liquid if kept on palm. But Gallium has very high boiling point which makes it useful for high temperature thermometers.

Property	Metals	Non-Metals
1. Lustre	Metals have shining surface.	They do not have shining surface. • Except Iodine.
2. Hardness	They are generally hard. • Except Sodium, Lithium and Potassium which are soft and can be cut with Knife.	Generally soft. • Except Diamond, a form of carbon which is the hardest natural substance.
3. State	Exist as solids. • Except Mercury.	Exist as solids or gaseous • Except Bromine.
4. Malleability	Exist as solids. • Except Mercury.	Non-metals are non-malleable.
5. Ductility	Metals can be drawn into thin wires.	They are non-ductile.
6. Conductor of heat & electricity	Metals are good conductor of heat and electricity,	Non-metals are poor conductor of heat and electricity. • Except Graphite.
7. Density	Generally have high density and high melting point. • Except Sodium and Potassium	Have low density and low melting point.
8. Sonorous	Metals produce a sound on striking a hard surface.	They are not sonorous.
9. Oxides	Metallic oxides are basic in nature.	Non-metallic oxides are acidic in nature.

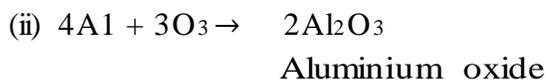
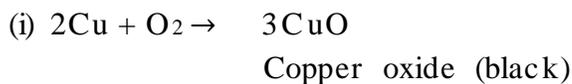
I. Physical Properties

➤ Reaction with Air:

Metals combine with oxygen to form metal oxide.

Metals + O₂ → Metal oxide

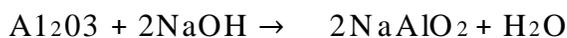
Examples:



Different metals show different reactivities towards O_2

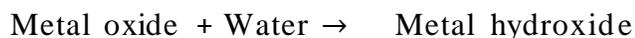
- Na and K react so vigorously that they catch fire if kept in open so they are kept immersed in kerosene.
- Surfaces of Mg, Al, Zn, Pb are covered with a thin layer of oxide which prevent them from further oxidation.
- Fe does not burn on heating but iron filings burn vigorously.
- Cu does not burn but is coated with black copper oxide.
- Au and Ag does not react with oxygen.

Amphoteric Oxides: Metal oxides which react with both acids as well as bases to produce salts and water called amphoteric oxides.



Sodium Aluminate

(B) Reaction of Metals with Water:



(C) Reaction of Metals with Solutions of other Metal Salts:



- Reactive metals can displace less reactive metals from their compounds in solution form.
 $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$
- All the metals do not react with the same rate. Some react very fast, some react moderately whereas others react very slowly. The series of metals in decreasing order of reactivity is called **reactivity or activity series of metals**. The metals at the top are most reactive whereas metals at the bottom are less reactive.
K, Na, Ca, Mg, Al, Zn, Fe, Sn, Pb, H, Cu, Hg, Ag, Au, Pt.
- Metals react with dilute acids to form salt and hydrogen gas. The metal replaces hydrogen of the acid to form salt.
- **Aqua Regia** is a mixture of conc. HCl and conc. HNO_3 in the ratio of 3: 1. It can dissolve gold and platinum. Regia is a strong oxidising agent due to the formation of NOCl (Nitrosyl chloride) and chlorine produced reaction of two acids.
- **Alloys** are homogenous mixture of two or more metals. One of them can be non-metal also, e.g., Brass is an alloy of copper and zinc. When a metal is alloyed with mercury, it is called amalgam.

- Metal, in reactivity series, if placed above hydrogen, can displace hydrogen from dilute acids (HCl and H₂SO₄).

Ionic Compounds

The compounds formed by the transfer of electrons from a metal to a non-metal are called ionic compounds or electrovalent compounds.

Properties of ionic Compounds

1. **Physical nature:** They are solid and hard, generally brittle.
2. **Melting and Boiling Point:** They have high melting and boiling point.
3. **Solubility:** Generally soluble in water and insoluble in solvents such as kerosene, petrol etc.
4. **Conduction of electricity:** Ionic compounds conduct electricity in molten and solution form but not in solid state.

Occurrence of Metals

Minerals: The elements or compounds which occur naturally in the earth's crust are called minerals.

Ores: Minerals that contain very high percentage of particular metal and the metal can be profitably extracted from it, such minerals are called ores.

Know the Terms

- The ability of a metal due to which it can be beaten into sheets is called **malleability**. Iron, copper, zinc and aluminium are available in the form of sheets. Aluminium, steel, copper, brass and bronze are used in making utensils.
- **Ductility** is the ability of metal due to which it can be drawn into wires. Copper, aluminium and iron can be drawn into wires. Silver, gold and platinum are highly ductile metals.
- **Electrical conductance** is the property due to which electric current can pass through the metal. It is due to presence of free electrons or mobile electrons. Copper, silver, gold and aluminium are good conductors of electricity.
- **Thermal conductivity** is the property due to which metals can conduct heat. e.g., Copper, silver, aluminium, gold and iron are good conductors of heat.
- The process of forming oxide layer on the surface of metal is called **anodising**, e.g., Aluminium forms an oxide layer on its surface when it is exposed to air. It is non-penetrating layer which protects it from corrosion.
- Metals in their pure state have bright shining surfaces. This property is called **metallic lustre**.
- When metals are struck with a hard substance, they produce sound. This property is called **sonority** and the metals are said to be sonorous.
- Those bases, which are soluble in water are called **alkalies**. Example, NaOH, KOH, Ca(OH)₂. The oxides which react with acids or acidic oxides to form salt and water are called Basic oxides. Example, Na₂O, CaO, K₂O, MgO. The oxides which react with bases or basic oxides to form salt and water are called **Acidic oxides**. Example, CO₂, SO₂, SO₃, P₂O₅ etc.

- The compounds in which metal loses electrons and non-metal gains electrons are called **electrovalent compounds or ionic compounds**. Example, NaCl, KCl etc.



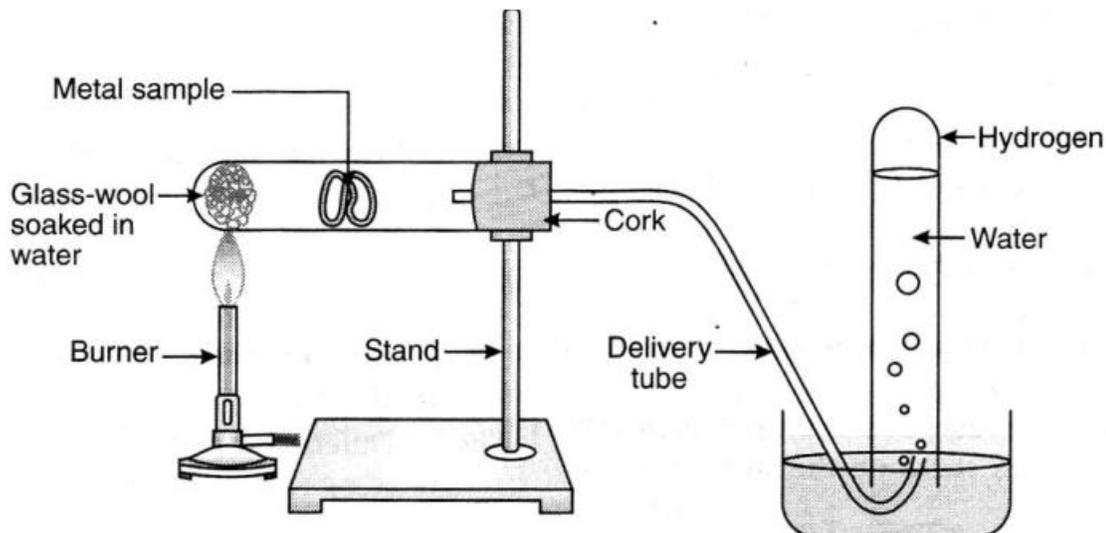
- A stable group of eight electrons in the outermost orbit of the atom is known as **Octet**. The bond which is formed by loss and gain of electrons is called ionic or **electrovalent bond**.
- **Ionic compounds or electrovalent compounds** are solid, hard and brittle due to strong force of attraction between them. They have high melting and boiling points. These compounds are soluble in water but insoluble in organic solvents.
- **Corrosion** is a process in which metal reacts with substance present in the atmosphere to form surface compounds e.g., silver metal turns black due to formation of Ag₂S, iron forms reddish brown coating of hydrated ferric oxide, Fe₂O₃ · H₂O.
- The process of coating iron articles with zinc which is more reactive than iron is called **Galvanisation**.
- **Metallurgy**: All the processes involved in the extraction of metals from their ores and refining them for use, is called metallurgy.
- **Ore-dressing** is a process of removing unwanted substances from the ore. This is also known as concentration of the ore or enrichment of ore. It is usually done by hydraulic washing, magnetic separation or froth floatation process.
- **Froth floatation** process is based on the principle that the mineral particles are more wetted by the oil, whereas the gangue particles are more wetted by water. Compressed air is bubbled through the mixture. As a result of agitation, oil froth is formed which contains minerals which float on the top of water and can be separated easily.
- The unwanted material present in the ores mined from earth is called Gangue. It needs to be removed prior to the extraction process.
- **Leaching** makes use of difference in the chemical properties of minerals and gangue. The ore is treated with suitable reagent which reacts with the ore, but not with the gangue. The purified ore is regenerated by sequence of reactions. An example of leaching is Bayer's method of obtaining pure aluminium oxide from Bauxite.
- **Roasting** is the process in which ore is heated in the presence of air so as to obtain metal oxides, which can be reduced easily to get free metal. Sulphide ores are converted into oxides by roasting.



- **Calcination** is the process of heating ore in absence of air so as to remove moisture and volatile impurities and to convert carbonate ores into oxides.

- **Thermite** process is a process in which molten metal oxides are treated with aluminium powder. It is highly exothermic reaction. The molten metal obtained is used for welding of railway tracks or cracked machine parts.

Metals	Reaction	Observation	Chemical reaction
Fe	Steam	$\text{Fe}_3\text{O}_4(\text{s})$ and $\text{H}_2(\text{g})$	$3\text{Fe}(\text{s}) + 4\text{H}_2\text{O}(\text{g}) \rightarrow \text{Fe}_3\text{O}_4(\text{s}) + \text{H}_2(\text{g})$
Mg	Hot Water	$\text{Mg}(\text{OH})_2(\text{aq})$ & $\text{H}_2(\text{g})$	$\text{Mg}(\text{s}) + 2\text{H}_2\text{O}(\text{hot}) \rightarrow \text{Mg}(\text{OH})_2(\text{aq}) + \text{H}_2(\text{g})$
Ca	Cold Water	$\text{Ca}(\text{OH})_2(\text{aq})$ & $\text{H}_2(\text{g})$	$\text{Ca}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{H}_2(\text{g})$



After this activity it can be concluded that Ca is more reactive than Mg, which is more reactive than Fe.

14. What is meant by metallurgy?

Ans: The extraction of metals from their ores and then refining them for use is known as metallurgy.

15. Aluminium and zinc do not corrode easily even though they are reactive metals. Give reasons for your answer.

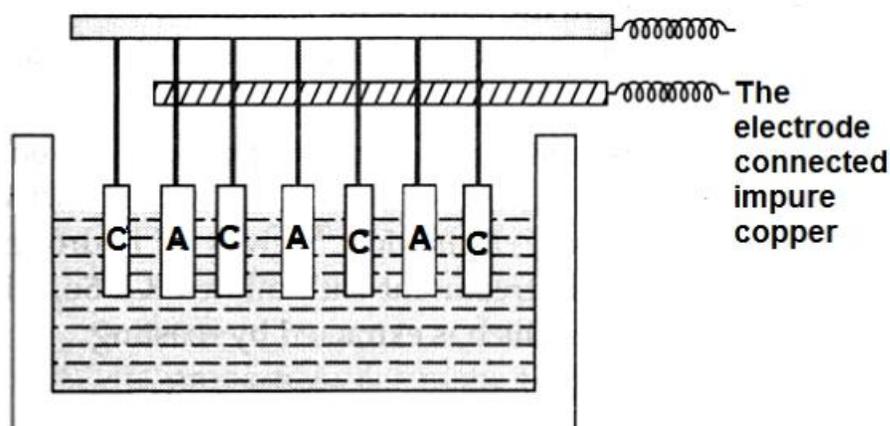
Ans: Aluminium and zinc react with moist air to form a thin protective layer of oxide on their surfaces. This layer prevents further corrosion of the metals.

16. Why is carbon not used for reducing aluminium from aluminium oxide?

Ans: Because aluminium has greater affinity for oxygen than for carbon, therefore carbon cannot reduce alumina (Al_2O_3) to aluminium.

17. Draw the diagram of an electrolytic cell used in the purification of copper and label in the purification of copper and label the electrode having impure copper.

Ans:



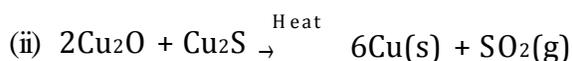
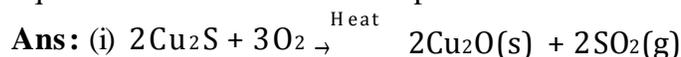
18. What are ionic compounds? List two properties of these compounds. [SSLC July 2018]

Ans: The compounds which have bonds formed by loss and gain of electrons are called ionic compounds or electrovalent compound and the bond formed is known as ionic bond or electrovalent bond.

Two properties of ionic compounds:

- (i) Ionic compounds are hard and brittle.
- (ii) Ionic compounds have high melting and boiling points.

19. Explain the steps for extraction of copper from its sulphide ore. Write the balanced equations involved in the process.

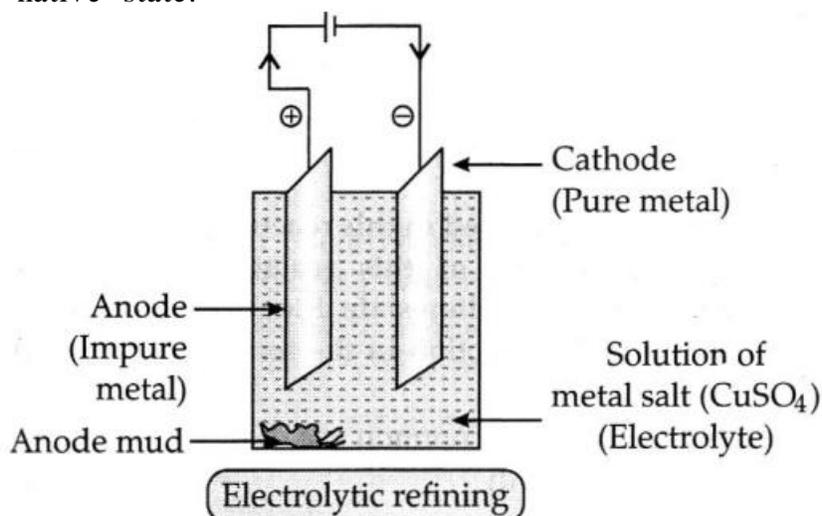


20. Corrosion is a serious problem. Every year an enormous amount of money is spent to replace damaged iron. What steps can be taken to prevent this damage?

Ans: The rusting of iron can be prevented by painting, oiling, greasing, galvanizing, chrome plating, anodizing or making alloys.

21. Describe electrolytic refining of copper with chemical equations. Draw a well labelled diagram for it. [SSLC July, 2018]

Ans: Electrolytic Refining: This method is widely used as purification of metals like zinc (Zn), copper (Cu), aluminium (Al), chromium (Cr), tin (Sn), lead (Pb), nickel (Ni) and gold (Au). In this process, impure metal is used as anode, a strip of pure metal is used as cathode and soluble salt of metal is used as electrolyte. On passing electric current through the electrolyte, cations move towards cathode, gain electrons and pure metal gets deposited on cathode. In electrolytic refining of copper, the impurities left behind at anode called anode mud contains valuable metals such as gold and silver which can be recovered in the native state.



22. Give reasons for the following:

- (i) Ionic compounds have high melting point and boiling point.
- (ii) Ionic compounds conduct electricity in molten state.
- (iii) Ionic compounds are solids at room temperature and are somewhat hard.

Ans: (i) A large amount of energy is required to break the strong inter-ionic attraction.

(ii) When ionic compounds are present in molten state, crystal structure deforms and they can easily conduct electricity with the mobile ions.

(iii) Due to the strong force of attraction between the positive and negative ions.

23. (a) Observe the following chemical equations: [SSLC April, 2018]



What is the conclusion that you take about the nature of aluminium oxide with the help of these equations. Give reason for your conclusion.

(b) Molten cryolite is mixed with molten alumina in the extraction of aluminium by electrolysis. Why? Name the substances that are used as anode and cathode in this method.

Ans: (a) Aluminium oxide is amphoteric in nature.

Aluminium oxide is reacting with base in the first equation to give salt & water,

It is reacting with acid in the second equation to give salt and water.

Hence, it is an amphoteric oxide.

(b) (i) Molten cryolite acts as a solvent for alumina forms an electrolyte at low temperature.

(ii) High temperature electrolysis can be avoided, which prevents the loss of aluminium in the form of vapours.

(iii) Anode \rightarrow Graphite rods

(iv) Cathode \rightarrow Carbon lining.

24. (a) Write the chemical name of the coating that forms on silver and copper articles when these are left exposed to moist air.

(b) Explain what is galvanization. What purpose is served by it?

(c) Define an alloy. How are alloys prepared? How do the properties of iron change when:

(i) Small quantity of carbon is mixed?

(ii) Nickel and chromium are mixed with it?

Ans: (a) Silver sulphide, copper carbonate coating is formed on Ag & Cu article.

(b) Galvanization is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc. The galvanized article is protected against rusting even if the zinc coating is broken.

(c) Alloy is a homogeneous mixture of two or more metals and non-metals. It is prepared by first melting the primary metal and then dissolving the other elements in it in definite proportion. It is then cooled at room temperature.

(i) On mixing carbons, it becomes hard and strong,

(ii) On mixing Ni and Cr, it becomes hard and does not

25. (i) Name the method used to extract metals of high reactivity.

(ii) Name the main ore of mercury. How is mercury obtained from its ore? Give balanced chemical equations.

(iii) Explain what is thermite reaction with the help of balanced equation. How is it used to join railway tracks or cracked machine parts?

Ans: (a) Electrolytic reduction.

(b) Cinnabar (HgS)

By roasting and then self reduction



(c) Reaction of Fe_2O_3 with Al is used to join railway tracks and machine parts as it is exothermic.

This reaction is known as thermite reaction. 1



The amount of heat evolved is so large that the metal (Fe) is produced in the molten state.

Textbook Exercises

1. Which of the pairs will give displacement reactions?

- (a) NaCl solution and copper metal (b) MgCl₂ solution and aluminium metal
(c) FeSO₄ solution and silver metal (d) AgNO₃ solution and copper metal

Ans: (d) AgNO₃ solution and copper metal.

2. Which of the following methods is suitable for preventing an iron frying pan from rusting?

- (a) Applying grease (b) Applying paint
(c) Applying a coating of zinc (d) All of the above

Ans: (c) Applying a coating of zinc

3. An element reacts with oxygen to give a compound with high melting point. This compound is also soluble in water. The element is likely to be

- (a) Calcium (b) Carbon (c) Silicon (d) Iron

Ans: (a) Calcium

4. Food cans are coated with tin and not with zinc because

- (a) Zinc is costlier than tin (b) Zinc has a higher melting point than tin
(c) Zinc is more reactive than tin (d) Zinc is less reactive than tin

Ans: (c) Zinc is more reactive than tin

5. You are given a hammer, a battery, a bulb, wires and a switch.

- (a) How could you use them to distinguish between samples of metals and non-metals?
(b) Assess the usefulness of these tests in distinguishing between metals and non-metals.

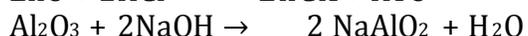
Ans: (a) If on hammering, the substance gets break into pieces, then it is a non-metal. But if the substance expands, then it is a metal. Test by passing electric current: Prepare the circuit and place the sample between the clips A and B and switch on the bulb. If the bulb glows then it is metal

(b) Due to malleability, the metals can be hammered into sheet which can be used for various purposes. Since metals are good conductor of electricity, these are used in designing of wire.

6. What are amphoteric oxides? Give two examples of amphoteric oxides.

Ans: Those metal oxides which can react with acids as well as bases to form salt and water are known as amphoteric oxides.

Ex: ZnO and Al₂O₃



7. Name two metals which will displace hydrogen from dilute acids, and two metals which will not.

Ans: Al, Zn will displace and Ag, Au will not displace hydrogen from dilute acids.

8. In the electrolytic refining of a metal M, what would take the anode, the cathode and the electrolyte?

Ans: Anode → Impure metal

Cathode → Pure metal

Electrolyte → Metal's salt solution

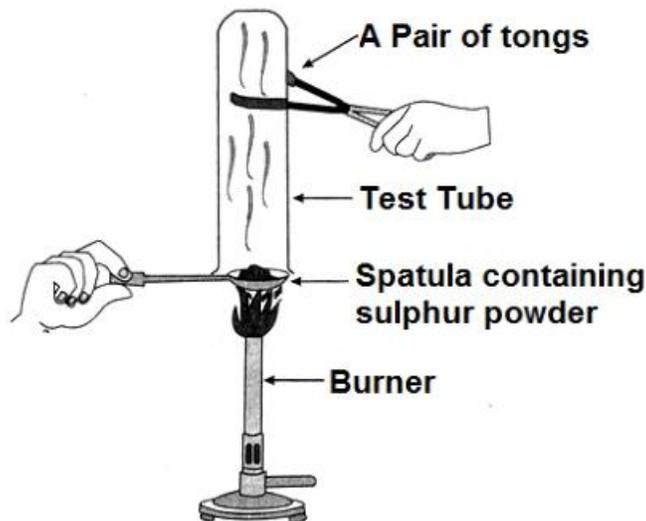
9. Pratyush took sulphur powder on a spatula and heated it. They collected the gas evolved by inverting a test tube over it, as shown in figure below.

(a) What will be the action of gas on:

(i) dry litmus paper?

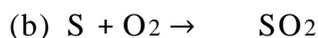
(ii) moist litmus paper?

(b) Write a balanced chemical equation for the reaction taking place.



Ans: (a) (i) No change in colour of litmus paper.

(ii) The colour of litmus paper will turn red because sulphur is non-metal and the oxides of non-metal are acidic in nature.



10. State two ways to prevent the rusting of iron.

Ans: (i) Coating with Zinc, i.e. galvanisation

(ii) Alloying with Chromium, nickel and titanium

11. What type of oxides are formed when non-metals combine with oxygen?

Ans: Neutral or acidic oxides.

12. Give reasons

(a) Platinum, gold and silver are used to make jewellery.

(b) Sodium, potassium and lithium are stored under oil.

(c) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.

(d) Carbonate and sulphide ores are usually converted into oxides during the process of extracting.

Ans: (a) It is because, they do not corrode. Hence, do not lose their shine and lustre.

(b) The reaction of these substances with oxygen is highly exothermic. This may cause fire, also they react with water to form base so they are kept in oil.

(c) This is because aluminium is good conductor of heat and electricity. To prevent its reaction with food at high temperature, a protective layer of aluminium oxide (Al_2O_3) is formed which prevent further corrosion.

(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction because it is easier to obtain metal from its oxide as compared with its sulphides or carbonates ore.

13. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why those sour substances are effective in cleaning the vessel.

Ans: In tarnished copper vessel, there is layer formed due to corrosion which is basic in nature. Lemon or tamarind juice which are acidic in nature cleans the vessels thoroughly.

14. Differentiate between metal and non-metal on the basis of chemical properties.

Ans:

Sl.No	Metal	Non – Metal
(i)	Metal + O ₂ → Metal oxide	Non – Metal + O ₂ → Non – Metal oxide
(ii)	Metal + H ₂ O → Metal Hydroxide	Non – Metal + steam → H ₂
(iii)	Metal + dil acid → Salt + H ₂ O	Non – Metal + acid → No reaction
(iv)	Metal + Cl ₂ → Metal chloride	Non – Metal + Cl ₂ → Non – Metal chloride
(v)	Metal + H ₂ → Metal hydride	

15. A man went door to door posing as a goldsmith he promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man had a hasty retreat. Can you play the detective to find out the nature of the solution he had used?

Ans: The solution he had used is Aqua regia. It is a mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3 : 1. Aqua regia has the ability to dissolve the metals like gold and platinum. Since the outer layer of the gold bangles gets dissolved in aqua regia so their weight was reduced drastically.

16. Give reasons why is copper used to make hot water tanks and not steel (an alloy of iron)

Ans: (i) Copper is good conductor of heat than the steel.

(ii) Copper will not be corroded by hot water while the steel may be corroded.

4. CARBON & ITS COMPOUNDS

Quick Review

- The element carbon is non-metal. Its symbol is C.
- Carbon is a versatile element the percentage of carbon present in earth crust in form of mineral is 0.02% and in atmosphere as CO₂ is 0.03%.

- All the living things, plants and animals are made up of carbon based compounds.

Carbon always form covalent bonds:

The atomic number of carbon is 6.

Electronic configuration:

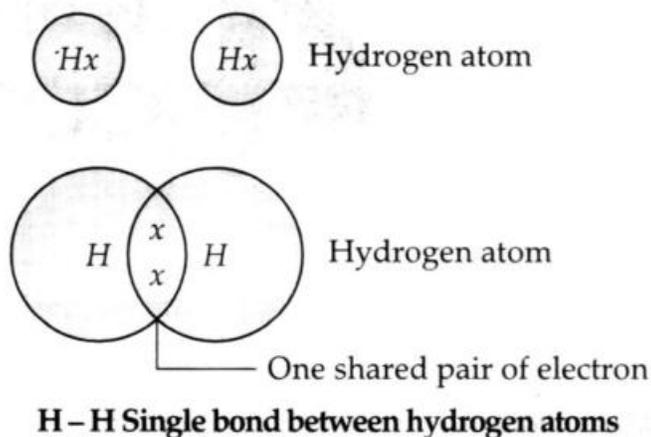
K L

C(6) 2 4

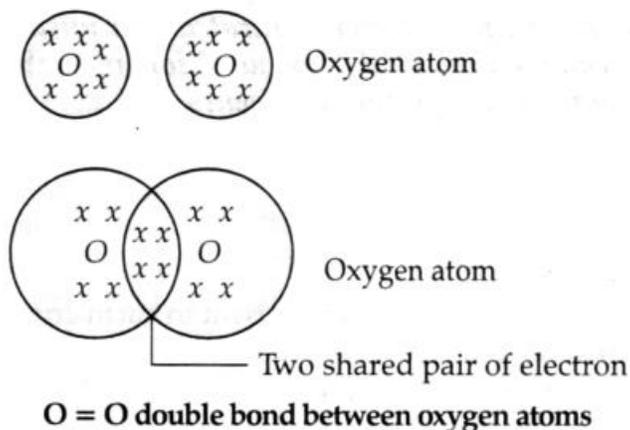
How carbon attain noble gas configuration?

- (i) Carbon is tetravalent, it does not form ionic bond by either losing four electrons (C⁴⁺) or by gaining four electrons (C⁴⁻). It is because, it is difficult to hold four extra electron and would require large amount of energy to remove four electrons. So, carbon can form bond by sharing of its electron with the electrons. of other carbon atom or with other element and attain noble gas configuration.
 - (ii) The atoms of other elements like hydrogen, oxygen and nitrogen, chlorine also form bonds by sharing of electrons.
 - (iii) The bond formed by sharing of electrons between same or different atoms is covalent bond.
- **Covalent Bond:** A covalent bond is formed by sharing of electrons between atoms. In a covalent bond, the shared pair of electrons belongs to the valence shell of both the atoms.
 - Carbon forms covalent bonds.
 - **Conditions for Formation of a Covalent Bond:**
 - (i) The combining atoms should have 4 to 7 electrons in their valence shell.
 - (ii) The combining atoms should not lose electrons easily.
 - (iii) The combining atoms should gain electrons readily.
 - (iv) The difference in electro negativities of two bonded atoms should be low.
 - **Properties of Covalent Compounds:**
 - (i) **Physical states:** They are generally liquid or gases. Some covalent compounds may exist as solid.
 - (ii) **Solubility:** They are generally insoluble in water and other polar solvents but soluble in organic solvents such as benzene, toluene etc.
 - (iii) **Melting and boiling points:** They generally have low melting and boiling points.
 - (iv) **Electrical conductivity:** They do not conduct electrical current.
 - **Steps for Writing the Lewis Dot Structures of a Covalent Compound:**
 - (i) Write the electronic configuration of all the atoms present in the molecule.
 - (ii) Identify how many electrons are needed by each atom to attain noble gas configuration.

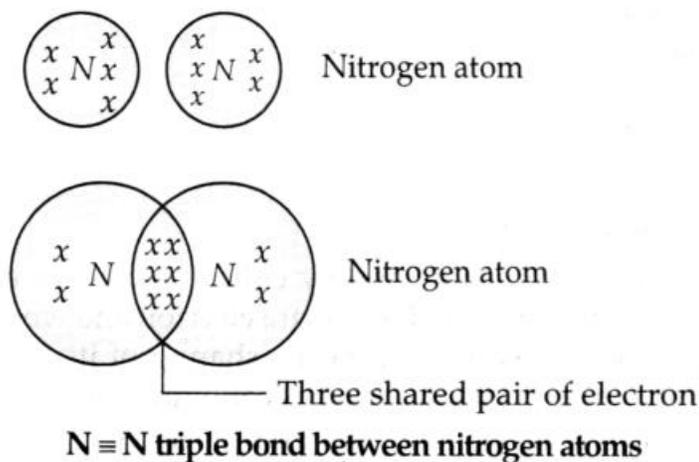
- (iii) Share the electrons between atoms in such a way that all the atoms in a molecule have noble gas configuration.
- (iv) Keep in mind that the shared electrons are counted in the valence shell of both the atoms sharing it.
- (i) H_2



- (ii) O_2

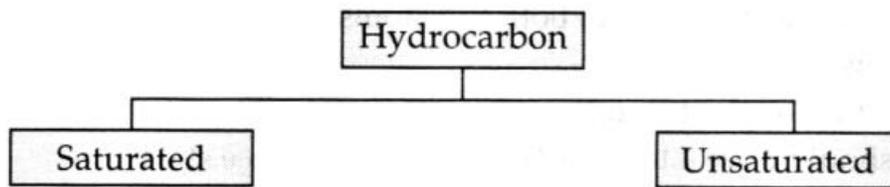


- (iii) N_2



Saturated and Unsaturated Carbon Compounds

Compounds made up of hydrogen and carbon are called hydrocarbon. There are acyclic carbon compounds which form open carbon chains.



- Single bond between carbon atoms.
- $-C-C-$
- Alkanes

- Double or triple bond between carbon atoms
- $-C=C-$ $-C\equiv C-$
- Alkenes Alkynes

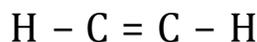
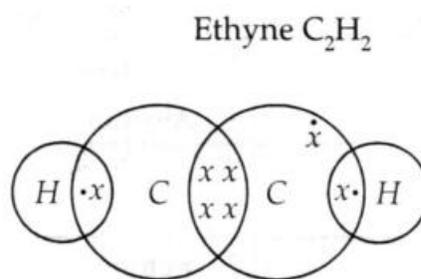
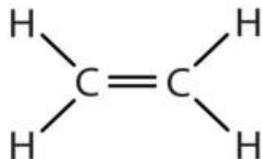
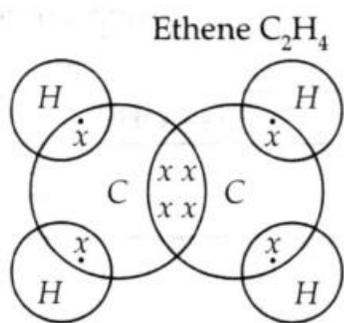
General formulae



Electron Dot Structure of Saturated Hydrocarbons

Ethane C_2H_6

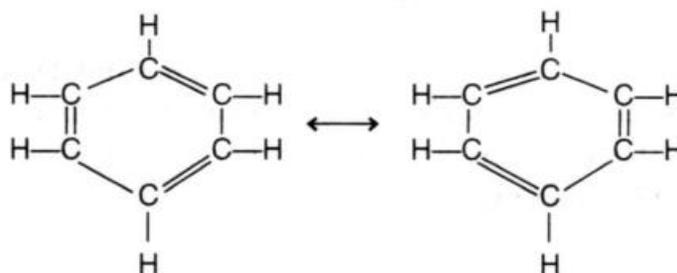
Electron Dot Structure of Unsaturated Hydrocarbons



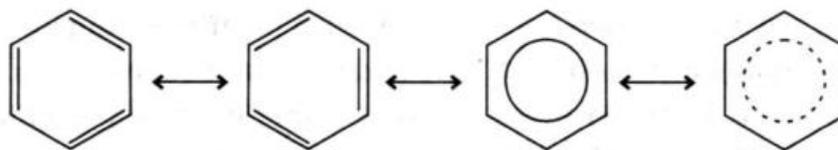
Cyclic or Closed Chain Hydrocarbons: These are the hydrocarbons which do not have carbon carbon closed chain.

They are classified as:

- (i) **Alicyclic hydrocarbons:** These are the hydrocarbons which do not have benzene ring in their structures.
 - (ii) **Aromatic hydrocarbons:** These are the hydrocarbons which have benzene ring in their structures. When hydrogen bonded to carbon of benzene is substituted with halogens, radicals or other functional groups, the derivatives are called aromatic compounds.
- **Benzene:** It is an aromatic hydrocarbon which has the molecular formula C_6H_6 . It has alternating carbon-carbon single and double bonds.



Benzene can also be represented as:



IUPAC name of hydrocarbon consists of two parts. It involves:

(i) Word root: Number of carbons in the longest carbon chain.

Number of carbon atoms	Word root (Greek name)
1	Meth
2	Eth
3	Prop
4	But
5	Pent
6	Hex
7	Hept
8	Oct
9	Non
10	Dec

(ii) Suffix: It depends on the type of carbon - carbon bond for single bond, suffix is —ane; for double bond, suffix is —ene; and for triple bond suffix is —yne.

Types of Formula for Writing Hydrocarbons:

- Molecular formula: It involves the actual number of each type of atom present in the compound.
- Structural formula: The actual arrangement of atoms is written in structural formula.
- Condensed formula: It is the shortened form of the structural formula.

Functional Groups

- In hydrocarbon chain, one or more hydrogen atom is replaced by other atoms in accordance with their valencies. These are heteroatom.
- These heteroatom or group of atoms which make carbon compound reactive and decides its properties are called functional groups.

Hetero atom	Functional group	Formula of functional group
DI/Br	Halo (Chloro/Bromo)	— Cl, — Br, — I
Oxygen	1. Alcohol	— OH
	2. Aldehyde	— CHO
	3. Ketone	$\begin{array}{c} \text{— C —} \\ \\ \text{O} \end{array}$
	4. Carboxylic acid	$\begin{array}{c} \text{O} \\ \\ \text{— C — OH} \end{array}$
Double bond	1. Alkene group	> C = C <
Triple bond	2. Alkyne group	— C ≡ C —

- **Homologous Series:** A series of organic compounds in which every succeeding member differs from the previous one by — CH₂ or 14 a.m.u. is called homologous series. The molecular formula of all the members of a homologous series can be derived from a general formula.
- **Properties of a homologous series:** As the molecular mass increases in a series, physical properties of the compounds show a variation, but chemical properties which are determined by a functional group remain the same within a series.
- **Homologous series of alkanes:** General formula: C_nH_{2n+2}, where n = number of carbon atoms. CH₄, C₂H₆, C₃H₈..
- **Homologous series of alkenes:** General formula: C_nH_{2n}, where n = number of carbon atoms. C₂H₄, C₃H₆, C₄H₈..
- **Homologous series of alkynes:** General formula: C_nH_{2n-2}, where n = number of carbon atoms. C₂H₂, C₃H₄, C₄H₆..

Chemical Properties of Carbon Compounds

(a) Combustion



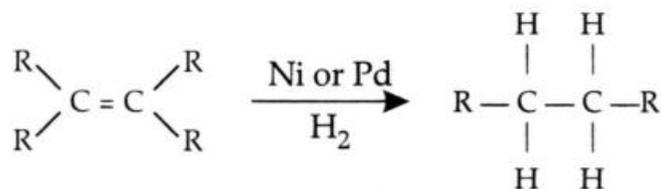
- Carbon and its compounds are used as fuels because they burn in air releasing lot of heat energy.
- Saturated hydrocarbon generally burn in air with blue and non-sooty flame.
- Unsaturated hydrocarbon burns in air with yellow sooty flame because percentage of carbon is higher than saturated hydrocarbon which does not get completely oxidized in air

(b) Oxidation

Alcohols can be converted to carboxylic acid in presence of oxidizing agent alkaline KMnO₄ (potassium permanganate) or acidic potassium dichromate.

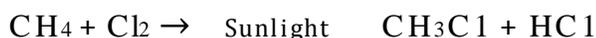


(c) Addition Reaction:



Unsaturated hydrocarbon add hydrogen in the presence of catalyst palladium or nickel. Vegetable oils are converted into vegetable ghee using this process. It is also called hydrogenation of vegetable oils.

(d) Substitution Reaction:



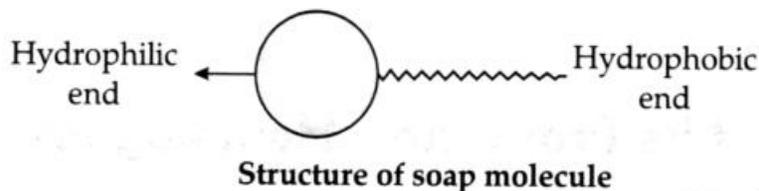
Soaps and Detergents

- Soap is sodium or potassium salt of long chain carboxylic acid. e.g., C₁₇H₃₅COONa⁺
- Soaps are effective only in soft water.

- Detergents are ammonium or sulphonate salt of long chain of carboxylic acid.
- Detergents are effective in both hard and soft water.

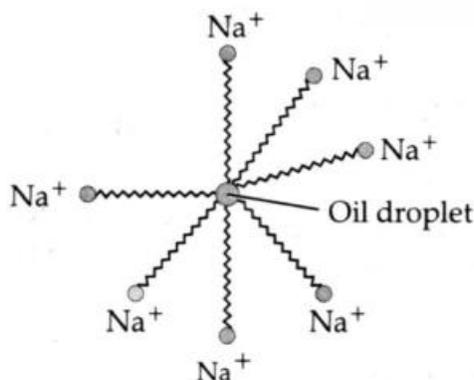
Soap molecule has:

- Ionic (hydrophilic) part
- Long hydrocarbon chain (hydrophobic) part



Cleansing Action of Soap

- Most dirt is oily in nature and hydrophobic end attaches itself with dirt and the ionic end is surrounded with molecule of water. This results in formation of a radial structure called micelles.
- Soap micelles help to dissolve dirt and grease in water and cloth gets cleaned.



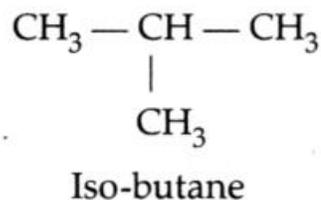
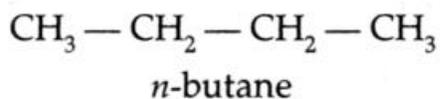
- The magnesium and calcium salt present in hard water react with soap molecule to form insoluble product called scum. This scum creates difficulty in cleansing action.
- By use of detergent, insoluble scum is not formed with hard water and cloths get cleaned effectively.

Know the Terms

- **Catenation:** The self-linking property of carbon atoms through covalent bonds to form long chains and rings is called catenation.
- **Tetravalency:** Tetravalency is the state of an atom in which there are four electrons available with the atom for covalent chemical bonding. Carbon has a valency of four. So, it is capable of making bonds with four other atoms of carbon or any other element.
- **Electronegativity:** It is the ability of an atom to attract a shared pair of electrons towards itself.

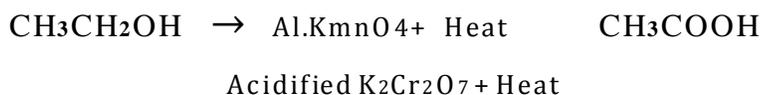
If the atoms forming a covalent bond have different electronegativities, the atom with higher electronegativity pulls the shared pair of electrons towards itself. Thus, the atom with the higher electronegativity develops a partial negative charge and the atom with the lower electronegativity develops a partial positive charge. This bond with some polarity is called a polar covalent bond.

- **Isomerism:** The compounds which possess the same molecular formula but different structural formulae, are called isomers, and the phenomenon is known as isomerism. For example, butane with a molecular formula C_4H_{10} has two isomers.

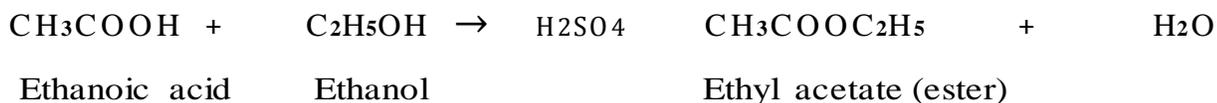


➤ **Homologous Series:** It is a family of organic compounds having the same functional group in which the formulae of successive members differ by — CH₂ group. For example, CH₄, C₂H₆, C₃H₈, C₄H₁₀ etc. All the members of a homologous series have similar structures and same chemical properties.

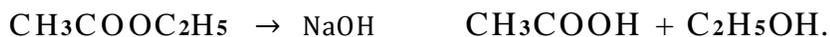
➤ **Oxidation:** Oxidation means controlled combustion. For example, when ethanol is heated with alkaline potassium permanganate solution or acidified potassium dichromate solution, it gets oxidised to ethanoic acid.



➤ **Esterification Reaction:** When an organic acid reacts with an alcohol in the presence of acid catalyst, it produces a sweet smelling (fruity smell) substance called ester. The reaction is known as esterification reaction.



➤ **Saponification Reaction:** Esters react in the presence of an acid or a base to give back the alcohol and the carboxylic acid. This reaction is known as saponification because it is used in the preparation of soap.



➤ **Soaps and Detergents:** Soaps are sodium and potassium salts of long chain (higher) fatty acids such as stearic acid, palmitic acid etc. Detergents are ammonium or sulphonate salts of long chain hydrocarbons.

Questions:

1. Identify a property of amorphous silicon in the following. [SSLC, April 2018]

- (a) Does not burn in the air (b) Has dark grey colour
(c) Oxidizes at the surface level when heated in the air (d) Less reactive

Ans: (c) Oxidizes at the surface level when heated in the air.

2. An example of polyfunctional compound is [SSLC, April, 2017]

- (a) Glycine (b) Ethanol (c) Ethanamine (d) Methanal

Ans: (a) Glycine.

3. Match the Column: [SSLC, April, 2018]

Column I		Column II	
(A)	Preparation of Methane gas.	(i)	Production of salts of fatty acids starting from oils or fats.
(B)	Substitution reaction.	(ii)	Conversion of liquid oils into solid saturated fats.

(C)	Hydrogenation.	(iii)	Heating fused sodium acetate with soda lime.
(D)	Saponification.	(iv)	Exposing the mixture of methane and chlorine to ultraviolet light

Ans: A. (iii), B. (iv), C. (ii), D. (i)

4. What is a homologous series of carbon compounds?

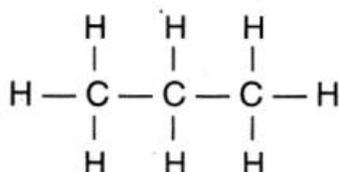
Ans: A homologous series is the family of organic compound having the same functional group, and the successive (adjacent) members of which differ by CH_2 unit or 14 mass unit.

5. Write the name and molecular formula of the first member of the homologous series of alkynes.

Ans: Ethyne, C_2H_2 .

6. Molecular formula of a hydrocarbon is C_3H_8 . Draw its complete structure and write its name.

Ans:



The name of the hydrocarbon is propane.

7. What is the difference between two consecutive members in a homologous series in alkanes in terms of:

(i) Molecular mass, (ii) Number of atoms of elements.

Ans: Difference in:

(i) Molecular mass = 14 a.m.u. (ii) Number of atoms of elements = CH_2

8. Write the number of covalent bonds in the molecule of Ethane

Ans: Seven covalent bonds.

9. Name the process by which unsaturated fats are changed to saturated fats.

Ans: Hydrogenation.

10. The molecular formula of the first member of a certain group of organic compounds is CH_2O (HCHO). Determine the name and the molecular formula of the third member of this group if the members of this group are in homologous series. What is the general name for this group of organic compounds? [SSLC April, 2018]

Ans: Name \rightarrow Propanol/Propanaldehyde.

Molecular formula \rightarrow $\text{C}_3\text{H}_6\text{O}$ ($\text{C}_2\text{H}_5\text{CHO}$)

Aldehydes

11. What is a covalent bond? What type of bond exists in (i) CCl_4 , (ii) CaCl_2 ?

Ans: The chemical bonds formed between two atoms by the sharing of electrons between them is known as a covalent bond. The sharing of electrons between the two atoms takes place in such a way that both the atoms acquire stable electronic configuration of their nearest noble gas

(i) CCl_4 : Covalent bond (ii) CaCl_2 : Ionic bond

12. List two differences between saturated and unsaturated hydrocarbons.

Saturated Hydrocarbons		Unsaturated Hydrocarbons	
(i)	Hydrocarbons having single bonds between carbon atoms are called saturated hydrocarbons.	(i)	Hydrocarbons having one or more multiple bonds between carbon atoms are called unsaturated hydrocarbons.
(ii)	Gives a clean flame on burning,	(ii)	They give yellow flame with a lot of black smoke on burning.

13. What are covalent compounds? Why are they different from ionic compounds? List their three characteristics.

Ans: (a) Covalent compounds are those compounds which are formed by sharing of electrons between two atoms/which contain covalent bonds.

(b) Covalent compounds are different from ionic compounds because the ionic compounds are formed by the transfer of electrons.

(c) Three characteristics of covalent compounds are:

(i) Generally have low melting and boiling points.

(ii) Generally insoluble or less soluble in water but soluble in organic solvents.

(iii) Do not conduct electricity.

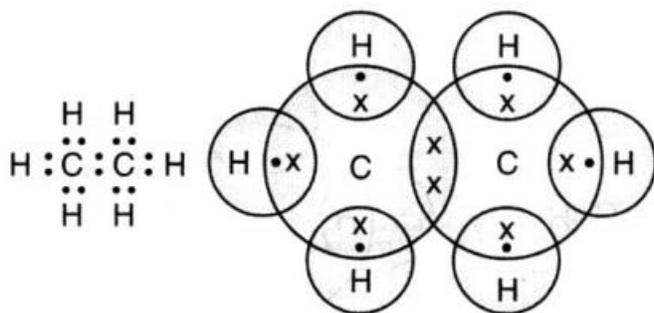
14. Write the molecular formula of the following compounds and draw their electron-dot structures:

(i) Ethane

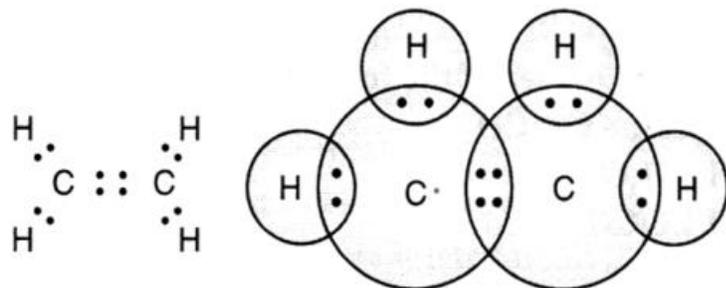
(ii) Ethene

(iii) Ethyne

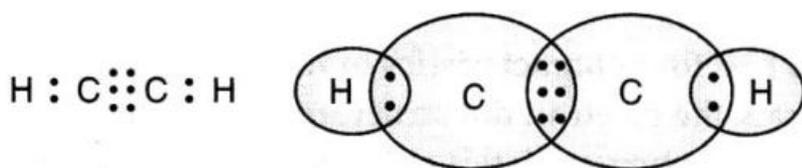
Ans: (i) Ethane: C_2H_6



(ii) Ethene: C_2H_4



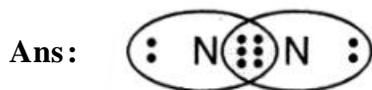
(iii) Ethyne: C_2H_2



20. Name the products formed when ethanoic acid reacts with a sodium hydrogen carbonate.

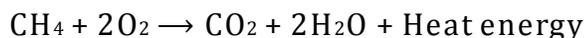
Ans: Sodium ethanoate, carbon dioxide and water.

21. Draw the electron dot structure of nitrogen molecule.



22. What happens when methane is burnt in air?

Ans: Methane burns in air with the formation of carbon dioxide and water.



23. (i) Describe the mechanism of cleansing action of soaps. [SSLC July, 2018]

(ii) Why do soaps not work in hard water?

Ans: (i) Soap molecules form micelles where ionic end of soap dissolves in water while carbon chain dissolves in oil. The emulsion in water thus formed helps in dissolving the dirt in water and we can wash our clothes clean.

(ii) Soaps react with calcium or magnesium ions to form an insoluble substance which results in wastage of soap.

24. What is hydrogenation of Oils? Write two advantage of its. [SSLC April, 2016]

Ans: It is the process of converting liquid oils into solid fat by passing hydrogen gas in presence of suitable catalyst.

Advantages:

(i) Shelf life increases

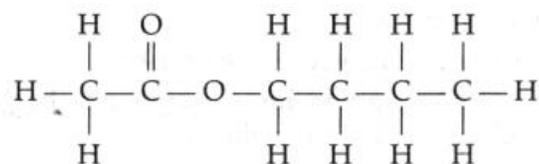
(ii) Easy to transport

25. List any four differences between soaps and detergents.

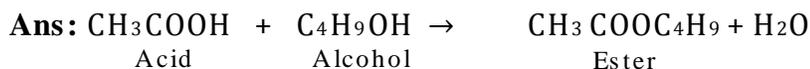
Ans: Difference between soaps and detergents:

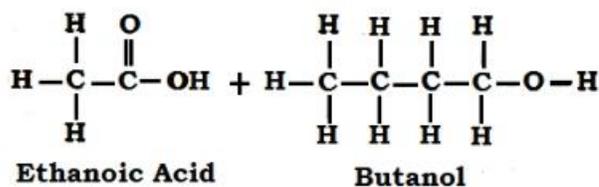
Sl.No	Soaps	Detergents
(i)	They are sodium salts of long chain fatty acids	These are sodium or potassium salts of sulphonic acids of hydrocarbons
(ii)	Soaps cannot be used with hard water	Detergents work well with hard and soft water
(iii)	They are fully biodegradable	They are non – biodegradable
(iv)	They take time to dissolve in water	They dissolve faster in water.

26. The structural formula of an ester is:



Write the structural formula of the acid and the alcohol from which it might be prepared. Name the process of formation of ester.

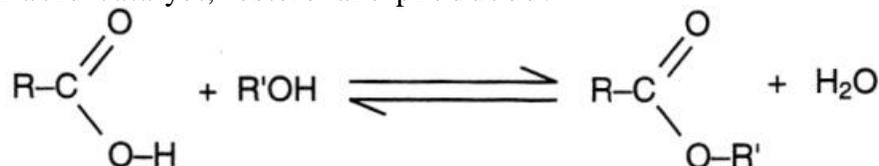




Process is Esterification.

27. What are esters? How they are prepared? List two uses of esters.

Ans: Esters are the derivatives of carboxylic acids which contain —COOR group. The -OH group in an acid is replaced by —O— alkyl or aryl group to form an ester. Esters are represented by the formula R_1COOR_2 where R_1 and R_2 represent an alkyl or aryl group. Preparation of esters: When carboxylic acids are heated with alcohols in the presence of an acid catalyst, esters are produced.



Uses of esters:

- (i) Esters are used in food as flavours and fragrances.
- (ii) In making of soaps
- (iii) Esters are used as solvents
- (iv) Ester are used in medicines.
- (v) Esters are used as emulsifying agents.

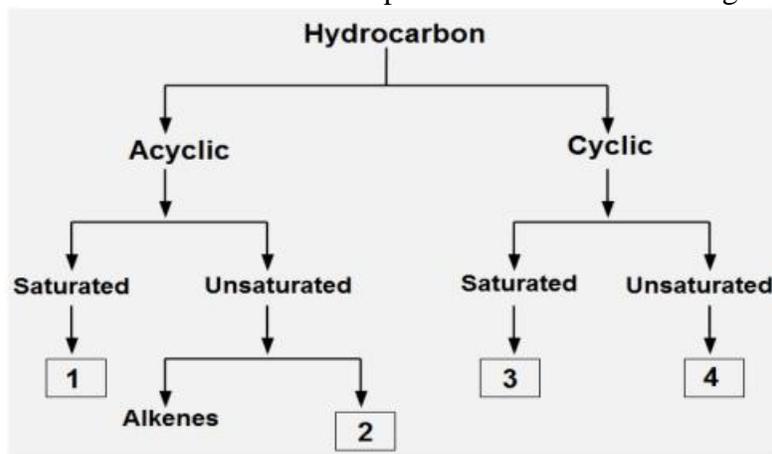
28. (a) What is isomerism? Name the isomers of butane. [SSLC April, 2018]
 (b) Name the air pollutant liberated during incomplete combustion of methane.
 (c) Name the importance of hydrogenation of oils.

Ans: (a) Phenomenon in which organic compounds have same molecular formula with different structural arrangement of atoms in them is known as isomerism.
 n-butane and iso-butane.

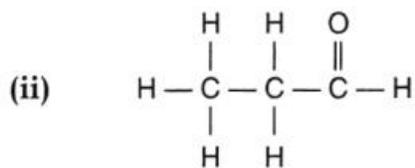
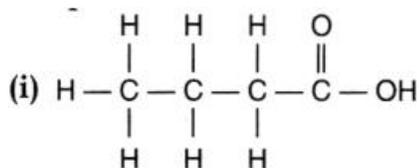
- (b) Carbon monoxide (CO)
- (c) Hydrogenated oils.

(i) Have more shelf life, easy to transport. (ii) Do not produce foul smell.

29. (a) The boxes given here with numbers 1, 2, 3 and 4 represent a class of hydrocarbons. Write the name of first member of that respective class according to the numbers given.



(b) Name the functional group in the following structures of hydrocarbon compounds and name these hydrocarbon compounds:

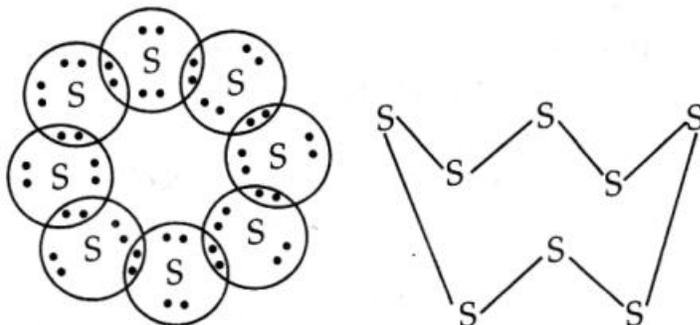


[SSLC June, 2016]

- Ans:** (a) (1) Methane (2) Ethyne (3) Cyclopropane (4) Benzene
 (b) (i) Carboxylic group, Butanoic acid (ii) Aldehyde, Propanal

30. What would be the electron dot structure of a molecule of sulphur which is made up of eight atoms of sulphur?

Ans:



Textbook Exercises:

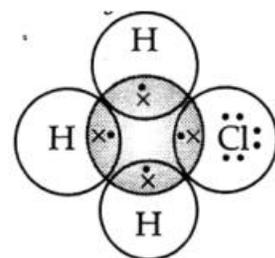
1. Ethane, with the molecular formula C_2H_6 has
 (a) 6 covalent bonds (b) 7 covalent bonds (c) 8 covalent bonds (d) 9 covalent bonds
Ans: (b) 7 covalent bonds

2. Butanone is a four-carbon compound with functional group
 (a) Carboxylic group (b) Aldehyde (c) Ketone (d) Alcohol
Ans: (c) Ketone

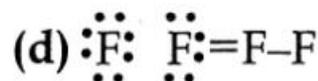
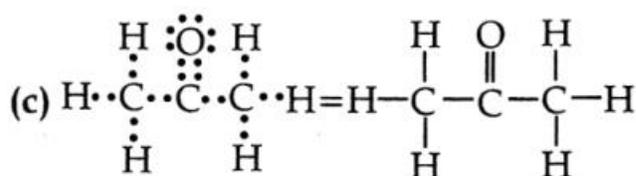
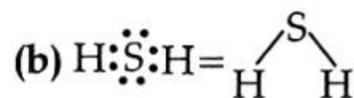
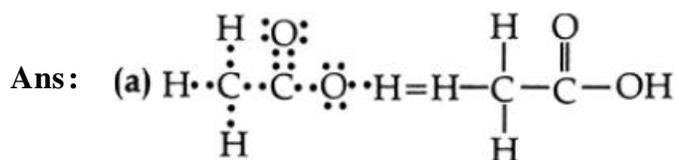
3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that
 (a) Food is not cooked completely (b) The fuel is not burning completely
 (c) The fuel is wet (d) The fuel is burning completely
Ans: (b) The fuel is not burning completely

4. Explain the nature of covalent bond using the bond formation of CH_3Cl .

Ans: The carbon atom will share 4 electrons and hydrogen or chlorine share one each to become stable. In this way, C forms three covalent bonds with hydrogen atoms and one covalent bond with chlorine atom.



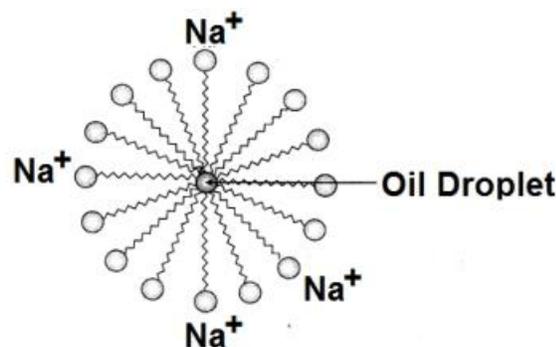
5. Draw the electron dot structures for (a) Ethanoic acid (b) H_2S (c) Propanone (d) F_2



6. What is a homologous series? Explain with an example.
Ans: The family of organic compounds in which all the members can be represented by same general formula is known as homologous series.
 E.g. All the members of alcohol homologous series can be represented by C_nH_{2n+1} formula.
7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?
Ans: Ethanol has low boiling point (18°C) as compared to ethanoic acid (118°C)
 Ethanol can't react with sodium carbonate while ethanoic acids produces CO_2 gas.
8. Why does micelle formation take place when soap is added to water? Will the micelle be formed in other solvents such as ethanol also?
Ans: Micelle formation takes place due to two opposite ends in soap molecules, the hydrophilic end, i.e. water soluble and the hydrophobic end, i.e. water repelling end.
9. Why re carbon and its compounds used as fuels for most application?
Ans: Because these compounds have high calorific value and low ignition temperature.
10. Explain the formation of scum when hard water is treated with soap?
Ans: When soap is added in hard water, the calcium and magnesium ions cause precipitation of soap and the precipitate formed is called scum.
11. What change will you observes if you test soap with litmus paper (red and blue)?
Ans: It will change red litmus into blue and no effect will be there on blue litmus.
12. What is hydrogenation? What is its industrial application?
Ans: The reaction in which unsaturated hydrocarbon combines with hydrogen in the presence of nickel or palladium is known as hydrogenation reaction.
 Application: Conversion of vegetable oil into vegetable ghee.
13. Which of the following hydrocarbon undergo addition reactions?
 C_2H_6 , C_3H_8 , C_3H_6 , C_2H_2 and CH_4
Ans: C_3H_6 and C_2H_2
14. Give a test which is used to differentiate chemically between butter and cooking oil?
Ans: The cooking oil will fade the colour of Baeyer's reagent (alkaline KMnO_4 sol. and bromine water). The butter will not have any effect on these reagents.

15. Explain the mechanism of the cleaning action of soap.

Ans: When soap is dissolved in water, it forms a colloidal suspension. In this colloidal suspension, the soap molecules cluster together to form micelles and remain radially suspended in water with the hydrocarbon end towards the centre and the ionic end directed outward. The dirt particles always adhere to the oily or greasy layer present on the skin or clothes. When a dirty cloth is dipped into a soap solution, its non-polar hydrocarbon end of micelles get attached to the grease or oil present in dirt and polar end remains in water layer. The mechanical action of rubbing subsequently, dislodges the oily layer from the dirty surface shaping it into small globules. A stable emulsion of oil in water is formed. The emulsified oil or grease globules bearing the dirt can now be readily washed with water.



5. PERIODIC CLASSIFICATION OF ELEMENTS

Quick Review

Need for Periodic Classification

- To make the study of these elements easy, these elements have been divided into few groups in such a way that elements in the same group have similar properties. Now study of a large number of elements is reduced to a few groups of elements.
- **Dobereiner's Triads:** When elements were arranged in the order of increasing atomic masses, groups of three elements (known as triads), having similar chemical properties are obtained.
- The atomic mass of the middle element of the triad was roughly the average of the atomic masses of the other two elements.

Elements	Atomic Mass
Ca	40.1
Sr	87.6
Ba	137.3

Limitations: Only three triads were recognized from the elements known at that time.

Li	Ca	Cl
Na	Sr	Br
K	Ba	I

- Dobereiner could identify only three triads. He was not able to prepare triads of all the known elements.
- **Newlands Law of Octaves:** John Newlands arranged elements in order of increasing atomic mass.

It states when elements are arranged in increasing order of atomic mass, the properties of the eighth element are a kind of repetition of the first, just like notes of music.

- **Table showing Newlands Octaves:**

Sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	dha (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co & Ni	Cu	Zn	Y	In	A	Se
Br	Rb	Sr	Ce, La	Za		

- **Limitations of Newlands law of octaves:**
 - (i) The law was applicable to elements up to calcium (Ca) only.
 - (ii) It contained only 56 elements. Further it was assumed by Newlands that only 56 elements existed in nature and no more elements would be discovered in the future.
 - (iii) In order to fit elements into the table, Newlands adjusted two elements in the same column as fluorine, chlorine and bromine which have very different properties than these elements. Iron, which resembles cobalt and nickel in properties, has been placed differently away from these elements.

- Mendeleev's Periodic Table: Dmitri Ivanovich Mendeleev, a Russian chemist, was the most important contributor to the early development of a periodic table of elements where the elements were arranged on the basis of their atomic mass and chemical properties.
- **Characteristics of Mendeleev's Periodic Table:**
 - (i) Mendeleev arranged all the 63 known elements in increasing order of their atomic masses.
 - (ii) The table consists of vertical columns called 'groups' and horizontal rows called 'periods'.
 - (iii) The elements with similar physical and chemical properties came under same groups.
- **Mendeleev's Periodic Law:** The properties of elements are the periodic functions of their atomic masses.
- **Merits of Mendeleev's Periodic Table**
 - (i) Mendeleev left some blank spaces for undiscovered elements.
 - (ii) Mendeleev predicted the discovery of some elements and named them as eka-boron, eka aluminium and ekasilicon.
 - (iii) Noble gases discovered later could be placed without disturbing the existing order.
- **Limitations of Mendeleev's periodic table:**
 - (i) **Position of Hydrogen:** Could not assign a correct position to hydrogen as hydrogen resembles alkali metals as well as halogens.
 - (ii) **Position of Isotopes:** Isotopes are placed in same position though they have different atomic masses.
 - (iii) Separation of chemically similar elements while dissimilar elements are placed in the same group.
- **Modern Periodic Table:** Henry Moseley gave a new property of elements, 'atomic numbers' and this was adopted as the basis of Modern Periodic Table.
- **Modern Periodic Law:** Properties of elements are the periodic functions of their atomic numbers.
- **Position of elements in modern periodic table:**
 - (i) The Modern Periodic Table consists of 18 groups and 7 periods.
 - (ii) Elements present in any one group have the same number of valence electrons. Also, the number of shells increases as we go down the group.
 - (iii) Elements present in any one period, contain the same number of shells. Also, with increase in atomic number by one unit on moving from left to right, the valence shell electron increases by one unit.
 - (iv) Each period marks a new electronic shell getting filled.
- **Trends in the Modern Periodic Table:**
 - (i) **Periodicity in Properties:** The properties of elements depend upon the electronic configuration which changes along a period and down a group in the periodic table. The periodicity properties i.e. repetition of properties after a regular interval is due to similarity in electronic configuration.

(ii) **Tendency to lose or gain electron:** Chemical reactivity of an element depends upon the ability of its atoms to donate or accept electrons.

(iii) **Variations of tendency to lose electron down the group:** Tendency to lose electron goes on increasing down the group.

Reason: It is due to the increase in the distance between the valence electrons and the nucleus as the atomic size increases down the group, the force of attraction between the nucleus and the valence electrons decreases, therefore, tendency to lose electron also increases down the group.

(iv) **Variation of tendency to lose electron along a period:** It goes on decreasing generally along a period from left to right with decrease in atomic size.

Reason: Due to decrease in the atomic size, the force of attraction between the valence electrons and the nucleus increases and, therefore, electrons cannot be removed easily.

(v) **Variation of tendency to gain electron down the group:** It goes on decreasing down the group in general. Reason: Due to increase in atomic size, the force of attraction between the nucleus and the electron to be added becomes less.

(vi) **Variation of tendency to gain electron along a period:** It increases left to right in a period.

Reason: It is due to decrease in the atomic size which leads to an increase in the force of attraction between the nucleus and the electron to be added.

➤ **Metallic and non-metallic character:** Group 1 to 12 are metals. Group 13 to 18 comprises non-metals, metalloids and metals.

➤ **Properties of Metals:**

(i) They are malleable.

(ii) They are ductile.

(iii) They are good conductors of heat and electricity.

(iv) They have generally 1 to 3 valence electrons.

(v) They have the same or less number of electrons in their outermost shell than the number of shells.

(vi) They are mostly solids.

➤ **Properties of Non-metals:**

(i) They exist in solid, liquid or gaseous state.

(ii) Non-metals are generally brittle.

(iii) They are non-conductors.

(iv) They have 4 to 8 valence electrons.

Know the Terms

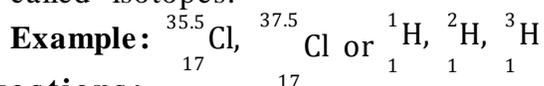
➤ **Mendeleev's Periodic Law:** This law states that the properties of elements are the periodic function of their atomic masses.

➤ Anomalies in arrangement of elements based on increasing atomic mass could be removed when the elements were arranged in order of increasing atomic number, a fundamental property of the element discovered by Moseley in 1913.

➤ **Modern Periodic Law:** According to this law, the properties of elements are periodic function of their atomic number.

➤ The 18 vertical columns in modern periodic table are known as groups whereas 7 horizontal rows in modern periodic table are called periods.

- **Periodicity:** When the elements are arranged in order of increasing atomic numbers, elements with similar chemical properties are repeated at definite intervals. This is known as periodicity.
- **Atomic Radius:** Atomic radius is defined as the distance from the centre of the nucleus of an atom to the outermost shell of electrons.
- **Covalent Radii:** It is defined as half of the distance between the centre of nuclei of two atoms (bond length) bonded by a single covalent bond e.g., bond length in case of H—H is 74 pm.
Covalent radius: $\frac{1}{2} \times 74 = 37$ pm
It can be measured in case of diatomic molecules of non-metals.
- **Metallic Radii:** It is defined as half of the internuclear distance between the two metal ions in a metallic crystal.
- **Metalloids:** Those elements which resemble both metals and non-metals are called metalloids. They are also called semi-metals. e.g., Boron, Silicon, Germanium, Arsenic, Antimony, Tellurium and Polonium.
- **Isotopes:** Elements which have same atomic number but different mass number are called isotopes.



Questions :

1. The atomic number of an element X' is 16. In the modern periodic table the element belongs to this block and period.

(a) p – block, 3 rd period	(b) p – block, 2 nd period
(c) s – block, 3 rd period	(d) s – block, 2 nd period

Ans: (a) p – block, 3rd period
2. Write the number of Vertical columns in the modern periodic table. What are these columns called?

Ans: There are 18 vertical columns in the modern periodic table and these are known as groups.
3. What are cations and anions?

Ans: Positively charged ions are called cations and negatively charged ions are called anions.
4. State Mendeleev's periodic law. Write two achievements of Mendeleev's periodic table.

Ans: Mendeleev's Periodic Law "Properties of elements are the periodic function of their atomic masses."

Achievements:

 - (i) It could classify all the elements discovered at that time.
 - (ii) It helped in discovery of new elements.
 - (iii) It helped in correction of atomic mass of some of the elements.
5. Give an account of the process adopted by Mendeleev for the classification of elements. How did he arrive at "Periodic Law"? [NCERT Exemplar]

Ans: (i) When Mendeleev started his work, 63 elements were known. He studied the compounds of these elements with oxygen and hydrogen. He selected hydrogen and oxygen as they are very reactive and formed compounds with most elements. The formulae of the hydrides and oxides formed by an element were treated as one of the basic properties of an element for its classification.

(ii) Elements with similar properties were arranged in a group.

(iii) Mendeleev observed that elements were automatically arranged in the order of increasing atomic masses.

6. (i) What are metalloids?

(ii) Name any four metalloids?

Ans: (i) Borderline elements which are intermediate in properties between metals and non-metals are called metalloids.

(ii) Boron, silicon, germanium and arsenic.

7. What were the limitations of Newlands' law of Octaves?

Ans: The limitations of Newlands' Law of Octaves are:

(i) The law was applicable to elements upto calcium (Ca) only.

(ii) It contained only 56 elements. Further it was assumed by Newland that only 56 elements existed in nature and no more elements would be discovered in the future.

(iii) In order to fit elements into the table, Newland adjusted two elements in the same column as fluorine, chlorine and bromine which have very different properties than these elements. Iron, which resembles cobalt and nickel in properties, has been placed differently away from these elements.

8. (a) Why did Mendeleev have gaps in his periodic table?

(b) State any three limitations of Mendeleev's classification?

(c) How does electronic configurations of atoms change in a period with increase in atomic number?

Ans: (a) Gaps were left for undiscovered elements in the periodic table.

(b) (i) Position of hydrogen was not justified.

(ii) Increasing order of atomic mass could not be maintained.

(iii) Isotopes have similar chemical properties but different atomic masses, they cannot be given separate places.

(c) Number of shells remains the same, number of valence electrons goes on increasing from left to right in a period till octet is complete. e.g.,

Li 2, 1	Be 2, 2	B 2, 3	C 2, 4	N 2, 5	O 2, 6	F 2, 7	Ne 2, 8
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9. A part of s-block in the modern periodic table is given here. The correct arrangement of these atoms in the increasing order of their atomic size is [SSLC June, 2016]

11 Na	12 Mg
19 K	

(a) Na, Mg, K

(b) K, Na, Mg

(c) Mg, Na, K

(d) Na, K, Mg

Ans: (c) Mg, Na, K

10. Write any one difference between the electronic configuration of group-1 and group-2 elements.

Ans: Group 1 elements have 1 valence electron while Group 2 elements have 2 valence electrons.

11. List any two properties of the elements belonging to the first group of the modern periodic table.

Ans: First group elements are also known as alkali metals. They possess following properties:

- (i) These elements exhibit +1 valency.
- (ii) These are very reactive as they are not found freely in nature.

12. What is ionisation energy? How does ionisation energy vary along the period in the modern periodic table? [SSLC June, 2016]

Ans: The energy required to remove the electron from the outermost shell of an isolated gaseous atom is known as ionisation energy. It increases while going from left to right in modern periodic table.

13. What are electropositive atoms? How does electro positivity vary along the period in modern periodic table? [SSLC June 2016]

Ans: Atoms which give up electrons to form cations are called electropositive atoms. Decreases while going from left to right.

14. How does the atomic radius change as we go:

- (i) From left to right across a period
- (ii) Down a group in the periodic table?

Ans: On going

- (i) From left to right across a period, atomic radius decreases as one proton and one electron are added continuously, therefore effective nuclear charge increases.
- (ii) Down a group in the periodic table, atomic radius increases because number of shells goes on increasing, therefore distance between nucleus and valence shell increases.

15. (i) Atomic radius of hydrogen is 37 pm. Express it in metres.

(ii) How does atomic size vary in a group and in a period.

Ans: (i) $1\text{pm} = 10^{-12}\text{m}$.

$$\text{Atomic radius} = 37 \times 10^{-12} \text{ m}$$

(ii) In a group atomic size: increases down the group.

In a period atomic size: decreases in moving from left to right.

16. The atomic number of elements A, B, C, D and E are given below

Element	A	B	C	D	E
Atomic No	7	10	12	4	19

From the above table answer the following questions:

- (i) Which two elements are chemically similar?
- (ii) Which is an inert gas?
- (iii) Which element belongs to 3rd period of periodic table?
- (iv) Which element among these is a non-metal?

Ans: (i) C and D (ii) B (iii) C (iv) A

17. How many groups and periods are there in the modern periodic table? How do the atomic size and metallic character of elements vary as we move?

- (i) Down a group and
- (ii) From left to right in a period.

Ans: There are 18 groups and 7 periods in the modern periodic table.

- (i) Atomic size generally increases down a group due to the addition of new shell and metallic character also increases down a group due to the increase in tendency to lose electrons.

- (ii) Atomic size goes on decreasing along a period from left to right. Metallic character decreases along a period due to decrease in tendency to lose electrons.

18. What is meant by 'group' in the modern periodic table? How do the following change on moving from top to bottom in a group?

- Number of valence electrons
- Number of occupied shells
- Size of atoms
- Metallic character of element
- Effective nuclear charge experienced by valence electrons.

Ans: Vertical columns of the periodic table are known as groups.

- The number of valence electrons remains constant when we move down the group.
- The number of occupied shells increases down the group.
- The size of atom increases down the group.
- The metallic character of elements increases down the group.
- The effective nuclear charge decreases down the group.

19. Name any two elements of group one and write their electronic configurations. What similarity do you observe in their electronic configurations? Write the formula of oxide of any of the above said element.

Ans: (i) Two elements of group 1 are Na, K / Sodium, potassium.

Electronic configurations Na = 2,8,1; K = 2,8,8,1

- Similarity: Both have one valence electron / One electron in outermost shell.
- Oxide: Na₂O / K₂O.

20. Two elements 'A' and 'B' belong to the 3 period of Modern periodic table and are in group 2 and 13 respectively. Compare their following characteristics in tabular form:

- Number of electrons in their atoms
- Size of their atoms
- Their tendencies to lose electrons
- The formula of their oxides
- Their metallic character
- The formula of their chlorides.

Ans:

Sl.No	Characteristics	A	B
(i)	Number of electrons in their atoms	4 or 12 or 20	5 or 13 or 21
(ii)	Size of their atoms	Bigger	Smaller
(iii)	Their tendencies to lose electrons	More	Less
(iv)	The formula of their oxides	AO	B ₂ O ₃
(v)	Their metallic character	More metallic	Less Metallic
(vi)	The formula of their chlorides	ACl ₂	BCl ₃

21. An element 'X' belongs to 3rd period and group 16 of the Modern Periodic Table.

- Determine the number of valence electrons and the valency of 'X'.
- Molecular formula of the compound when 'X' reacts with hydrogen and write its electron dot structure.
- Name the element 'X' and state whether it is metallic or non-metallic.

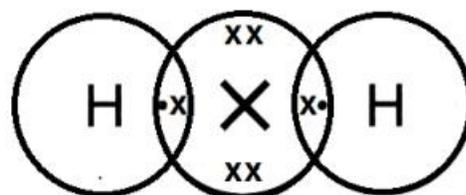
Ans: (i) Electronic configuration of X = 2,8,6.

Valence electrons = 6,

Valency = 8 - 6 = 2

(ii) Formula with hydrogen - H₂X or H₂S

(iii) Sulphur; non-metal.



22. Na, Mg and Al are the elements of the same period of modern periodic table having one, two and three valence electrons respectively. Which of these elements (i) has the largest atomic radius, (ii) is least reactive? Justify your answer stating reason for each case.

Ans: (i) Na will have the largest atomic radius as atomic size goes on decreasing along a period from left to right. It is due to increase in nuclear charge (number of protons in nucleus) which pulls the electrons towards it, i.e., force of attraction between nucleus and valence electrons increases, therefore atomic size decreases.

(ii) Al is least reactive because reactivity of an element depends upon the ability of its atoms to donate or accept electrons. Tendency to lose electrons along a period generally decrease with decrease in atomic size, i.e., the force of attraction between the valence electrons and the nucleus increases, therefore electrons cannot be removed easily.

23. Four elements F, Q, K and S belong to the third period of the Modern Periodic Table and have respectively 1,3,5 and 7 electrons in their outermost shells. Write the electronic configurations of Q and K and determine their valencies. Write the molecular formula of the compound formed when P and S combine.

Ans: Electronic configuration of Q = 2, 8, 3

Valency of Q = 3

Electronic Configuration of R = 2, 8, 5

Valency of R = $8 - 5 = 3$

Electronic configuration of P = 2, 8, 1

Electronic configuration of S = 2, 8, 7

Formula: PS/NaCl

24. Study the following table in which positions of six elements A, B, C, D, E and F are shown as they are in the modern periodic table:

Group → Period ↓	1	2	3 – 12	13	14	15	16	17	18
1.	A					B			C
2.				D	E				F

On the basis of the above table, answer the following questions:

- Name the element which forms only covalent compounds.
- Name the element which is a metal with valency three.
- Name the element which is a non-metal with valency three.
- Out of D and E, which is bigger in size and why?
- Write the common name- for the family to which the elements C and F belong.

Ans: (i) Element E will form covalent compounds by sharing its four valence electrons.

(ii) Element D is a metal with valency three.

(iii) Element B is a non-metal with valency three.

(iv) We know that the size of elements decreases on moving left to right in a period. Therefore, element D is greater than element E.

(v) The name of the family to which elements C and F belong is the noble gas family (group 18).

25. Four elements A, B, C and D along with their electronic configuration are given below:

Elements	A	B	C	D
Electronic configuration	2, 1	2, 8	2, 8, 1	2, 8, 8

Now answer the following questions:

- (i) Which two elements belong to the same period?
- (ii) Which two elements belong to the same group?
- (iii) Which element out of A and C is more reactive and why?

Ans: (i) A and B, C and D belong to the same period.

(ii) A and C have one valence electron, so they belong to same group.

(iii) C is more reactive because C is placed below A in the periodic table and reactivity increases down the group.

26. Write the number of period the modern periodic table has. How do the valency and metallic character of elements vary on moving from left to right in a period? How do the valency and atomic size of elements vary down a group?

Ans: There are 7 horizontal rows known as periods, that the modern periodic table has. In periods, the number of valence electrons increases from left to right and due to decrease in atomic size, the force of attraction between the valence electrons and the nucleus increases. Metallic character decreases along the period due to decrease in tendency to lose electrons. Atomic size generally increases from top to bottom in a group due to the addition of a new shell i.e., number of shells goes on increasing down the group.

27. Examine the elements of the third period and classify them as metals or non-metals. Comment on the metallic and non-metallic character of the third period. Name the most metallic element and non-metallic element of this period.

Ans: Na (Sodium), Mg (Magnesium) and Al (Aluminium) are metals. Si (Silicon) is a metalloid. P (Phosphorus), S (Sulphur) and Cl (Chlorine) are non-metals. As we go from left to right across the third period, metallic character decreases and non-metallic character increases. The most metallic element in the third period is Na and the most non-metallic element is Cl.

28. An element X (2, 8, 2) combines separately with SO_4^{2-} , PO_4^{3-} radicals.

(i) Write the formulae of the two compounds so formed.

(ii) To which group of the modern periodic table does the element X belong?

(iii) Will it form covalent or ionic compound? Give reasons.

Ans: (i) Formulae of these compounds are XSO_4 , $\text{X}_3(\text{PO}_4)_2$.

(ii) It belongs to group 2nd and 3rd period.

(iii) It will form ionic compounds as it can lose two electrons to acquire stable electronic configuration.

29. What were the limitations of Newlands' Law of Octaves?

Ans: (i) The law was applicable to elements upto calcium (Ca) only.

(ii) It contained only 56 elements. Further it was assumed by Newlands that only 56 elements existed in nature and no more elements would be discovered in the future.

(iii) In order to fit elements into the table, Newland adjusted two elements in the same column as fluorine, chlorine and bromine which have very different properties than these elements. Iron, which resemble cobalt and nickel in properties, has been placed differently away from these elements.

30. Name

(a) Three elements that have a single electron in their outermost shell.

(b) Two elements that have two electrons in their outer most shell.

(c) Three elements with filled outermost shell.

Ans: (a) Li, Na, K

(b) Be, Mg

(c) He, Ne, Ar

Textbook Exercises

1. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic table?
- (a) The elements become less metallic in nature.
 - (b) The number of valence electrons increases.
 - (c) The atoms lose their electrons more easily.
 - (d) The oxides become more acidic.

Ans: (c) The atoms lose their electrons more easily.

2. Element X forms a chloride with the formula XCl_2 , which is a solid with high melting point. X would most like be in the same group of the periodic table as
- (a) Na
 - (b) Mg
 - (c) Al
 - (d) Si

Ans: (b) Mg

3. Which element has
- (a) Two shells both of which are completely filled with electrons?
 - (b) The electronic configuration 2, 8, 2?
 - (c) A total of three shells, with four electrons in its valence shell?
 - (d) A total of two shells, with three in its valence shell?
 - (e) Twice as many electrons in its second shell as in its first shell.

Ans: (a) Ne (b) Mg (c) Si (d) B (e) C

4. (a) What property do all elements in the same column of the periodic Table as Boron have in common?
- (b) What property do all elements in the same column of the periodic Table as fluorine have in common?
- Ans:** (a) All the elements have 3 valency and their oxides are generally amphoteric.
- (b) All the elements have valency 1, high non metallic character and form ionic bonds.

5. An atom has electronic configuration 2, 8, 7
- (a) What is the atomic number of this element?
 - (b) To which of the following elements would it be chemically similar?
- N (7), F (9), P (15), Ar (18)

Ans: (a) 17 (b) F (9)

6. The position of three elements A, B and C in the periodic Table is shown below:

Group 16	Group 17
	A
B	C

- (a) State whether A is a metal or non-metal
- (b) State whether C is more reactive or less reactive than A
- (c) Will C be larger or smaller in size than B?
- (d) Which type of ion, cation or anion, will be formed by element C?

Ans: (a) Element A will be a non-metal

(b) C will be less reactive than A

(c) C will be smaller than B

(d) C will form anion

7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the periodic Table. Write the electronic configuration of these two elements. Which of these will be more electronegative? Why?

Ans: N = 2, 5 ; P = 2, 8, 5

Due to smaller size, nitrogen atom will be more electronegative.

8. How does the electronic configuration of an atom related to its position in the modern periodic table?

Ans: The position of elements depends upon number of valence electrons which depend upon electronic configuration. Those elements which have same valence electrons, occupy same group. Those elements which have one valence electron belong to group 1. Elements which have two valence electrons belong to group 2. Period number is equal to the number of shells.

9. In the modern periodic table, calcium (atomic number 20) is surrounded by elements with atomic number 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium?

Ans: The element with atomic no. 12 and 38 will have same physical and chemical properties.

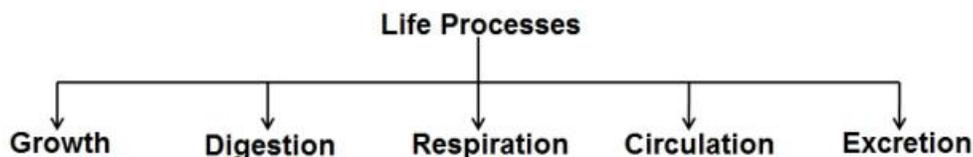
10. Compare and contrast the arrangement of elements in Mendeleev's Periodic Table and Modern Periodic Table

	Mendeleev's Periodic Table	Modern Periodic Table
(i)	It is based on the atomic masses	It is based on the atomic numbers
(ii)	Elements are arranged in order of increasing atomic masses	Elements are arranged in order of increasing atomic numbers.
(iii)	Electronic configuration of an element can't be predicted by its position in the periodic table.	Electronic configuration of an element can be predicted by its position in periodic table.

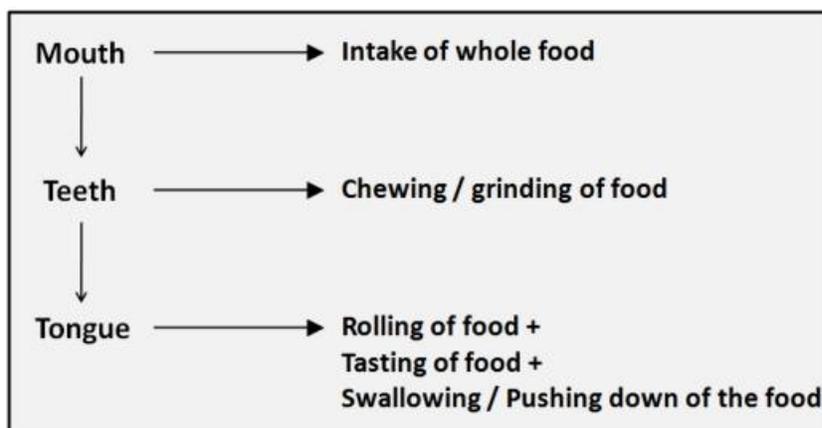
6. LIFE PROCESSES

Quick Review

- All living things perform certain life processes like growth, excretion, respiration, circulation etc. All the processes like respiration, digestion, which together keep the living organisms alive and perform the job of body maintenance are called life processes.



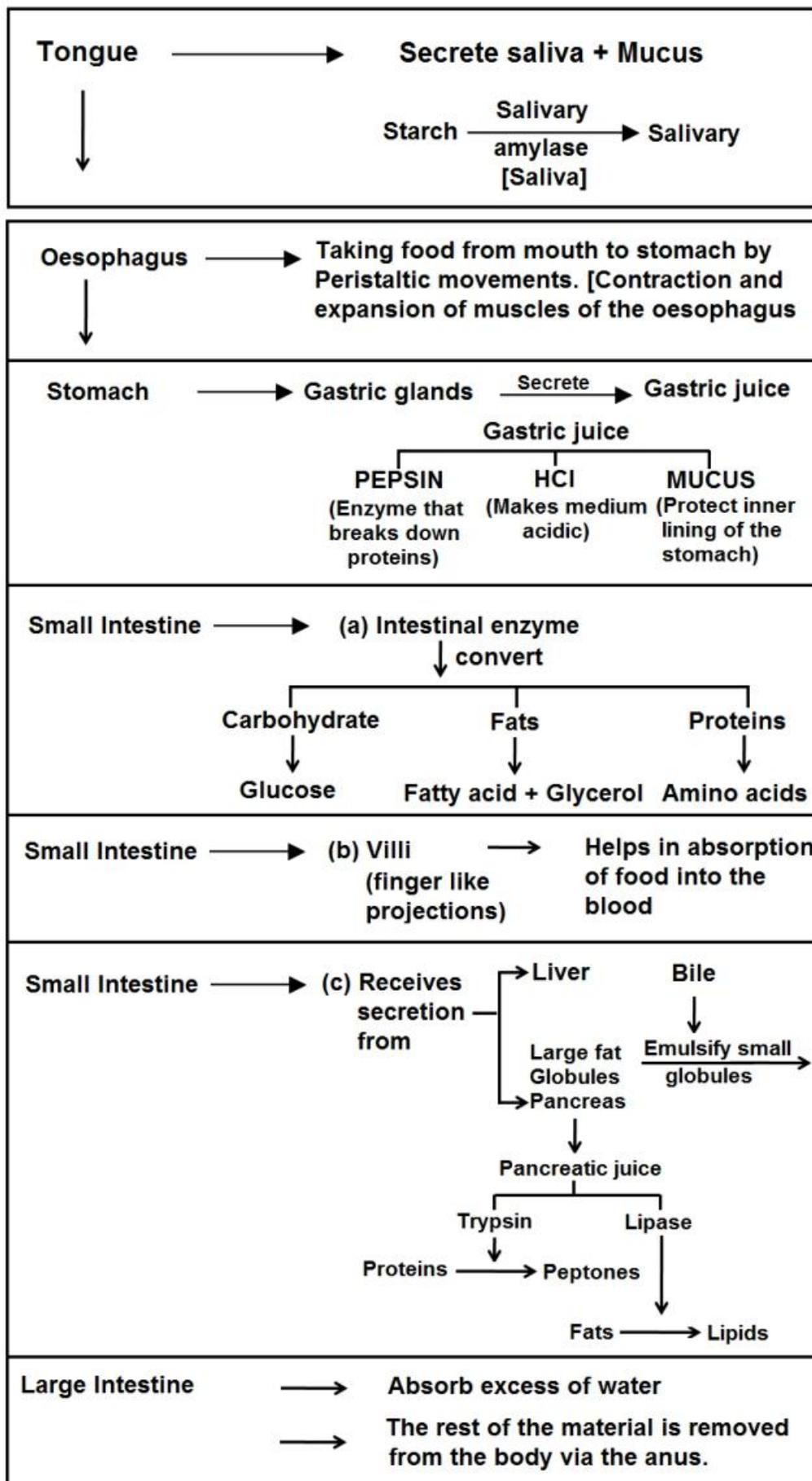
- Energy required to carry out the different life processes, is obtained from carbon-based food sources through nutrition.
- Depending on the mode of obtaining nutrition, organisms are classified as autotrophs or heterotrophs.
 - Autotrophs** can prepare their own food from simple inorganic sources like carbon dioxide and water. (e.g., green plants, some bacteria).
 - Heterotrophs** cannot synthesise their own food and is dependent on the autotrophs for obtaining complex organic substance for nutrition. (e.g., animals)
- Green plants prepare their food by the process of photosynthesis. Here, they utilise CO_2 , H_2O and sunlight, with the help of chlorophyll, giving out O_2 as a by product.
- In the light reaction of photosynthesis, light energy is absorbed and converted to chemical energy in the form of ATE Also water molecules split into hydrogen and oxygen.
- Carbon dioxide is reduced to carbohydrates in the dark phase of photosynthesis.
- Plants carry out gaseous exchange with surrounding through stomata.
- In humans, digestion of food takes place in the alimentary canal, made up of various organs and glands.
- Liver secretes bile which emulsifies fat.



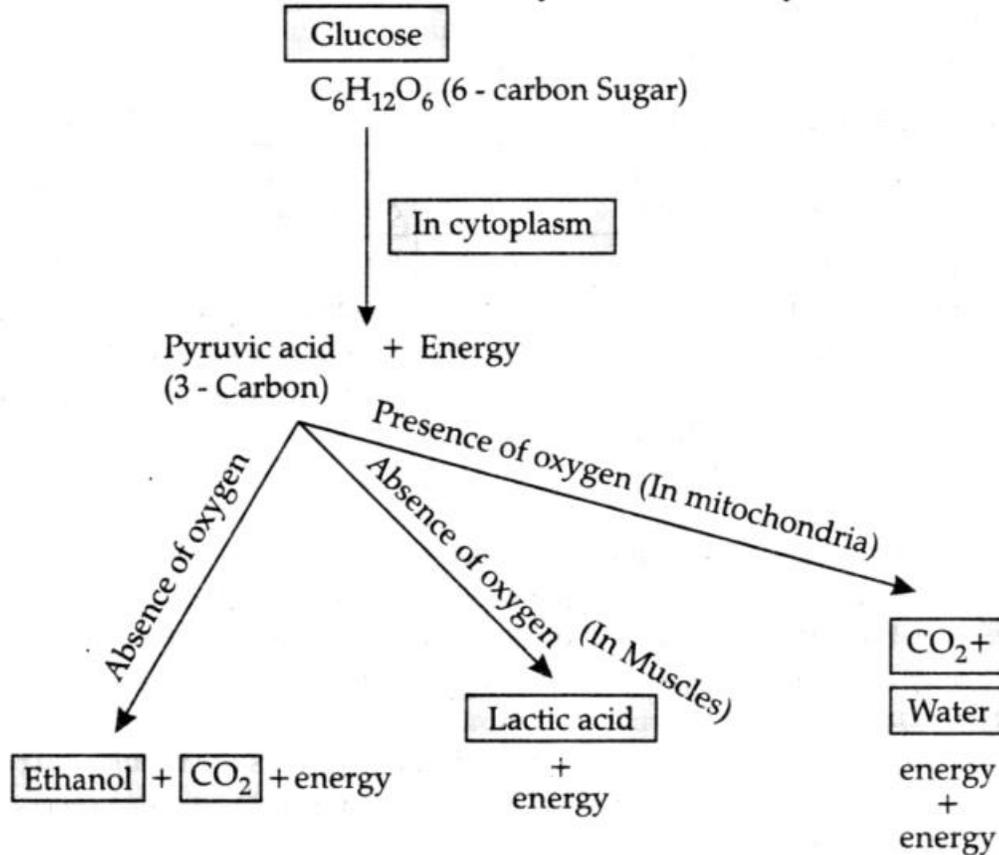
RESPIRATION:

Respiration involves:

- Gaseous exchange Intake of oxygen from the atmosphere and release of CO_2 → Breathing
- Breakdown of simple food in order to release energy inside the cell → Cellular respiration



Breakdown of Glucose by Various Pathways



Respiration	
Aerobic	Anaerobic
Takes place in the presence of oxygen	Takes place in the absence of oxygen
Occurs in mitochondria	Occurs in cytoplasm
End products are CO ₂ and H ₂ O	End products are alcohol or lactic acid
More amount of energy is released	Less amount of energy is released

- Plants release CO₂ at night and oxygen during the day.
- In humans, air takes the following path on entering the nostrils.
- Nostrils → Nasal passage → Pharynx → Larynx → Trachea → Bronchus → Bronchiole → Alveolus.
- The alveoli of lungs are richly supplied with blood and are the sites where exchange of gases (O₂ and CO₂) occurs between blood and atmosphere.
- In humans, the respiratory pigment haemoglobin, carry oxygen from lungs to different tissues of the body.
- Human heart has 4 chambers - 2 atria (right and left) and 2 ventricles (right and left). Right half of the heart receives deoxygenated blood whereas the left half receives oxygenated blood.
- Arteries carry blood from heart to different parts of the body whereas veins deliver the blood back to the heart. Arteries are connected to veins by thin capillaries, where materials are exchanged between blood and cells.

- Blood platelets are essential for clotting of blood at the place of injury and thus preventing blood loss.
- Lymphatic system consists of lymph, lymph nodes, lymphatic capillaries and lymph vessels which drain into larger veins. Lymph is also important in the process of transportation.

Double circulation

- Blood travels twice through the heart in one complete cycle of the body.
- **Pulmonary Circulation:** Blood moves from the heart to the lungs and back to the heart.
- **Systemic Circulation:** Blood moves from the heart to rest of the body and back to the heart

Blood Vessels

	Arteries		Veins
1.	Carry oxygenated blood from heart to body parts except pulmonary artery.	1.	Carry deoxygenated blood from body parts to heart except pulmonary vein.
2.	Also called distributing vessel.	2.	Also called collecting vessel.
3.	Thick and elastic.	3.	Thin and less elastic.
4.	Deep seated	4.	Superficial as compared to arteries

Transportation in plants

There are two main conducting pathways in plant.

	Xylem		Phloem
1.	Carries water & minerals from the roots to other parts of the plant.	1.	Carries product of photosynthesis from leaves to the other parts of the plant.
2.	No energy is used.	2.	Energy is used from ATE

Transpiration: is the process of loss of water as vapour from aerial parts of the plant.

- During excretion, the harmful metabolic nitrogenous wastes generated are removed from the body.
- Nephrons are the basic filtration units of kidneys. They carry out filtration, selective reabsorption and tubular secretion to form urine in kidney, which is then passed out through the urethra, via the ureters and urinary bladder.

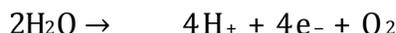
Formation of Urine

- Each kidney contains many filtration units called as nephrons.
- Nephrons are made up of a cluster of thin walled capillaries called as glomerulus which is associated with a cup like structure called as Bowman's capsule and the long tube which terminates through this capsule.
- The renal artery brings oxygenated blood to the kidneys along with the nitrogenous wastes like urea and uric acid and many other substances.
- The blood gets filtered through the glomerulus and this filtrate enters the tubular part of nephron.
- As this filtrate moves down the tubular part, glucose, amino acids, salts and excess of water gets selectively reabsorbed by the blood vessels surrounding tubules.
- The amount of water reabsorbed depends upon:
 - ✓ How much excess of water is there in the body and
 - ✓ How much nitrogenous wastes need to be excreted out.

- So the fluid now flowing in the tubular part is urine which gets collected in collecting ducts of nephrons.
- These collecting ducts together leave the kidney at a common point by forming the ureter.
- Each ureter drains the urine in the urinary bladder where it is stored until the pressure of expanded bladder leads to an urge to pass it out through urethra.
- This bladder is a muscular structure which is under nervous control.
- 180 litres of filtrate is formed daily but only 2 litres is excreted out as urine so the rest is reabsorbed in the body.

Know the Terms

- **Metabolism:** It is the sum total of all the chemical reactions which occur in a living being due to interaction amongst its molecules. It has two components—Anabolism (build-up reactions) and Catabolism (breakdown reactions).
- **Nutrition:** It is the process by which living beings procure food for obtaining energy and body building materials.
- **Autotrophic Nutrition:** It is one in which an organism is able to build up its own organic food from inorganic raw materials with the help of energy.
- **Photosynthesis:** It is the synthesis of organic food from inorganic raw materials with the help of light energy inside chlorophyll containing cells.
- **Photolysis:** Photolysis of water is photocatalytic splitting of water into its components, hydrogen and oxygen.



- **Photo-phosphorylation:** It is the synthesis of energy rich molecules of ATP from ADP and inorganic phosphate with the help of light energy.
- **Compensation Point:** It is that value of a factor (e.g. light, carbon dioxide) at which the photosynthetic consumption of carbon dioxide exactly matches the liberation of CO₂ in respiration.
- **Heterotrophic Nutrition:** It is that mode of nutrition in which the organisms obtain food from outside sources.
- **Digestion:** It is the enzyme mediated breakdown of complex insoluble components of food into simple soluble and absorbable forms.
- **Lysozyme:** It is an antimicrobial enzyme found in saliva, tears, egg white and many animal fluids that causes breakdown of peptidoglycan and chitin covering of microbes.
- **Peristalsis:** It is a wave of contraction behind the food and expansion in the region of contained food that occurs in the alimentary canal for pushing the food from anterior to posterior ends.
- **Succus Entericus:** It is the name of digestive juice of small intestine also known as intestinal juice.
- **Emulsification:** Emulsification of fats is conversion of large fat pieces into very fine fat globules.
- **Phagocytosis:** This is the process of ingestion of solid food particle by a cell or unicellular organism.
- **Circumvallation:** This is the method of intake of food when Amoeba comes in contact with a food particle or prey, it throws pseudopodia all around the same. The tips of encircling pseudopodia fuse and the prey comes to lie in a vesicle or phagosome.

- **Respiration:** It is an enzyme controlled biochemical process of stepwise oxidative breakdown of organic compounds releasing energy at various steps.
- **Cutaneous Respiration:** It is the mode of exchange of respiratory gases that occurs through skin which is thin, permeable, moist and vascularised for this function.
- **Branchial Respiration:** It is the respiration performed with the help of gills.
- **Breathing:** It is a physical process of alternate inhalation of fresh air and exhalation of foul air.
- **Aerobic respiration:** It is the stepwise complete oxidative breakdown of respiratory substrate into carbon dioxide and water with the help of oxygen that act as terminal oxidant.
- **Glycolysis (EMP):** It is the first step of breakdown of respiratory substrate which occurs in cytoplasm and produces two molecules of pyruvate from a molecule of glucose.
- **Kreb's Cycle:** It is a cyclic series of metabolic reactions of aerobic respiration that occur inside mitochondria Acetyl-CoA is completely oxidised into carbon dioxide and reduced coenzymes NADH₂ as well as FADH₂ are produced.
- **Terminal Oxidation:** It is the combining of oxygen with hydrogen released from reduced coenzymes during oxidative phosphorylation.
- **Transportation:** It is the movement of materials from one part to another, usually from the region of their availability to the region of their use, storage or elimination.
- **Circulatory System:** It is a system of organs, tubes and a blood-like fluid that circulates various materials inside the body.
- **Haemolysis:** It is the process of destruction of RBC's.
- **Serum:** It is a whitish water fluid that is squeezed out from contracting blood clot.
- **Diapedesis:** It is the crawling of white blood corpuscles out of blood capillaries into surrounding tissues.
- **Pulse:** It is a repeated throb felt in a superficial artery of the body due to forceful pumping of the blood.
- **Translocation:** It is the movement of materials in solution form within an organism especially in phloem of plants.
- **Transpiration:** It is the loss of water in vapour form from the exposed parts of a plant.
- **Ascent of Sap:** It is the upward movement of absorbed water or sap from root to the top of the plant.
- **Excretion:** It is the process of throwing out of waste products and other harmful chemicals from the body.
- **Nephric Filtrate:** It is the fluid passed out of glomerulus due to ultrafiltration in the Malpighian capsule of a nephron.
- **Ultrafiltration:** It is the filtration under pressure of small particles, solutes and solvents, through a finely porous membrane.
- **Glomerulus:** It is a bunch of fine blood vessels or capillaries present in the depression of Bowman's capsule where ultrafiltration occurs.
- **Micturition:** It is the expulsion of urine from the body.
- **Bowman's Capsule:** It is a broad, blind cup-shaped, proximal end of a nephron in which glomerulus is located for ultrafiltration.
- **Osmoregulation:** It is the maintenance of a fixed osmotic concentration of body fluids by controlling the amount of water and salts.

Questions:

1. The first Step in photosynthesis is

- (a) Photolysis of water
- (b) Production of assimilatory pigments
- (c) Excitation of chlorophyll
- (d) Synthesis of ATP

Ans: (c) Excitation of chlorophyll

2. What is the role of saliva in the digestion of food?

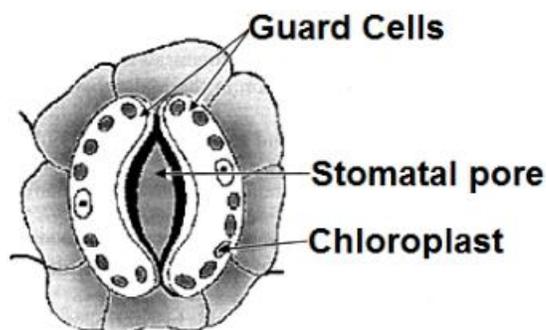
Ans: Saliva moistens the ingested food with mucus, sterilises it with lysozyme and partially digests starch part of food into sugar with the help of salivary amylase or ptyalin.

3. State the function of digestive enzyme.

Ans: Digestive enzyme are hydrolytic proteinaceous substances which cause breakdown of complex insoluble components of food into simple, soluble and absorbable substances.

4. Draw the diagram of an open stomatal pore of a leaf and label on it chloroplast and guard cells.

Ans:



Open Stomatal pore

5. Mention the site of complete digestion in our body. Name the end products formed on complete digestion of carbohydrates, proteins and fats.

Ans: Site of Complete digestion: Small intestine in alimentary canal.

End products formed are:

Proteins → Amino acids

Carbohydrates → Simple sugars

Fats → Fatty acids + Glycerol.

6. Why does the medium become acidic in mouth? What is the ill effect of this acidic medium? How can this be prevented?

Ans: (i) Bacteria present in the mouth produce acids by degradation of sugar and food particles in the mouth that may bring down pH in the mouth below 5.5.

(ii) Tooth enamel get corroded by the action of acids and tooth decay occurs.

(iii) By cleaning the teeth with tooth paste which is basic in nature.

7. What is the function of digestive enzymes?

Ans: Digestive enzymes convert the large and insoluble food molecules into small water soluble molecules during the process of digestion.

8. Describe heterotrophic mode of nutrition and give its examples. Name the three types of this nutrition.

Ans: It is the mode of nutrition in which an organism cannot make its own food and depends on other organisms for food. All the animals including man, most bacteria and some fungi have heterotrophic mode of nutrition and these organisms are called heterotrophs. Holozoic, Saprophytic and Parasitic.

9. Name three different glands associated with the digestive system in humans. Also name their secretions.

Ans: Difference between name of the glands and name of secretions.

Sl.No	Name of the glands	Name of Secretions
(i)	Salivary glands	Saliva contains enzyme, ptyalin
(ii)	Gastric glands	Secretes gastric juice, HCl, mucus, pepsin.
(iii)	Liver	Bile juice.
(iv)	Intestinal glands	Intestinal juice.
(v)	Pancreas	Pancreatic juice which contains trypsin, lipase and amylase.

10. List the role of each of the following in our digestive system:

- (i) Muscles of stomach wall (ii) Hydrochloric acid (iii) Mucus.

Ans: (i) Help in mixing the food thoroughly with more digestive juice by peristalsis.

(ii) Creates an acidic medium which facilitates the action of the enzyme pepsin.

(iii) Protects the inner lining of the stomach from the action of the acid.

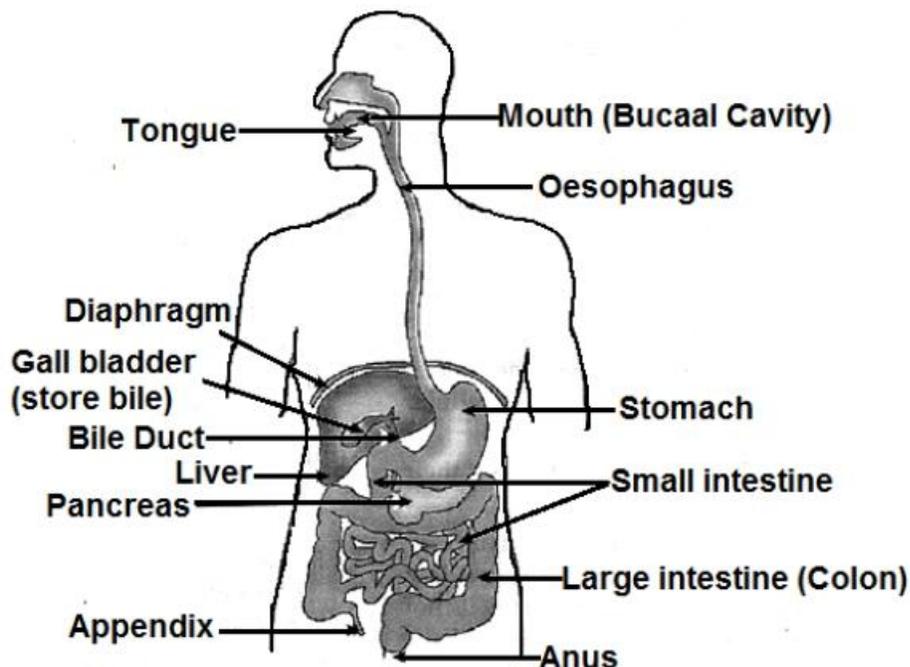
11. Mention the organ and site of photosynthesis in green plants. What are the raw materials essential for this process? How are they obtained? Write complete balanced chemical equation for the process. Name the byproducts.

Ans: (i) Photosynthesis takes place in the grana and stroma of the chloroplast (Plastid) in green plants.

(ii) The raw materials required for this process are carbon dioxide and water in the presence of sunlight and chlorophyll.

12. (a) Draw a well labelled diagram of human alimentary canal, and label the following parts:

- (i) Liver (ii) Pancreas (iii) Small intestine (iv) Large intestine.
- (b) What is peristaltic movement?



(b) Peristaltic movement: The lining of alimentary canal has muscles that contract rhythmically in order to push the food forward. This is called are peristaltic movements.

13. Haemoglobin levels in the blood samples of two persons A and B are found to be 9 gm/dL and 13 gm/dL respectively. Which statement is true with respect to the amount of oxygen supply in their body? [SSLC, 2016 April]

- (a) More in person B than in person A
- (b) More in person A than in person B
- (c) Equal in person A and person B
- (d) No relation between oxygen supply and the level of haemoglobin.

Ans: (a) More in person B than in person A.

14. Name the respiratory pigment in human beings. Where is this pigment found?

Ans: The respiratory pigment in human being is haemoglobin. Haemoglobin is present in RBC's of blood in humans.

15. How do guard cells regulate opening and closing of stomatal pores?

Ans: The swelling of guard cells due to absorption of water causes opening of stomatal pores while shrinking of guard cell closes the pores. Opening and closing of stomata occur due to turgor changes in guard cells. When guard cells are turgid, stomatal pores is open while in flaccid conditions the stomatal aperture doses.

16. "Respiration is an Exothermic Reaction." Justify this statement giving the chemical equation for the reaction involved.

Ans: During respiration, the carbohydrates are broken down to form glucose. This glucose combine with oxygen in our cells and provide energy (heat).



17. Give reasons for:

[SSLC July, 2018-19]

- (i) Oxygenated and deoxygenated bloods are separate in the heart of mammals.
- (ii) Ventricles are thick walled.
- (iii) Herbivores have longer small intestine as compared to carnivores.

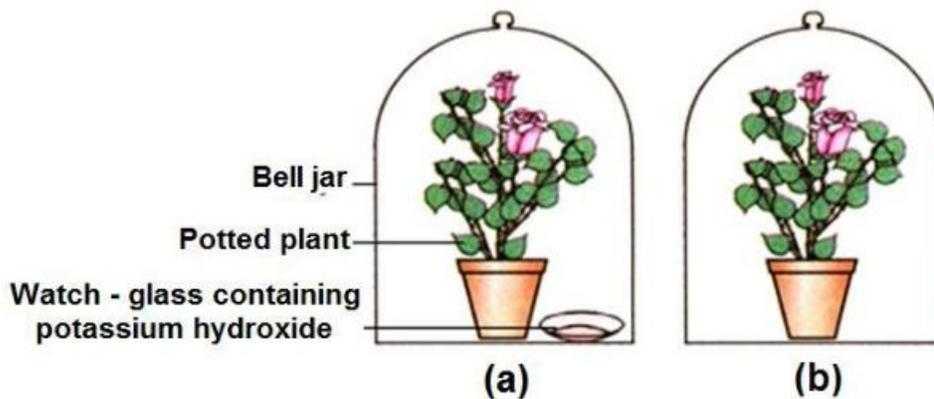
Ans: (i) This allows a highly efficient supply of oxygen, and meet their high energy needs (as they are warm-blooded animals).

- (ii) Because they have to pump blood throughout the body or into various organs.
- (iii) To allow cellulose to be digested.

18. Explain the activity with diagram to show that carbon dioxide is essential for photosynthesis.

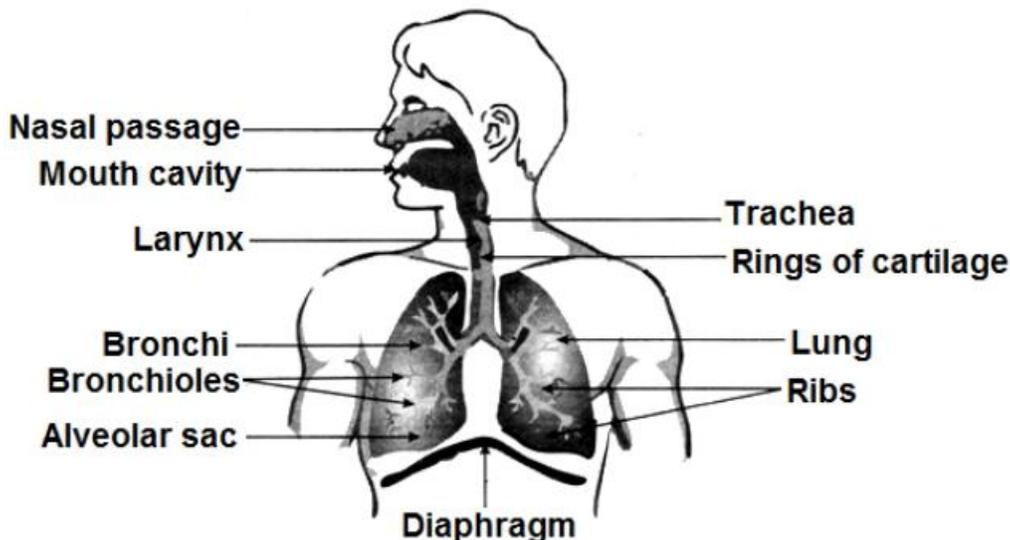
Ans:

- (i) Take two healthy potted plants which are nearly the same size.
- (ii) Keep them in a dark room for three days.
- (iii) Now place each plant on separate glass plates. Place a watch glass containing potassium hydroxide by the side of one of the plants. The potassium hydroxide is used to absorb carbon dioxide.
- (iv) Take two separate bell-jars and cover both plants with them.
- (v) To seal the bottom of the jars to the glass plates use vaseline so that the setup is air tight.
- (vi) Now place the plants in sunlight for about two hours.
- (vii) Pluck a leaf from each plant and check for the presence of starch.
- (viii) Leaf from plant A shows absence of starch whereas leaf from plant B tests positive for starch.



19. (i) Draw the human respiratory system and label the following— lung, bronchi and alveolar sac.

(ii) During breathing cycle, what is the advantage of residual volume of air in lungs? Explain.



20. Why do veins have thin walls as compared to arteries?

Ans: Veins have thin walls because the blood flowing through them is no longer under pressure, instead they have valves that ensure the blood flows in one direction only.

21. Explain how water and minerals are transported in plants?

Ans: Transport of materials in Xylem: The movement of water and minerals absorbed by the plant's root from the soil through xylem elements – tracheids and vessels are transported to other plant parts. Transpiration helps in upward conduction.

Transport of materials in Phloem: Food synthesized in the leaves is transported through sieve tubes of phloem tissues to other parts both upwards and downwards.

22. (a) What is lymph?

[SSLC April, 2016]

(b) How is composition of lymph different from blood plasma?

(c) List two functions of lymphatic system.

Ans: (a) Lymph is a tissue fluid, that contain plasma, proteins and blood cells which escapes into intercellular spaces.

(b) Lymph is colourless and contains less protein than plasma.

(c) Functions:

(i) Carries digested food

(ii) Drains excess fluid from extracellular space back into the blood.

23. Write three points of differences between artery and vein.

Ans: Difference between Artery and Vein

Sl.No	Artery	Vein
(i)	Wall is thick	Wall is thin
(ii)	Valves absent	Valves present
(iii)	Blood flows from heart to different organs	Blood flows from different organs to heart
(iv)	The flow of blood is fast jerky and with great pressure	The flow of blood is slow steady and with less pressure

24. Plants absorb water from the soil. Explain how does the water reach the tree top?

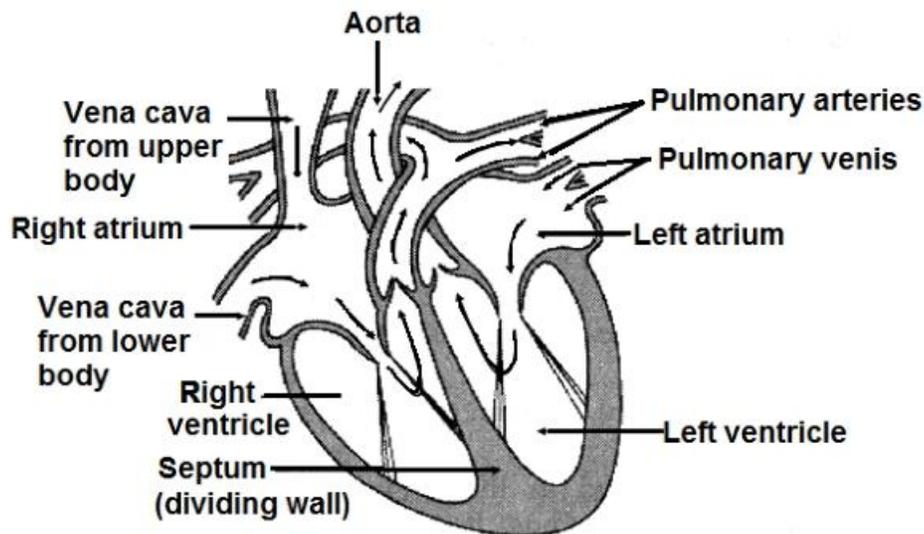
Ans: Xylem (vessels) of roots, stems and leaves are interconnected to form a continuous column. Roots also take up mineral salts actively, water moves in and as a result, it creates pressure which pushes the water up. Transpiration pull creates a suction force puffing up water.

25. (a) Draw a diagram of cross-section of the human heart and label the following parts:

- (i) Right ventricle (ii) Aorta (iii) Left atrium (iv) Pulmonary arteries

(b) Give reasons for the following:

- (i) The muscular walls of ventricles are thicker than the walls of atria.
 (ii) Arteries have thick elastic walls.



26. Why is nitrogen considered an essential element? How do plants acquire nitrogen?

Ans: Nitrogen is an essential element used in the synthesis of proteins and other compounds. It is taken up in the form of inorganic nitrates (or nitrites) or as organic compounds prepared by bacteria from atmospheric nitrogen.

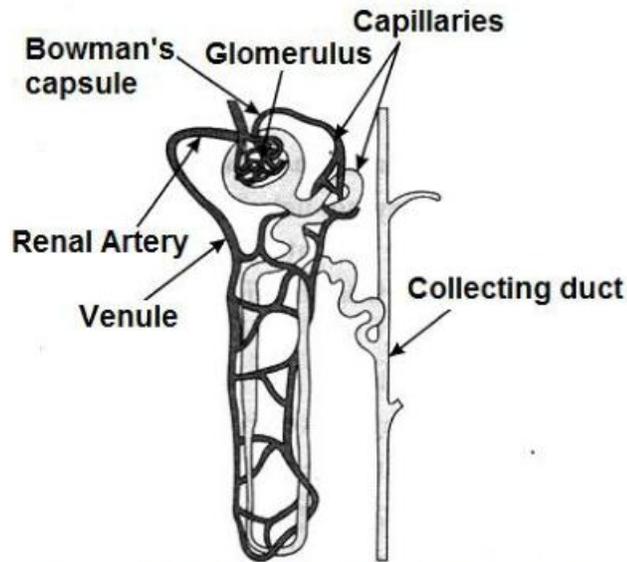
27. List any four strategies used by the plants for excretion.

Ans: Strategies used by plants for excretion are:

- (i) Many plant waste products are stored in cellular vacuoles.
 (ii) Waste products may be stored in leaves that fall off.
 (iii) Waste products are stored as resin and gums, especially in old xylem.
 (iv) They can get rid of excess water and oxygen through stomata.

28. (i) Draw a diagram of an excretory unit of a human kidney and label the following:
Bowman's capsule, Glomerulus, Collecting duct, Renal artery.
- (ii) Write the important function of the structural and functional unit of kidney.
- (iii) Write any one function of an Artificial Kidney. [SSLC 2018-19, July]

Ans: (i)



Urinerous tubule with its blood vesseles

- (ii) Function of nephron is filtration, reabsorption and secretion.
- (iii) Function of Artificial Kidney: Helps to remove harmful wastes, extra salts and water, control blood pressure. Maintain the balance of sodium potassium salts in a patient whose kidneys have failed.

Textbook Exercises

- The kidneys in human beings are a part of the system for
(a) nutrition (b) respiration (c) excretion (d) transportation.
Ans: (c) excretion
- The xylem in plants are responsible for
(a) transport of water (b) transport of food
(c) transport of amino acids (d) transport of oxygen
Ans: (a) transport of water
- The autotrophic mode of nutrition requires
(a) carbon dioxide and water (b) chlorophyll (c) sunlight (d) all of the above
Ans: (d) all of the above
- The breakdown of pyruvate to give carbon dioxide, water and energy takes place in
(a) cytoplasm (b) mitochondria (c) chloroplast (d) nucleus
Ans: (b) mitochondria
- How are fats digested in our bodies? Where does the process take place?
Ans: Fats are digested with the help of pancreatic juices which contains an enzyme lipase which brings about the digestion of fat. Bile contains certain salts which bring about the emulsification of fat molecules into small globules. It takes place in small intestine.
- What is the role of saliva in the digestion of food?
Ans: The enzyme ptyalin present in saliva splits starch and glycogen into maltose.

7. What are necessary conditions for autotrophic nutrition and what are its by product?
Ans: Light, appropriate temperature, CO₂ chlorophyll and water are conditions necessary for autotrophic nutrition. Molecular oxygen is the by product.

8. What are the differences between aerobic respiration and anaerobic respiration. Name some organism that use anaerobic mode of respiration.

Ans: Difference between Aerobic Respiration and Anaerobic Respiration:

S.No	Aerobic Respiration	Anaerobic Respiration
(i)	Aerobic respiration takes place in the presence of oxygen.	Anaerobic respiration takes place in the absence of oxygen.
(ii)	Complete breakdown of food occurs in this process.	Partial or incomplete breakdown of food occurs in the process.
(iii)	The end products are carbon dioxide (CO ₂) and water (H ₂ O).	The end products maybe ethyl alcohol, CO ₂ or lactic acid.

Organism that use the anaerobic mode of respiration are yeast, some bacteria and some parasite.

9. How are alveoli designed to maximise exchange of gases?

Ans: Alveoli contain an extensive network of blood vessels which provides a large surface area of exchange of gases.

10. What are the consequences of deficiency of haemoglobin in our bodies?

Ans: The deficiency of haemoglobin causes anaemia. The symptoms of anaemia are breathlessness, tiredness pale skin, palpitations and poor resistance to infection.

11. Describe double circulation in human beings, Why is it necessary?

Ans: The human heart consists of two sides: right and left. The right side of the heart receives deoxygenated blood and sends it further for purification to lungs. The left side of heart receives oxygenated blood from the lungs which is pumped further and sent to all the parts of the body through blood vessels. This is called double circulation. The energy demands for human beings is too large and hence it is necessary for the separation of oxygenated and deoxygenated blood to meet this energy demand.

12. What are the differences between the transport of materials in xylem and phloem.

Ans: (a) Xylem:

(i) It transports water and mineral. (ii) It involves upward movement. (Unidirectional)

(b) Phloem:

(i) It transports food and hormones.

(ii) It involves upward and downward movements (bidirectional).

13. Compare the functioning of alveoli in lungs and nephron in the kidneys with respect to their structure and functioning.

	Alveoli	Nephron
Structure	Ballon like structure containing an extensive network of blood vessels	Cup shaped structure followed tubule which also contains a cluster of very thin walled blood capillaries
Functioning	Helps in the exchange of gases	Separates nitrogenous waste from the blood

7. CONTROL & CO-ORDINATION

Quick Review

- All the living organisms respond and react to changes in the environment around them.
- The changes in the environment to which the organisms respond and react are called stimuli such as light, heat, cold, smell, touch etc.
- Both plants and animals respond to stimuli but in a different manner.

Control and Coordination in Animals

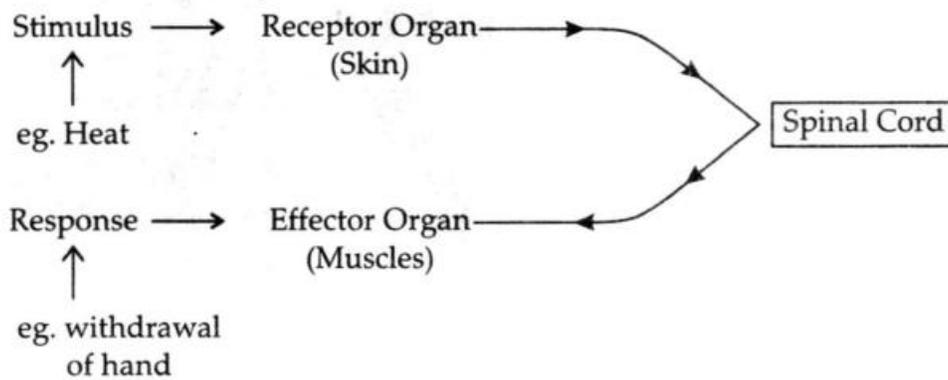
- It is brought about in all animals with the help of two main systems:
 - a) Nervous system
 - b) Endocrine system

Nervous System

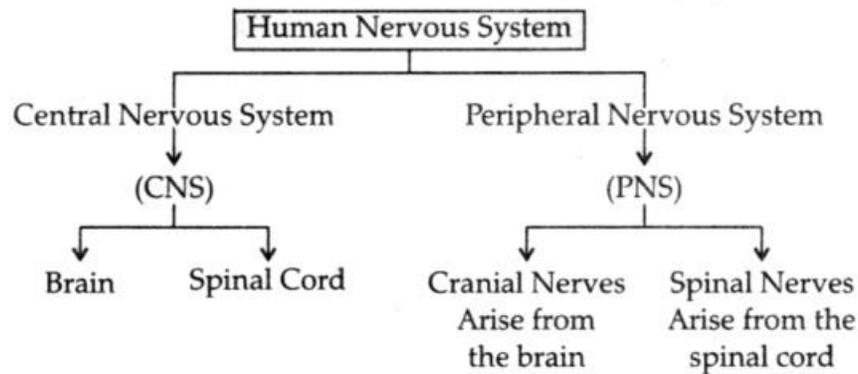
- Control and coordination are provided by nervous and muscular tissues.
- Nervous tissue is made up of an organized network of nerve cells or neurons, and it is specialized for conduction of information via electrical impulses from one part of the body to another.
- **Nervous system** is the system of conducting tissues that receives the stimulus and transmits it to other parts of the body forming a network of nerves.
- The units which make up the nervous system are called nerve cells or neurons.
- The **receptors** pass the information to the brain through a type of nerve cells called sensory neurons.
- **Motor neurons** transmit the information from the brain to the effector organs, mainly muscles and glands.
- **Nerve Impulse:** It is the information in the form of chemical and electrical signals passing through neurons. These impulses are carried by dendrites towards the cell body.
- **Neuromuscular Junction:** It is the point where a muscle fibre comes in contact with a motor neuron carrying nerve impulses from the central nervous system. The impulses travel from the neuron to the muscle fibres by means of neurotransmitter in the same way as the transmission of impulses across a synapse between two neurons.
- **Voluntary Action:** These are the actions which need thinking and are performed knowingly i.e. these are controlled by conscious thought.
Example: Speaking to a friend, writing a letter etc.
- **Involuntary Action:** These are not under the control of the will of an individual and are automatic response to a stimulus which is not under the voluntary control of the brain.
Example: Touching a hot plate unknowingly.

Reflex Action

- Reflex action is quick, sudden and immediate response of the body to a stimulus. E.g., Knee jerk, withdrawal of hand on touching hot object.
- **Reflex arc:** The pathway through which nerve impulses pass during reflex action is called reflex arc.



- **Response:** Responses are of three main types:
 - (a) Voluntary: Controlled by fore brain. E.g., talking, writing.
 - (b) Involuntary: Controlled by mid and hind brain. E.g., heartbeat, vomiting, respiration.
 - (c) Reflex action: Controlled by spinal cord. E.g., withdrawal of hand on touching a hot object.
- **Need of Reflex Actions:** In some situations such as touching a hot object, pinching etc. we need to act quickly, otherwise our body would be harmed. Here response is generated from spinal cord instead of brain.



HUMAN BRAIN

- Brain is the main coordinating centre of the body. It has three major parts:
 - (a) Fore-brain
 - (b) Mid-brain
 - (c) Hind-brain
- (a) **Fore-brain:** It is the most complex or specialized part of the brain. It consists of cerebrum.
- Functions:**
 - (i) Thinking part of the brain.
 - (ii) Control the voluntary actions.
 - (iii) Store information (Memory).
 - (iv) Receives sensory impulses from various parts of the body and integrate it.
 - (v) Centre associated with hunger.
- (b) **Mid-brain:** Controls involuntary actions .such as:
- (c) **Hind-brain:** It has three parts:
 - (i) **Cerebellum:** Controls posture and balance. Precision of voluntary actions e.g., picking pen.
 - (ii) **Medulla:** Controls involuntary actions e.g., blood pressure, salivation, vomiting.
 - (iii) **Pons:** Involuntary actions, regulation of respiration.
- Autonomic Nervous System means 'Self governing nervous system', consists of a pair of chain of nerves and ganglia found on both the sides of the vertebral column.

- Spinal cord is a cylindrical structure and a part of the central nervous system. It is made up of nerves which supply information to think.
- **Plant Movements:** The movements of the individual plant parts or organs of a plant like shoot, root etc. are due to some external stimuli like light, force of gravity, chemical substance, water etc.
- **Tropic Movement:** It is the directional growth or movement of a plant organ in response to an external stimulus. Growth towards the stimulus is positive tropism and growth away from the stimulus is negative tropism.
- **Hormones** are the chemical substances which co-ordinate and control the activities of living organisms and also their growth.

No.	Gland	Hormones	Functions	Target Site
1.	Hypothalamus	(i) Releasing hormones (RH) (ii) Inhibiting hormones	Regulates secretion of pituitary hormones.	Pituitary gland
2.	Pituitary Gland	(i) Growth hormone (GH)	Controls growth-dwarfism & gigantism.	Most tissues
3.	Thyroid Gland	(i) Thyroxm (ii) Triiodothyronine (iii) Thyrocalcitonin (TCT)	Basal metabolic rate, RBC formation. Regulated Ca level.	Body tissues
4.	Adrenal Gland	(i) Adrenaline (ii) Nor adrenaline (iii) Corticoids	Increase alertness, pupillary dilation, piloerection, sweating and heart beat.	Body tissues
5.	Pancreas	(i) Insulin	Regulates glucose homeostasis stimulates glycogenesis, controls carbohydrate metabolism	Tissues
		(ii) Glucagon	Maintains, glucose levels, stimulates gluconeogenesis. Release of sugar from liver.	
6.	Testis	(i) Testosterone (ii) Androgens	Develops male reproduction organs & accessory sexual characters. Influence male sexual behaviour.	Male body tissues
7.	Ovary	(i) Estrogen	Develops female reproductive organs, accessory sexual characters & female secondary behaviour.	Female body tissues
		(ii) Progesterone	Support pregnancy, stimulates milk secretion.	

- **Plant Hormones:** Are chemical compounds which help to coordinate growth, development and responses to the environment.

Main plant hormones are:

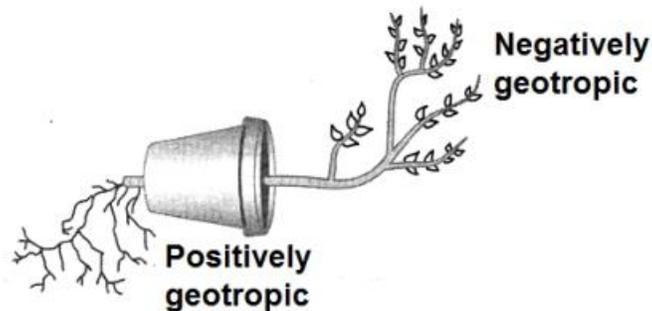
- (a) **Auxin:** Synthesized at shoot tip, Helps the cells to grow longer Involved in phototropism
- (b) **Gibberellin:** Helps in the growth of the stem.
- (c) **Cytokinins:** Promotes cell division Present in greater concentration in fruits and seeds.
- (d) **Abscisic Acid:** Inhibits growth, Cause wilting of leaves, Stress hormone.

Questions:

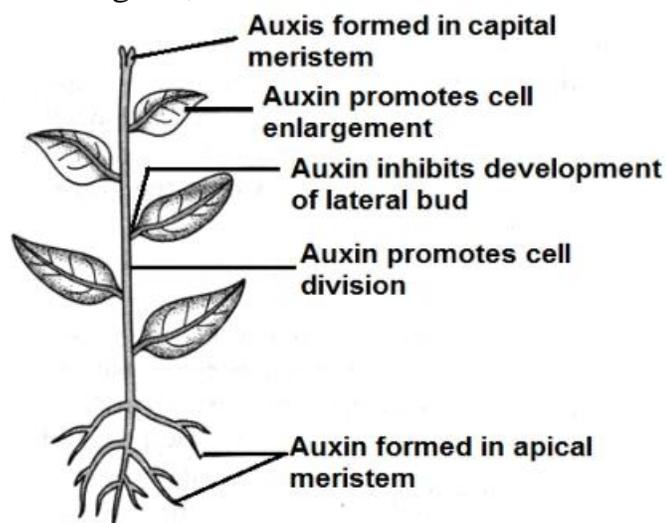
1. The growth of pollen tubes towards ovules is the example of:
(a) Hydrotropism (b) Geotropism (c) Chemotropism (d) Phototropism
Ans: (c) chemotropism
2. How do the shoot and roots of a plant respond to the pull of earth's gravity?
Ans: Roots grow downwards, towards gravity while shoot usually grow upwards and away from earth.
3. Explain the cause of shoots of the plant bending towards light.
Ans: Stems are positively phototropic and bend towards the direction of light. The movement is due to occurrence of more auxin on the darker side and lesser auxin on the illuminated side. Thus there is more growth on the darker side which causes the stem to bend towards light.
4. Define positive geotropism and negative geotropism. Give one example of each.

[SSLC July, 2018-19]

Ans: The movement of plant part in response to gravity is called geotropic movement and the phenomenon involved is called geotropism. When the tip of the stem grows away from the earth's gravitational forces, it is known as negative geotropism and when the root tips grow towards gravity, it is known as positive geotropism. E.g., Stem shows negative geotropism. Roots show positive geotropism.



5. How do auxins promote the growth of a tendril around a support? Describe in brief.
Ans: Auxins produced in the shoot tip move downwards in the plant. These auxins cause cell elongation in the growing tissues. In the tendrils, auxins move away from the point of contact with the supporting object. More growth occurs on the side away from the support. As a result of unequal growth on the two sides, the tendril coils around the support.
6. Illustrate with the help of a diagram, the effect of auxins in different parts of a plant.



7. List in tabular form three differences in the movement of leaves of a Touch-me-not plant (the plant of Mimosa family) when touched and movement of a tendril towards a support.

S.No	Mimosa Leaves	Tendril
(i)	Growth independent response	Growth dependent response
(ii)	It is a fast process	It is a slow process
(iii)	It is non – directional	It is directional

8. (a) Write the names and one function of each of any three growth hormones in plants.
 (b) In the absence of muscle cells, how do plant cells show movement?

Ans: (a) Three growth hormones in plants are—

(i) *Auxin*: It is synthesized in the young tip of roots and shoots. It promotes elongation and division of cell and root formation.

(ii) *Gibberellins*: They help in the growth of the stem.

(iii) *Cytokinins*: They promote cell division and delay leaf ageing.

- (b) The ability of a plant to detect change and respond to that change is termed as the sensitivity of the plant. Yet plants have no nervous system and no muscle tissue, they use electrical and chemical means to convey the information from one cell to another cell. The leaves of the sensitive plant (*Mimosa pudica*) folds up in response to touch. These leaf movements are independent of growth whereas, the directional movement of the shoot of a germinating seedling breaking through the soil is growth dependent.

9. Match the Column

Column – A		Column – B	
(i)	Reflex action	(a)	Thinking
(ii)	Stress hormone	(b)	Vomiting
(iii)	Cytokinin	(c)	Abscisic acid
(iv)	Hind brain	(d)	Cell division
(v)	Fore brain	(e)	Sudden response

Ans: (i) – (e), (ii) – (c), (iii) – (d), (iv) – (b), (v) – (a).

10. Name the two components of peripheral nervous system.

Ans: Cranial nerves arising from the brain and the spinal nerves arising from the spinal cord.

11. How does our body maintain blood sugar level?

Ans: Timing and amount of hormone released are regulated by feed back mechanisms. If sugar level in blood rises, cells of pancreas detect and secrete more insulin which leads to the fall off sugar level.

12. (i) What is a reflex action?

(ii) Give example of involuntary action.

Ans: (i) Reflex action is defined as an unconscious and involuntary response of effectors to a stimulus.

(ii) Involuntary action: Beating of heart, salivation in the mouth on chewing of tasty food.

13. During exercise, the breathing rate is automatically enhanced. What is the reason behind it?

Ans: During exercise, the body demands more energy and oxygen. To fulfill these demands, the breathing rate is automatically enhanced, the heart beats faster, thus sending a greater volume of oxygenated blood to the muscles.

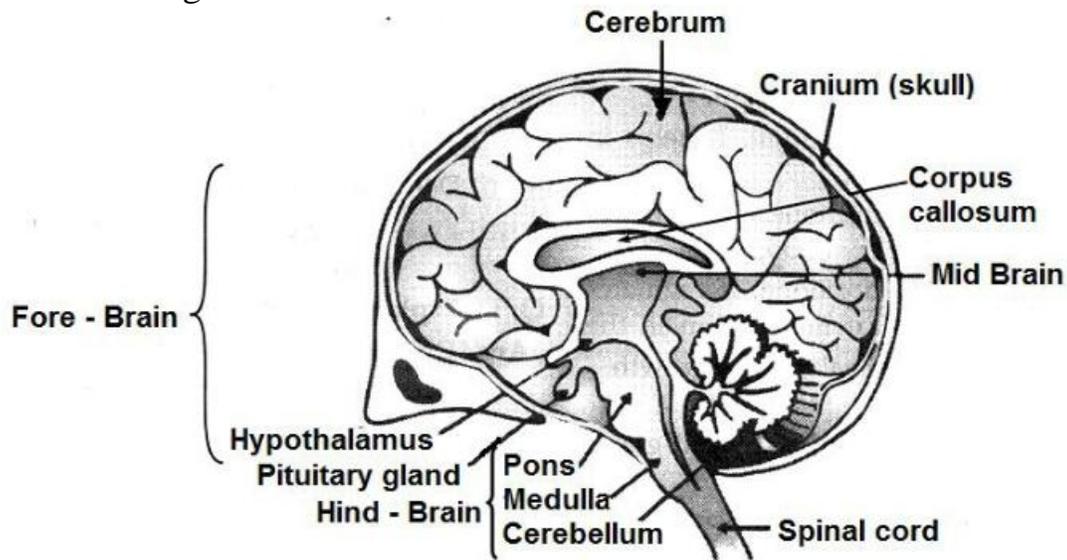
14. Draw a neat diagram of human brain and label on it the following parts:

- (i) Mid brain (ii) Pituitary gland (iii) Cerebellum (iv) Cerebrum

OR

- (i) Draw a well – labelled diagram of human brain.
(ii) Which is the main thinking part of brain?

Ans: (i) Labelled diagram of Human brain



(ii) Fore-brain.

15. Explain the feed back mechanism to regulate the action of the hormones with the help of one suitable example.

Ans: Hormones should be secreted in precise quantities. The timing and amount of hormone released are regulated by feedback mechanism. For example, if the sugar level in blood rises, they are detected by the cells of the pancreas which respond by producing more insulin. As the blood sugar level, falls, insulin secretion is reduced.

16. State three common features of respiratory organs of animals.

- Ans:** (i) All respiratory organs have large surface area to get enough oxygen.
(ii) They are thin-walled for easy diffusion of gases and substances.
(iii) They have rich supply of blood for transporting respiratory gases.

17. Write three main functions of the nervous system.

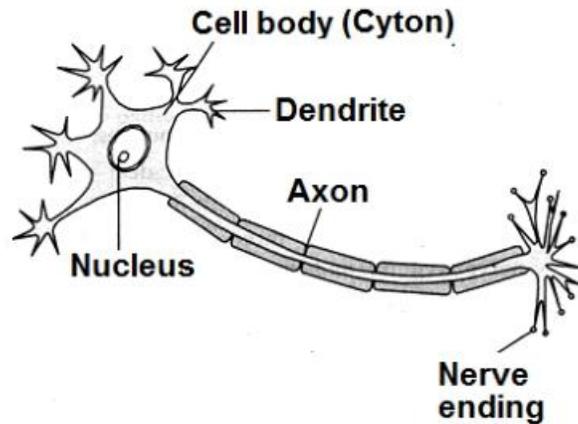
- Ans:** (i) Collects information from the surroundings.
(ii) Controls and co-ordinates the movement of muscles.
(iii) Helps to recognise smell, taste, vision, hearing etc. with the help of sense organs.

18. (a) Draw the structure of neuron and label cell body and axon.

(b) Name the part of neuron:

- (i) Where the information is acquired.
(ii) Through which information travels as an electrical impulse.

Ans: (a)



- (b) (i) The information is acquired at the end of the dendrite tip of a nerve cell
(ii) The information travels as an electrical impulse from the dendrite to the cell body and then along the axon to its end.

19. 'Brain and Spinal cord are two vital organs of our body'. How is our body designed to protect them?

Ans: Brain and spinal cord are the parts of central nervous system. Brain is located inside a bony box, named as cranium and a fluid is present in this balloon, known as cerebrospinal fluid which is a shock absorber.

Spinal cord is placed in a vertebral column and back bone protects it.

20. (i) Define receptor and state their location in our body. Mention any two receptors present in our forebrain and their functions

(ii) How do nerve impulses travel in our body?

Ans: (i) Specialised tips of some nerve cells which receive information from the surroundings are receptor.

Location: Sense organs

Gustatory receptor: Detect taste

Olfactory receptor: Detect smell

(ii) The information acquired at the end of the dendritic tip of a nerve cell, sets off a chemical reaction that creates an electrical impulse, which travels to the cell body, then along the axon to its end, releases some chemicals, across the synapses.

21. (i) Write names of hormones secreted by pituitary gland and adrenal gland. State their functions in the body.

(ii) Explain feedback mechanism for regulation of hormonal secretion with the help of one example.

Ans: (i) Pituitary gland secretes growth hormone. It regulates growth and development of the body. Adrenal gland secretes adrenaline hormone. It creates stress in our body.

(ii) The timing and amount of hormones released by various glands is controlled by feedback mechanism which is inbuilt in our body, e.g. if sugar level in blood rises too high, it is detected by cells of pancreas which respond by producing and secreting more insulin into blood. As blood sugar falls to certain level, the secretion of insulin is reduced automatically.

22. What happens at the synapse between two neurons?

Ans: At synapse the electrical impulse generated at dendrites of a neuron is passed on to dendrite of another neuron in the form of chemicals by axon ending of the first neuron.

23. Design an experiment to demonstrate hydrotropism.

Ans: Hydrotropism can be demonstrated with any germinating seedlings, which are allowed to grow on ground. The soil around the roots is separated by a polythene partition. The left side is kept moist and the right side dry.

The radicle at first grows in a downward direction and after some time the roots bend towards the moist soil. This is due to movement of the germinating roots to water.

24. Why is use of iodised salt advisable?

Ans: Iodine is necessary to make thyroxine hormone which regulates carbohydrates, protein and fat metabolism in the body so as to provide the best balance for growth.

25. Why are some patients of diabetes treated by giving injections of insulin?

Ans: Insulin regulates the sugar level in the blood. When this hormone is not synthesised in proper amount then the sugar level in the blood rises and the persons suffer from diabetes. This is the reason why diabetic patients are treated by giving injections of insulin.

Textbook Exercises

1. Which of the following is a plant hormone?

- (a) Insulin (b) Thyroxin (c) Oestrogen (d) Cytokinin

Ans: (d) Cytokinin

2. The gap between two neurons is called a

- (a) dendrite (b) synapse (c) axon (d) impulse

Ans: (b) synapse

3. The brain is responsible for

- (a) thinking (b) regulating the heart beat (c) balancing the body (d) all of the above

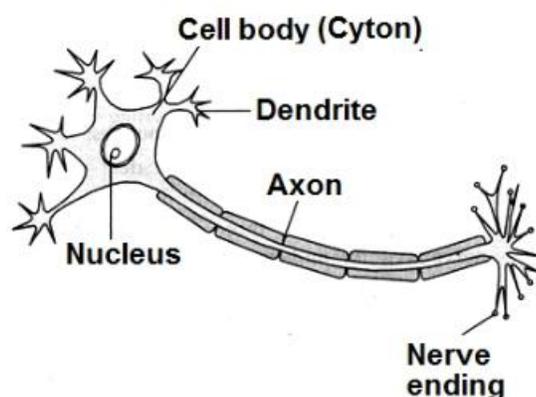
Ans: (d) all of the above

4. What is the function of receptors in our body? Think of situations where receptors do not work properly. What problems are likely to arise?

Ans: All information from environment is detected by receptors. When receptors do not work properly then information from environment cannot be detected and our body cannot respond accordingly.

5. Draw the structure of neuron and explain its function.

Ans: (a)



(b) (i) The information is acquired at the end of the dendrite tip of a nerve cell

(ii) The information travels as an electrical impulse from the dendrite to the cell body and then along the axon to its end.

6. How does phototropism occur in plants?

Ans: The chemical compounds released by stimulated cells for control and coordination in plants are called plant hormones or phytohormones.

Auxin: Controls growth

Gibberellins: Helps in growth of stem

Cytokinin: Promotes cell division

Abscisic acid: Inhibits growth, wilting of leaves.

7. Which signals will get disrupted in case of spinal cord injury?

Ans: In case of a spinal cord injury, signals for reflex action and involuntary action will get disrupted.

Reflex actions are monitored and controlled through the spinal cord of nervous system and not by the brain. In fact, nerves from all over the body meet in a bundle in the spinal cord on their way to the brain. In case of any injury to the spinal cord, the signals coming from the nerves as well as signals coming to the receptors will be disrupted.

8. How does chemical coordination occur in plants?

Ans: Chemical coordination occurs in plants by the help of plant hormones.

9. What is the need for a system of control and coordination in an organism?

Ans: It is necessary that various organs of the body of an organism work together in a proper manner to produce proper reaction to a stimulus.

10. How are involuntary actions and reflex actions different from each other?

Ans: Involuntary actions do not require thinking. They are controlled by the brain. For example, beating of heart. While on the other hand, the reflex action is rapid and spontaneous action in response to any stimulus. It doesn't involve the brain.

11. Compare and contrast nervous and hormonal mechanisms for control and coordination in animals.

Nervous system mechanism	Hormonal system mechanism
The information is conveyed in the form of electric impulse.	Information is conveyed in the form of chemical messengers.
The information is transmitted via axons and dendrites.	Information is transmitted through blood.
The flow of information is rapid and quick.	Flow of information is slow.
Its effects are short lived.	It has prolonged effects.

12. What is the difference between the manner in which movement takes place in a sensitive plant and the movement in our legs?

Ans: Sensitive plant, in response to touch, shows quick movement of leaves which fold up and droop. On the other hand, movement in legs is voluntary - action which is controlled by cerebellum part of hind brain.

8. HOW DO ORGANISMS REPRODUCE?

Quick Review

- Reproduction is the process by which living organisms produce new individuals similar to themselves. It ensures continuity of life on earth.
- Nucleus of the cell contains DNA (Deoxyribose Nucleic Acid) which is the heredity material
- DNA replicates and forms new cells causing variation. So, these new cells will be similar but may not be identical to original cell.
- Variations are useful for the survival of the individual and species over time as well as basis for evolution.

Types of Reproduction

(a) Asexual Reproduction

- A single individual give rise to new individual.
- Gametes are not formed.
- New individual is identical to parent.
- Adopted by lower organisms.

(b) Sexual Reproduction

- Two individuals i.e., one male and one female are needed to give rise to new individual.
- Gametes are formed.
- New individual is genetically similar but not identical to parents.
- It is usefull to generate more variations in species.
- Adopted by higher organisms.
- **Asexual reproduction** takes place through fission, fragmentation, regeneration, budding vegetative propagation, spore formation. These modes of reproduction depend on the body design of the organisms.
- Fission is of two types - binary fission and multiple fission.
- **Binary fission** is the division of one cell into two similar or identical cells. The nucleus first divides amitotically into two, followed by the division of the cytoplasm. The cell finally splits into two daughter cells. e.g., Amoeba
- In **multiple fission**, many individuals are formed from a single individual. e.g., Plasmodium
- The nucleus divides repeatedly, producing many nuclei and many daughter cells are formed.
- **Fragmentation:** Multicellular organisms with simple body organisation such as filamentous algae—Spirogyra breaks up into two or more small pieces of fragments upon maturation. These fragments grow into new individuals.
- **Regeneration:** It is the ability of a fully differentiated organism to give rise to new individual organisms from its body parts. Small cut or broken parts of the organism's body grow or regenerate into separate individuals. For example: Planaria and Hydra.
- In budding, a small part of the body of the parent grows out as a bud which then detaches and becomes a new organism. Hydra reproduces by budding using the regenerative cells.

Vegetative Propagation: In many plants, new plants develops from vegetative parts such as

- By roots: E.g., dahlias, sweet potato.
- By stem: E.g., potato, ginger.
- By leaves: E.g., bryophyllum (leaf notches bear buds which develop into plants).
- **Artificial methods:**
 - (a) Grafting E.g., Mango
 - (b) Cutting: E.g., Rose
 - (c) Layering: E.g., Jasmine
 - (d) Tissue culture: New plants are grown by using growing tip of a plant. These growing cells are kept in a culture medium which leads to the formation of callus. Callus is then transferred to hormone medium which causes growth and differentiation.
E.g., ornamental plants, orchid.

Benefits of tissue culture

- We can grow plants like banana, rose, jasmine etc. that have lost the capacity to produce seeds.
- New plants are genetically similar to parents.
- **Spore Formation:** Spores are small bulb like structures which are covered by thick walls. Under favourable conditions, they germinate and produce new organism.
- Sexual reproduction in flowering plants takes place in the phylum angiosperm. The gametes are produced within the flowers and the ovules are enclosed in a carpel.
- The flowers are usually bisexual i.e., male and female reproductive parts are present in the same plant. The m parts of a flower are: sepals, petals, stamens and carpel.
- Stamens and carpels are the reproductive parts of a flower which contain the germ cells. The male organ of a flower called 'stamen' makes the male gamete which are present in the pollen grain. The female organ of a flower calls 'carpel' or 'pistil' makes the female gamete, which are present in ovules of the plant.
- **Pollination** is the transfer of pollen grain from the anther of a stamen to the stigma of a carpel. Pollination is of two types: Self pollination and Cross pollination.
- **Embryo:** It is the stage of development between the zygote or fertilized egg and the newly formed offspring.

Reproduction in Human Beings:

- Humans use sexual mode of reproduction.
- **Sexual maturation:** The period of life when production of germ cells i.e., ova (female) and sperm (male) start in the body. This period of sexual maturation is called puberty.

Changes at Puberty

(a) Common in male and female

- Thick hair growth in armpits and genital area.
- Skin becomes oily, may result in pimples.

(b) In girls

- Breast size begin to increase.
- Girls begin to menstruate.

(c) In boys

- Thick hair growth on face.
- Voice begin to crack.

These changes signals that sexual maturity is taking place.

Male Reproductive System

(a) **Testes:** A pair of testes are located inside scrotum which is present outside the abdominal cavity. Scrotum has a relatively lower temperature needed for the production of sperms.

- Male germ cell i.e., sperms are formed here.
- Testes release male sex hormone (testosterone). Its function is:
 - (i) Regulate production of sperms.
 - (ii) Bring changes at puberty.

(b) **Vas deferens:** It passes sperms from testes up to urethra.

(c) **Urethra:** It is a common passage for both sperms and urine. Its outer covering is called penis

(d) **Associated glands:** Seminal vesicles and prostate gland add their secretion to the sperms. This fluid provides nourishment to sperms and makes their transport easy. Sperm along with secretion of glands forms semen.

Female Reproductive System

(a) **Ovary:** A pair of ovaries is located on both sides of the abdomen.

- Female germ cells i.e., eggs are produced here.
- At the time of birth of a girl, thousands of immature eggs are present in the ovary.
- At the onset of puberty, some of these eggs start maturing.

(b) **Oviduct or Fallopian tube**

- Receives the egg produced by the ovary and transfers it to the uterus.
- Fertilisation i.e., fusion of gametes takes place here.

(c) **Uterus:** It is a bag-like structure where development of the baby takes place.

- Uterus opens into vagina through cervix.
- The embryo moves down to reach the uterus. The embedding of the embryo in the thick inner lining of the uterus is called **implantation**.
- The time period from the development of foetus inside the uterus till birth is called **gestation period**. The act of giving birth to the fully developed foetus at the end of gestation period is termed as **parturition**.
- The breakdown and removal of the inner, thick and soft lining of the uterus along with its blood vessels in the form of vaginal bleeding is called **menstrual flow** or **menstruation**.
- Reproductive health is all those aspects of general health which help a person to lead a normal, safe and satisfying reproductive life.
- **Sexually Transmitted Diseases (STDs)** are the diseases which are spread by sexual contact from an infected person to a healthy person. Some common STDs are Gonorrhoea, syphilis, trichomoniasis, AIDS.
- There are different methods which are developed to prevent and control pregnancy such as mechanical methods, chemical methods, oral pills and surgical methods.

Contraception

- It is the avoidance of pregnancy, can be achieved by preventing the fertilisation of ova.

Methods of contraception

(a) **Physical barrier**

- To prevent union of egg and sperm.
- Use of condoms, cervical caps and diaphragm.

(b) Chemical methods

- Use of oral pills
- These change hormonal balance of body so that eggs are not released.
- May have side effects.

(c) Intrauterine contraceptive device (IUCD)

- Copper-T or loop is placed in uterus to prevent pregnancy.

(d) Surgical methods

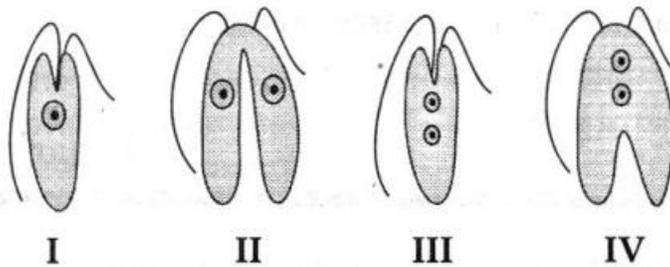
- In males the vas deferens is blocked to prevent sperm transfer called vasectomy.
- In females, the fallopian tube is blocked to prevent egg transfer called tubectomy.

Know the Terms

- **Reproduction:** It is the process of producing new individuals of the same species by existing organisms of a species i.e. parents.
- **Asexual reproduction:** It is the process of producing new organisms from a single parent without the involvement of sex cells or gametes.
- **Fission:** It is the simplest method of asexual reproduction in unicellular forms of life such as Amoeba, Paramecium and other protozoan.
- **Binary fission:** It is the division of one cell into two similar or identical cells. The nucleus first divides amitotically into two, followed by the division of the cytoplasm. The cells finally splits into two daughter cells.
- **Fragmentation:** It is an asexual reproduction in which a multicellular organisms breaks up into two or more small pieces of fragment upon maturation.
- **Regeneration:** It is the ability of a fully differentiated organism to give rise to new individual organism from its body parts.
- In vegetative propagation, new plants are obtained from the parts of old plants such as stem, roots and leaves, without help of any reproductive organs.
- **Tissue culture:** It is the production or propagation of new plants from isolated plant cells or small pieces of plant tissue in a synthetic medium of culture solution. This technique is also known as micropropagation, and In vitro culture because it takes place outside the body of the parent plant in a test tube using an artificial environment.
- **Micropropagation technique:** It is being used for the production of ornamental plants like orchids, Dahlia and carnation.
- **Sexual reproduction:** It is the process in which two sexes male and female are involved. The male sexual unit is known as male gamete or sperm while female sexual unit is termed as female gamete or ova.
- **Pollination:** It is the transfer of pollen grain from the anther of a stamen to the stigma of a carpel. The pollen grains are transferred by many agents as insects, birds, man, wind and water.
- **Fertilization:** It is defined as the fusion of a male gamete (sperm) with a female gamete (an ovum) to form a zygote during sexual reproduction.
- **Zygote:** The cell which is formed by the fusion of a male gamete and female gamete is called Zygote, i.e. it is a 'fertilised ovum' or 'fertilized egg.'
- **Sex ratio:** It is the ratio of the number of females to per thousand males in a population. The female-male sex ratio must be maintained for a healthy society.
- **Population size:** Organisms increase their population with the help of reproduction. The rates of birth and death in a given population determines its size.

Questions:

1. The correct order of binary fission in Leishmania is



(a) II, III, IV, I

(b) I, III, IV, II

(c) IV, I, III, II

(d) III, I, II, IV

Ans: (b) I, III, IV, II

2. What is DNA?

Ans: DNA is the carrier of hereditary information from parents to the next generation. Hereditary material is present in all living cells.

3. What is vegetative propagation?

Ans: It is a type of propagation in which new plants are obtained from the parts of old plants like stems, roots and leaves, without the help of any reproductive organ.

4. Name the method by which Hydra reproduces. Is this method sexual or asexual?

Ans: Hydra reproduces by Budding.
It is an asexual reproduction.

5. "Cell division is a type of reproduction in unicellular organism". Justify.

Ans: During cell division in unicellular organisms, the nucleus of the parent cell divides only once to form two daughter nuclei along with the cytoplasm that undergoes cleavage. In this way, two daughter cells are formed from one single parent.

6. List four advantages of vegetative propagation.

- Ans:** (i) Only one parent is required for reproduction, this eliminates the need of special mechanisms.
(ii) Many plants are able to tide over unfavourable conditions.
(iii) Plants that can not produce seeds are propagated by this method.
(iv) The trait of the parent plant is preserved.

7. How is the process of binary fission different in Amoeba and Leishmania?

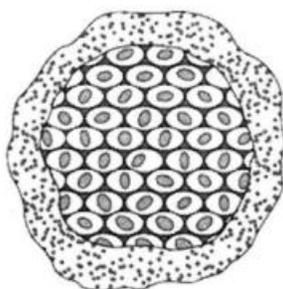
Ans: Amoeba reproduces through simple binary fission. Leishmania reproduces asexually through binary fission that occurs along a definite orientation related to the whip like structure at one end of the cell.

8. "Tissue culture helps to improve the nations' economy". Justify.

- Ans:** (i) Tissue culture is extensively used for large scale propagation of medicinal and ornamental plants. V
(ii) It is also used for propagation crop and forest plants.
(iii) It is also used for developing disease - free plants.
(iv) Cell culture is particularly used for extracting ion of many useful metabolites.

9. The picture given below depicts the process of asexual reproduction in Plasmodium.

- (i) Name the process depicted above and define it.
(ii) What is meant by asexual reproduction?



- Ans:** (i) Multiple Fission. It is a division of single-celled organisms into many daughter cells simultaneously.
 (ii) Creation of a new generation from a single individual or a single parent is involved.

10. Write one main difference between asexual and sexual mode of reproduction. Which species is likely to have comparatively better chances of survival-the one reproducing asexually or the one reproducing sexually? Justify your answer.

Ans: Asexual reproduction does not involve genetic fusion while sexual reproduction involves fusion of male and female gametes to form a zygote.

- (i) Species reproducing sexually have better chances of survival. 1
 (ii) Reason-Sexual reproduction gives rise to more variations which are essential for evolution as well as survival of species under unfavourable conditions.

11. What is the effect of DNA copying, which is not perfectly accurate, on the reproduction process? How does the amount of DNA remain constant though each new generation is a combination of DNA copies of two individuals?

Ans: Reproduction results in the production of offspring similar to parents in body design and form. The exact blue prints of body design is inherited in the offspring due to DNA replication/DNA copying. The imperfect DNA copying results in genetic variations that can be both useful or harmful for the offspring. The useful variations gets selected in nature and helps organism to survive in the changing environment while harmful variation gets eliminated.

If each new generation is to be the combination of the DNA copies from two pre-existing individuals, then each new generation will end up having twice the amount of DNA that the previous generation had. In sexual reproduction, the gametes usually contain half number of chromosomes and same numbers present in the body cells. These haploid gametes when fuse produce a new cell with double number of chromosomes than the gametes and same as the body cells. In this way organisms restrict doubling of DNA and maintain the chromosome number.

12. List three distinguishing features between sexual and asexual type of reproduction, in tabular form.

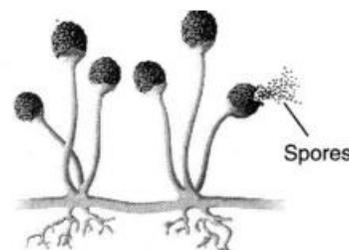
Ans: Differences between Sexual and Asexual reproduction:

S.No	Sexual Reproduction	Asexual Reproduction
(i)	In involves two parents	It involves only one parent
(ii)	Gametes are produced	Gametes are not produced
(iii)	Genetics variation occurs in the off spring	Offsprings are identical

13. (i) Identify the process depicted in the diagram given below.

(ii) The part labelled as spores has a covering of thick walls around it. What is its advantage?

(iii) What are hyphae?



Ans: (i) Spore formation in Rhizopus.

(ii) The thick walls protect the spores until they come in contact with soil.

(iii) The thread like projections are called hyphae.

14. What is vegetative propagation? List with brief explanation two advantages of practising this process for growing same types of plants. Select two plants from the following which are grown by this process:

Banana, Wheat, Mustard, Jasmine, Gram.

Ans: (a) Vegetative propagation is the development of a new plant from the vegetative parts / roots, stem and leaves of a plant.

(b) *Advantages:*

(i) Such plants can bear flowers and fruits earlier than those produced from seeds

(ii) Allows propagation of plants (banana, orange etc) that have lost capacity to produce seeds.

(iii) Jasmine, banana.

15. Differentiate between the following:

(i) Pollen tube and style.

(ii) Fission in Amoeba and Plasmodium

Pollen Tube	Style
Pollen tube is the part of the male gametophyte in plants. It is a long tube like structure that carries the male gamete from the stigma to the ovules.	It is a part of the female reproductive organ, carpel. It joins the stigma to the ovary. It is made up of soft tissues which allows the pollen tube to grow downwards towards the ovule.

Binary fission in Amoeba	Multiple fission in Plasmodium
A single cell divides itself into two daughter cells is known as binary fission, binary can also occur in particular axis. e.g., Amoeba.	It is also a mode of asexual reproduction in which a cell divides itself into many daughter fission cells simultaneously. It occurs in definite orientation. e.g., yeast, malarial parasites.

16. What is the function of pollen grains in flowers?

Ans: Pollen grains fertilise the egg cell present in the embryo sac.

17. What is the function of petals in a flower?

Ans: The functions of petals is to attract insects for pollination and to protect the reproductive organs, which are at the centre of the flower.

18. Why is fertilization not possible without pollination?

Ans: Pollination allows pollen grains that produce male germ cell to reach the carpel which contain the female germ cell, egg. Thus fertilization which involves fusion of male and female germ cells can only occur after pollination.

19. Explain giving one example of each, the unisexual and bisexual flowers.

Ans: Unisexual is the plant whose flowers contain either stamens or carpels but not both

Example: Papaya, watermelon,

Bisexual is the plant whose flowers contain both stamens and carpels.

Example: Hibiscus, Mustard.

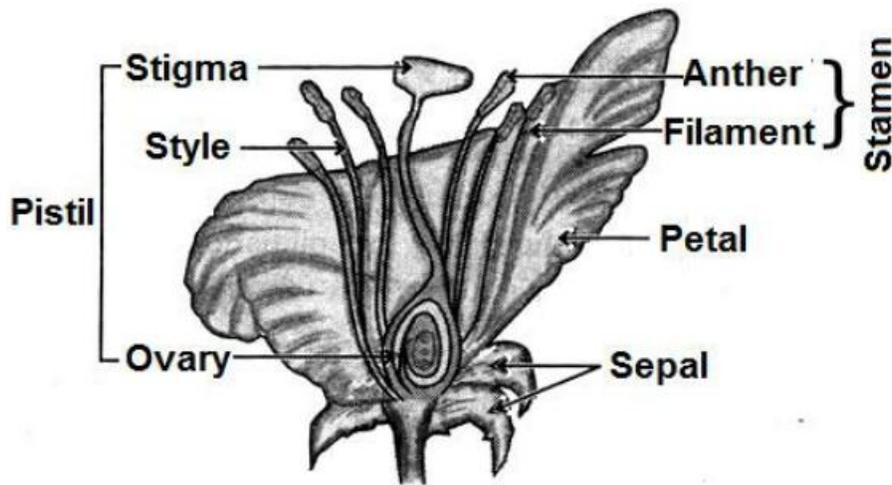
20. How is the process of pollination different from fertilization?

Ans: Pollination is the transfer of pollen grains from anther to the stigma of a flower

Fertilization is the fusion of male and female gametes.

21. Draw a labelled longitudinal structure of a flower showing its parts.

Ans:



Longitudinal section of a flower

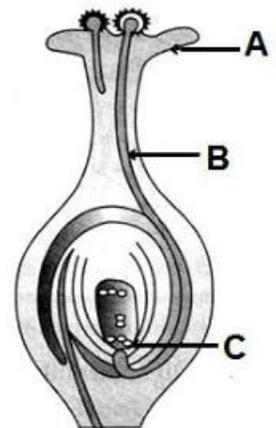
22. Name the parts A, B and C shown in the diagram and write their functions. [SSLC July 2018-19]

Ans: Part A is Stigma.

Function: It is the terminal part of carpel, which may be sticky and helps in receiving the pollen grains from the anther of stamen during pollination. Part B is Pollen tube.

Function: The pollen tube grows out of the pollen grain through the style to reach the ovary. Part C is Female Germ Cell.

Function: It is a female gamete which fuses with male gamete to form a diploid cell known as zygote.



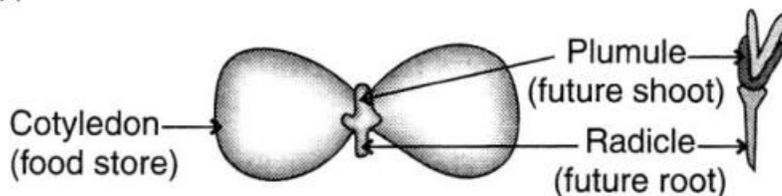
23. What is a seed? How does it help in reproduction in plants? Seed

Ans: A seed is the reproductive unit of a plant which can be used to grow into a new plant. It contains body plant or embryo and food for the baby plant. The baby plant present in a seed is in the dormant or inactive state. When the seeds get suitable conditions of water, warmth, air and light, then new plants grow out of these seeds. In this way, the parent plant reproduces more plants like itself by forming seeds through flowers.

24. (i) Draw a neat labelled diagram of a germinated seed and label radicle, plumule and cotyledon.

(ii) Mention function of each of these parts.

Ans: (i)



(ii) (a) Radicle Future root, (b) Plumule : Future stem, (c) Cotyledon (food store).

25. (i) Define the terms pollination and fertilisation.

(ii) Distinguish between self pollination and cross pollination.

Ans: (i) Pollination: It is the transfer of pollen grains from the anther of a stamen to the stigma of a carpel.

Fertilisation: It is defined as the fusion of a male gamete with a female gamete to form a zygote during sexual reproduction.

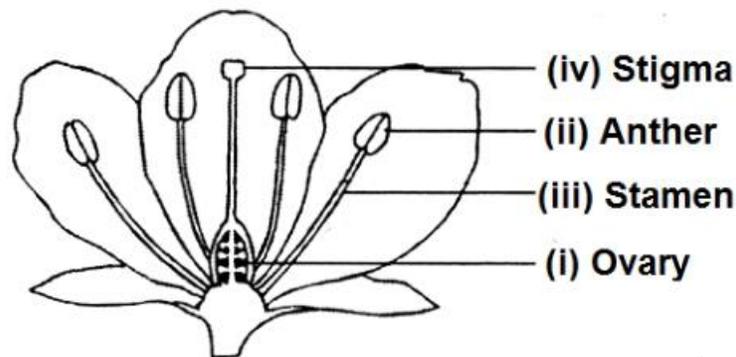
(ii) Difference between self pollination and cross pollination

S.No	Self Pollination	Cross Pollination
(i)	Self-pollination occurs within a flower or between two flowers of the same plants.	Cross-pollination occurs between two flowers borne on different plants of the same species.
(ii)	Flowers do not depend on other agencies for pollination,	Agents such as insects, water and wind are required for pollination.
(iii)	Flowers are not attractive nor do they produce nectar.	Flowers attract insects by various means like coloured petals, scent and nectar.

26. Draw a longitudinal section of a flower and label the following parts:

- (i) Part that develops into a fruit
- (ii) Part that produces pollen grain
- (iii) Part that transfers male gametes
- (iv) Part that is sticky to trap

Ans: A



27. No two individuals are absolutely alike in a population. Why?

Ans: Because hundreds of biochemical reactions occur during preparation of DNA copies. Few of them are liable to run and form a different product and hence they are not identical to the original. Thus, this gives rise to variations.

28. What is placenta? Write any two major functions of placenta. [SSLC July, 2018-19]

Ans: A disc shaped organ or special tissue in the uterus of pregnant mammal, nourishing and maintaining the foetus through the umbilical cord.

Functions of Placenta:

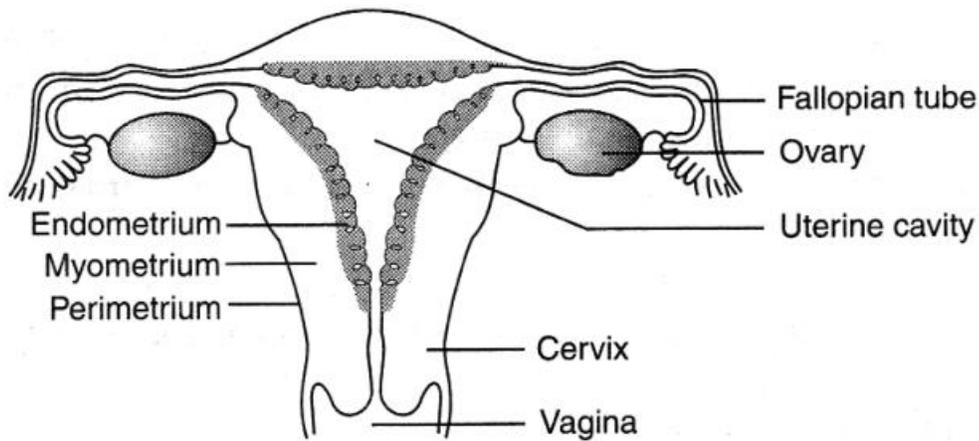
- (i) Helps in the transportation of glucose and oxygen from the mother to the embryo.
- (ii) Helps in removal of waste generated by the embryo

29. (a) Draw a sectional view of human female reproductive system and label the part where
 (i) Eggs develop (ii) Fertilization take place (iii) Fertilized egg gets implanted.

(b) Describe, in brief, the changes the uterus undergoes

- (i) To receive the zygote.
- (ii) If zygote is not formed.

Ans: (a) The human female reproductive system consists of a pair of ovaries, a pair of oviducts, the uterus and the vagina.



Human Female Reproductive System

- (i) The development of egg occurs in the ovary.
 - (ii) Fertilisation takes place in the fallopian tubes.
 - (iii) The fertilised egg gets implanted in the uterus.
- (b) (i) The uterus prepares itself every month to receive a fertilized egg/zygote. The inner uterus lining (endometrium) becomes thick and is supplied with blood to nourish the embryo.
- (ii) If the egg is not fertilised, then the uterus lining is not required. Hence, it breaks down and gets released in the form of blood and mucous through the vagina. This process lasts for 2—8 days. This cycle occurs every month and is known as menstruation.

30. Why is variation beneficial to the species but not necessarily for the individual?

Ans: Variations are beneficial to the species than individual because sometime for a species, the environmental conditions change so drastically that their survival becomes difficult. During that period, only few variants that are resistant would be able to survive. Thus, variants help in survival of the species. However, all variations are not necessarily beneficial for the individual organisms.

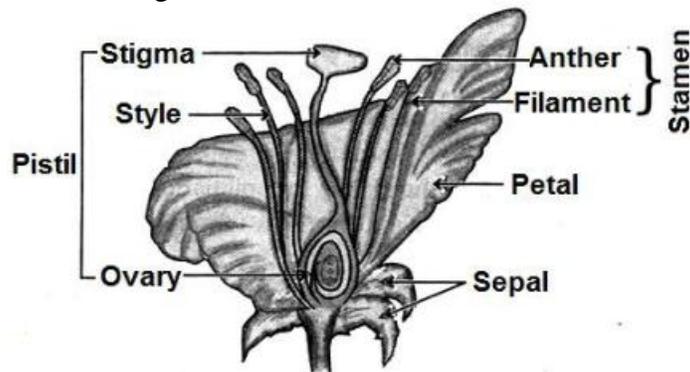
Textbook Exercises

1. Asexual reproduction takes place through budding in
 (a) Amoeba (b) Yeast (c) Plasmodium (d) Leishmania
Ans: (b) Yeast
2. Which of the following is not a part of the female reproductive system in human beings?
 (a) Ovary (b) Uterus (c) Vas deferens (d) Fallopian tubes
Ans: (c) Vas deferens
3. The anther contains
 (a) Sepals (b) Ovules (c) Pistil (d) Pollen grains
Ans: (d) Pollen grains
4. What are the advantages of sexual reproduction over asexual reproduction?
Ans: (i) The offspring exhibit diversity of characters as the fusing gametes come from two different and sexually distinct individuals.
 (ii) Meiosis during gametogenesis provides opportunities for new combination of genes.
5. What are the functions performed by testis in human beings?
Ans: The testis produce sperm and also male sex hormone testosterone.

6. Why does mensuration occur?

Ans: When the egg is not fertilised, menstruation occurs in human females.

7. Draw a labelled diagram of longitudinal section of a flower?



Longitudinal section of a flower

8. What are the different methods of contraception?

Ans: (i) Barrier method or mechanical method! Condom/Diaphragm, to prevent the meeting of sperms and ova.

(ii) Chemical method/ Oral pills—Changes the hormonal balance of the female partner so that the eggs are not released.

(iii) Surgical method - to block the vas deferens in males/vasectomy or the fallopian tube (oviduct) in females/ tubectomy, to prevent the transfer of sperms or egg and hence no fertilization takes place.

(iv) IUCDs/ Loop or the copper-T placed in the uterus, to prevent pregnancy.

9. How are the modes of reproduction different in unicellular and multicellular organisms?

Ans: Unicellular organisms reproduce asexually whereas multicellular organisms reproduce sexually.

10. How does reproduction help in providing stability to population of species?

Ans: Living organisms reproduce for the continuation of a particular species. It helps in providing stability to the population of species by producing new individual that resembles the parents.

11. What could be the reasons for adopting contraceptive methods?

Ans: Frequent and unwanted pregnancies can be avoided by adopting contraceptive methods. Also, these methods check population growth by controlling childbirth rate.

9. HERIDITY AND EVOLUTION

Quick Review

- Variations arise during the process of reproduction. They may be few in asexual reproduction, but many in case of sexual reproduction.
- The minor variations arising during Sexual reproduction are caused by slight inaccuracies in DNA copying. In sexual reproduction, variations are also caused by crossing over process of meiosis.
- Beneficial variations help the species to survive better in the environment.
- Nature selects the beneficial variations thereby leading to evolution.
- Reproduction produces offsprings with similar body design of the parents. However the offsprings are not identical, but show a great deal of variation from the parents.

Importance of Variation:

- (i) Depending upon the nature of variations different individuals would have different kinds of advantages. Example, Bacteria that can withstand heat will survive better in a heat wave.
 - (ii) Main advantage of variation to species is that it increases the chances of its survival in a changing environment.
- Sexually reproducing organisms such as humans have two (or more) versions of genes for each trait, called alleles.
 - **Gregor Johann Mendel** carried out several experiments on pea plants. He carried out large number of monohybrid and dihybrid crosses using many contrasting characteristics and put forward several important conclusions.

Mendel and His Work on Inheritance

- **Gregor Johann Mendel (1833 & 1884):** Started his experiments on plant breeding and hybridisation. He proposed the laws of inheritance in living organisms. Mendel was known as **Father of Genetics**.
- **Plant selected by Mendel:** *Pisum sativum* (garden pea). Mendel used a number of contrasting characters for garden pea.

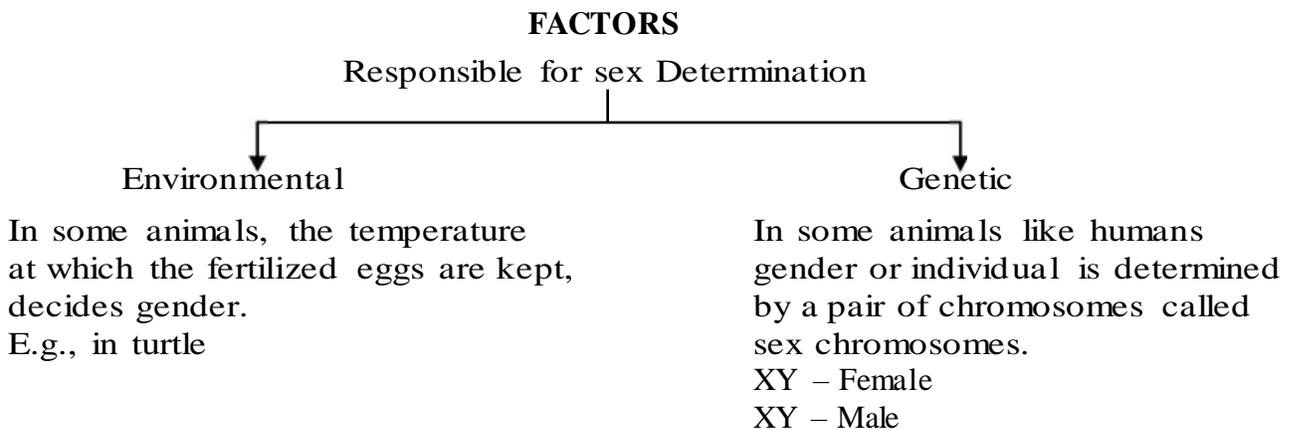
Seven pairs of contrasting characters in Garden Pea.

Character	Dominant Trait	Recessive Trait
Flower colour	Violet	White
Flower position	Axial	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf/Short

- In case of monohybrid cross with pure variety of plants, the phenotypic ratio obtained in F₂ generation is 3 : 1.
- In case of dihybrid cross involving two pairs of contrasting characters, the phenotypic ratio obtained in F₂ generation is 9 : 3 : 3 : 1.

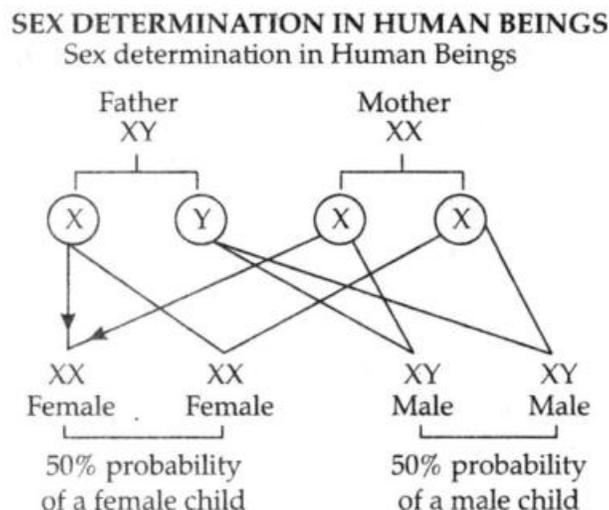
- Mendel concluded that out of any pair of contrasting characters, one is dominant and the other is recessive.
- The homozygous dominant trait is denoted by two capital letters whereas the homozygous recessive trait is denoted by two small letters.
- The factors or genes controlling a particular trait separate from each other during gamete formation. Hence gamete is always pure as far as contrasting characters are considered. Each gamete will possess only one gene set.
- In crossing if two or more traits are involved, their genes assort independently, irrespective of the combinations present in the parents.
- Genes carry information for producing proteins, which in turn control the various body characteristics.
- For a particular trait, the offspring receives one allele from the father and one allele from the mother.
- The combination of the male and female germ cells gives a diploid zygote. Thus the normal diploid number of chromosomes in the offspring is restored.
- Different mechanisms are used for sex determination in different species.

Determination of sex of an offspring.



Sex Chromosomes: In human beings, there are 23 pairs of chromosome. Out of these 22 chromosomes pairs are called autosomes and the last pair of chromosome which helps in deciding gender of the individual is called sex chromosome.

XX – Female
XY – Male



Evolution

- Evolution is the sequence of gradual changes which takes place in the primitive organisms, over millions of years, in which new species are produced.
- Genetic drift can alter gene frequencies in small population and provide diversity without any survival benefits.
- Several factors such as environment, mutations, reproduction, etc can cause alterations in gene frequencies in a population over generations, leading to evolution. -
- Changes occurring in the DNA of germ cells are heritable whereas changes taking place in the non-reproductive tissues are not inherited.
- Charles Darwin proposed that evolution of species occurred by natural selection, but he did not know the underlying mechanism.
- Natural selection, genetic drift, variations and geographical isolation can lead to speciation in sexually reproducing organisms.
- Gene flow between the members of a population prevents speciation.
- **The fundamental characteristics used to classify organisms are:**
 - (i) Presence of prokaryotic or eukaryotic cells.
 - (ii) Whether the organism is unicellular or multicellular.
 - (iii) Ability to perform photosynthesis.
 - (iv) Presence of endoskeleton or exoskeleton in heterotrophic organisms.
- Classification of living organisms is closely related to their evolution.

Evolution and Classification

Both evolution and classification are interlinked.

1. Classification of species is reflection of their evolutionary relationship.
2. The more characteristics two species have in common the more closely they are related.
3. The more closely they are related, the more recently they have a common ancestor.
4. Similarities among organisms allow us to group them together and to study their characteristics.

I. Homologous Organs: (Morphological and anatomical evidences). These are the organs that have same structural plan and origin but different functions.

Homologous organs provides evidence for evolution by telling us that they are derived from the same ancestor.

Example:

Forelimb of horse	(Running)	} Same basic structural plan, but perform different functions
wings of bat	(Flying)	
Paw of a cat	(Walk/scratch/attack)	

II. Analogous Organs: These are the organs that have different origin and structural plant but same function.

Example: Analogous organs provide mechanism for evolution.

Wings of bat →	Elongated fingers with skin folds	} Different basic structure, but perform similar function i.e., flight
Wings of bird →	Feathery covering along the arm	

- Fossils help in tracing evolutionary pathways.
- The age of fossils can be determined by using the relative method or the isotope dating method.
- Evolution is not a one-step process, but a continuous process occurring in several stages.
- Complex organs are formed slowly over many generations, sometimes with intermediate forms playing an important role.
- Sometimes the use of certain features gets modified with time. For example: Feathers may have provided insulation initially, but later became associated with flight.
- Evolutionary studies have shown that birds are closely related to reptiles.
- Humans have carried out artificial selection for various features of cabbage and produced different vegetables.

Vegetable produced	Selected feature
Broccoli	Arrested flower development
Cauliflower	Sterile flowers
Kohirabi	Swollen parts
Kale	Larger leaves

- Molecular phylogeny can also be used to trace evolutionary relationships. Here the DNA of different species is compared. Greater the differences in DNA, more distantly related are the species.
- Disappearance of the existing species is not a requirement for formation of new species.
- The new species formed are better adapted to the environment but they need not be superior to the existing species.
- The common ancestor of humans and chimpanzees evolved in different ways to produce the present forms. Evolution produces more diverse and complex body forms over a period of time, but the newly formed species are not more progressive than the already existing ones. So it is wrong to say that evolution produces progressive higher forms from lower ones.
- All human beings, whether fair skinned or dark skinned, belong to the same species i.e., *Homo sapiens* that originated in Africa.
- The human ancestors gradually migrated from Africa to various parts of the world such as Asia, Europe, Australia and America. Thus they spread to different parts of the earth and adapted as best as they could to their environmental conditions.

Know the Terms

- **F₁ generations:** The generations resulting immediately from a cross of the first set of parents (parental generation).
- **F₂ generations:** Offsprings resulting from a cross of the members of F₁ generation.
- **Dominant:** The gene which expresses itself if F₁ generation is known as dominant gene.
- **Recessive:** The gene which is unable to express itself in presence of the dominant gene.
- **Genotype:** It is the genetic constitution of an organism which determines the characters.
- **Phenotype:** It is the appearance of an individual.

- **Progeny:** The offspring produced as a result of reproduction of the parents.
- **Dominant trait:** A genetic trait is considered dominant if it is expressed in a person who has only one copy of that gene.
- **Recessive trait:** A genetic trait is considered recessive if it is expressed only when two copies of the gene are present.
- **Homozygous:** Having two identical alleles of the same gene.
- **Heterozygous:** Having dissimilar alleles at corresponding chromosomal loci.
- **Monohybrid cross:** A type of cross in which only one pair of contrasting characters are considered.
- **Dihybrid cross:** A type of cross that involves two sets of characteristics.
- **Allele:** Either of a pair (or series) of alternative forms of a gene that can occupy the same locus on a particular chromosome and that control the same character.
- **Somatic cells:** All cells forming the body of an organism, except the reproductive cells.
- **Sex chromosomes:** Either of a pair of chromosomes, usually designated X or Y, in the germ cells of most animals, that combine to determine the sex and sex-linked characteristics of an individual.
- **Gene:** A segment of DNA that is involved in producing a polypeptide chain and forms the basic unit of heredity.
- **Trait:** A trait is a distinct variant of a phenotypic character of an organism that may be inherited or environmentally determined,
- **Haploid cell:** Cell that has only one complete set of chromosomes.
- **Diploid cell:** Cell that has two sets of chromosomes, one of paternal origin, the other of maternal origin.
- **Micro-evolution:** Evolution resulting from small specific genetic changes that can lead to a new sub-species.
- **Genetic drift:** It refers to the random change in gene frequencies in a small population, presumably owing to change rather than natural selection, thereby providing diversity without any adaptations.
- **Speciation:** The process of formation of a new species.
- **Homologous organs:** Organs of different organisms which may be dissimilar externally and in function, but are similar in origin and in fundamental structural plan.
- **Analogous organs:** Organs of different organisms which are similar in function and external appearance, but dissimilar in origin and structural plan.
- **Fossils:** All preserved traces of living organisms.
- **Molecular phylogeny:** The use of a gene's molecular characteristics to trace the evolutionary history of organisms.

Questions :

1. A special property of DNA that ensures the equal distribution of similar genetic material to the offsprings is: [SSLC 2017, April]
 (a) Mutation (b) Recombination (c) Replication (d) Variation
Ans: (c) Replication

2. Identify the correct complementary base pairing among the following: [SSLC 2016, April]
- Adenine—Thymine and Guanine—Cytosine
 - Adenine—Guanine and Thymine—Cytosine
 - Adenine—Cytosine and Thymine—Guanine
 - Guanine—Adenine and Cytosine—Adenine

3. What is DNA?

Ans: DNA is the carrier of hereditary information from parents to the next generation.

4. Name the information source for making proteins in the cells.

Ans: Cellular DNA is the information source for making proteins in the cells.

5. What is a gene?

Ans: Gene is a part of DNA that encodes the instructions that allow a cell to produce a specific protein or enzyme.

6. Why will each gamete contain only one gene set?

Ans: The genes controlling a particular trait separate from each other during gamete formation. Hence gamete is always pure as far as contrasting characters considered and will possess only one gene set.

7. What is the difference between F₁ generation and F₂ generation?

Ans: Difference between F₁ generation and F₂ generation.

generation	generation
F ₁ generation refers to the offspring Resulting immediately from a cross between the first set of parents.	F ₂ generation on the other hand, refers to the offspring resulting from a cross among the members of F ₁ generation.

8. How do Mendel's experiment show that traits are inherited independently?

[SSLC July, 2018-19], [SSLC April, 2016]

Ans: (i) When a cross was made between a tall pea plant with round seeds and a short pea plant with wrinkled seeds, the F₁ progeny plants are all tall with round seeds. This indicates that tallness and round seeds are the dominant traits.

(ii) When the F₁ plants are self pollinated, the F₂ progeny consisted of some tall plants with round seeds and some short plants with wrinkled seeds which are the parental traits.

(iii) There were also some new combinations like tall plants with wrinkled seeds and short plants with round seeds.

(iv) Thus it may be concluded that tall and short traits and round and wrinkled seed traits have been inherited independently.

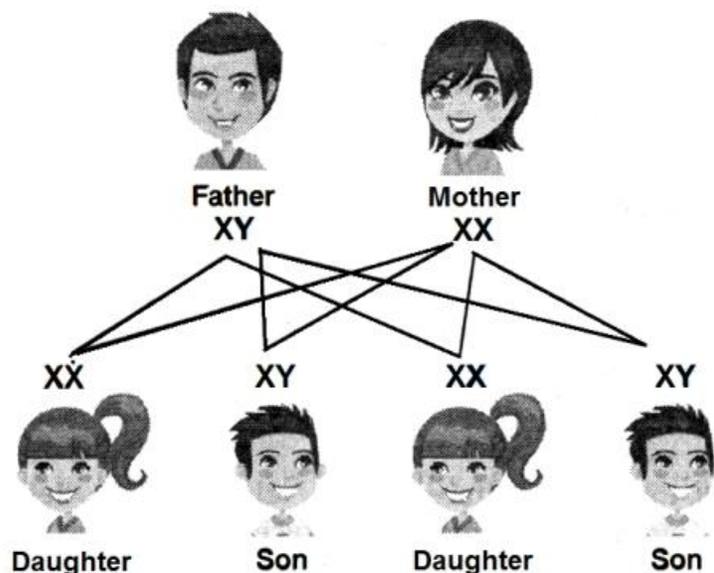
9. 'It is a matter of chance whether a couple will give birth to a male child or a female child.' Justify this statement with the help of a flow chart showing the fusion of sex chromosomes.

OR

How sex is determined in human beings?

Ans: Sex of a child is dependent on the type of the male gamete fusing with the female gamete. Human beings possess 23 pairs of chromosomes. Out of these, 22 pairs are known as autosomes, while the remaining one pair comprises sex chromosomes (XX in females and XY in males). At the time of fertilisation, the egg cell fuses with the sperm cell, resulting in the formation of the zygote. If the egg cell carrying an X chromosome fuses with the sperm carrying an X chromosome, the resulting child would be a girl. If

the egg cell carrying an X chromosome fuses with, the sperm carrying a Y chromosome, the resulting child would be a boy.



10. Explain Mendel's experiment with peas on inheritance of characters considering only one visible contrasting character.

Ans: Mendel conducted breeding experiments with garden peas:

- (i) He studied (pure) plants of a tall/short varieties.
- (ii) He crossed them and obtained F₁ progeny.
- (iii) He found that F₁ progeny was all tall plants.
- (iv) He selfed the (hybrid) plants of F₁ progeny.
- (v) He found that in F₂ progeny there were tall as well as short plants.
- (vi) The three quarter plants were tall and one quarter was short.

11. List in tabular form, two distinguishing features between the acquired traits and the inherited traits with one example of each.

Ans:

(i)	These traits are the characteristics which are developed during the lifetime of an individual.	(i)	These are the characteristics transmitted from parents to the offspring.
(ii)	Acquired traits are not passed on to the next generation. e.g., Less body weight due to starvation.	(ii)	Inherited traits is genetically determined characteristic that distinguishes a person. e.g., colour of hair and eye

12. How do Mendel's experiments show that traits may be dominant or recessive?

Ans: When Mendel cross-pollinated a pure male tall pea plant with a pure female dwarf pea plant, he got only tall plants in the F₁ generation.

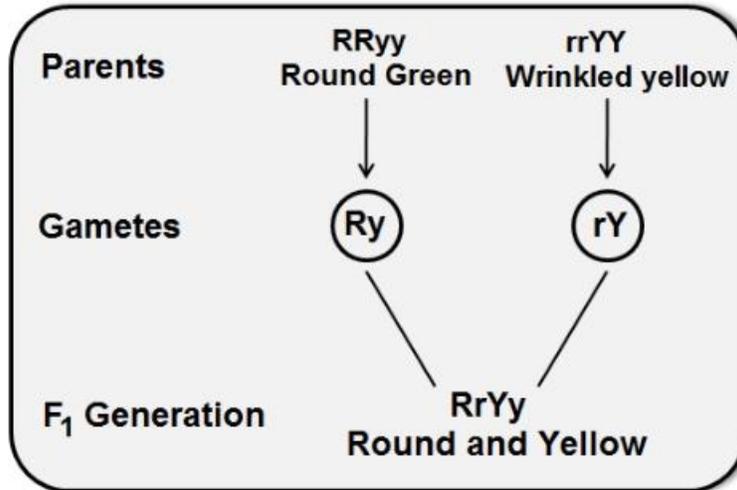
When F₁ tall plants were self-pollinated, Mendel got both tall and dwarf plants in the F₂ generation in the ratio 3: 1.

The trait of dwarfness was present in F₁ generation but was not expressed and only trait of tallness was expressed. The character which gets expressed in the presence of its contrasting form is termed dominant trait. The trait which remains unexpressed in the presence of its contrasting form is termed recessive trait.

13. A cross was made between pure breeding pea plants one with round and green seeds and the other with wrinkled and yellow seeds.

- (i) Write the phenotype of F₁ progeny. Give reason for your answer.
- (ii) Write the different types of F₂ progeny obtained along with their ratio when F₁ progeny was selfed.

Ans: (i) The cross was made between round, green seeds and wrinkled, yellow seeds. In the given cross, two traits were taken into account, which is a dihybrid cross. Yellow colour and round shape is dominant over green colour and wrinkled shape.



The above cross shows round and yellow seeds in the F₁ generation. It occurs because dominant traits (round and yellow) express itself, whereas recessive traits (wrinkled and green) get suppressed.

F₁ generation on selfing

	Ry	rY	ry
Ry	RRYy Round yellow	RRyy Round green	RrYy Round yellow
rY	RrYy Round yellow	rrYY Wrinkled yellow	rrYy Wrinkled yellow
ry	RrYy Round yellow	Rryy Round green	rryy Wrinkled green

Round yellow : Wrinkled yellow : Round green : Wrinkled green
9 : 3 : 3 : 1

Phenotypic ratio - 9 : 3 : 3 : 1
 Round yellow - 9 Round green - 3
 Wrinkled yellow - 3 Wrinkled green - 1

14. (i) Differentiate between dominant and recessive traits.
- (ii) 'Gene control traits' ? Explain this statement with an example.

Ans: (i) (a) The character which gets expressed in the presence of its contrasting form is termed as dominant trait.

(b) The trait which remains unexpressed in the presence of its contrasting form is called recessive trait.

(ii) Consider tallness as a characteristic. Plant height depends upon particular plant hormone which in turn will depend on the efficiency of the process for making it. If the enzyme responsible for the production of this hormone is efficient, plant will be tall. If the gene for that enzyme has an alteration that makes enzyme less efficient, the amount of hormone will be less and plant will be short.

15. (i) What is meant by traits of an individual?

(ii) Explain inherited trait and acquired trait.

(iii) Define speciation. List the factors which could lead to rise of a new species.

Ans: (i) Traits: A characteristic feature is called trait.

(ii) Inherited Traits are the traits which are transferred from parents to young ones.

Acquired Traits are the traits which an organism acquires in life time.

(iii) Formation of new species from the existing ones called speciation.

Factors which could lead to the rise of new species are: geographical isolation, genetic drift, and natural selection.

16. (i) Explain whether traits like eye colour or height is genetically inherited. Do power to lift weights and reading French also belong to the same category?

(ii) How do variations affect the evolution of those organisms that reproduce sexually?

Ans: (i) Yes, eye colour and height are genetically inherited traits, as these are expressed by genes. No, weight lifting and reading French are acquired traits.

(ii) Variations in individuals during sexual reproduction gives survival advantages to them, and help them to adapt even in extreme environments.

17. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzee have a 'better' body design? Why or why not?

Ans: In evolutionary terms, chimpanzee has the most complex body design but it will be wrong to say that they have a better body design as all the organisms are very well adapted to their environment and have their body designs evolved according to their body adaptation.

18. What is the only progressive trend seen in evolution?

Ans: The only progressive trend in evolution seems to be that more and more complex body designs have emerged over a period of time.

19. What are the physical changes that resulted in the upright posture in the course of evolution of human? [SSLC April, 2017]

Ans: (i) Developed stronger and straighter legs with feet suited more for walking.

(ii) They started using their hands for grasping and for various purposes.

(iii) The pelvic girdle changed into a broad basin like structure to support the trunk.

(iv) Changes in the pelvic girdle and associated muscles.

20. Write any four physical features of Australopithecus man.

[SSLC April, 2017]

Ans: (i) Walked erect

(ii) Forehead was low

(iii) They are short, about four and half feet in height.

(iv) The brain capacity was equal to much taller modern gorilla.

21. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Ans: No.

Geographical isolation prevents gene flow between populations of a species whereas asexual reproduction generally involves only one individual. In an asexually reproducing organism, variations can occur only when the copying of DNA is not accurate. Therefore, geographical isolation cannot prevent the formation of new species in an asexually reproducing organism.

22. (i) What are fossils ? How do we know how old the fossils are? [SSLC July, 2018-19]
 (ii) State two differences between homologous and analogous organs.

Ans: (i) Fossils: The remains and / or impressions of organisms that lived in the past.
 (a) The fossils that we find close to the surface are more recent than the one we find in deeper layers.
 (b) Dating fossils by detecting the ratio of different isotopes of the same element.
 (ii) (a) Homologous organs have same basic structural design.
 (b) Analogous organs have different basic structural design.
 (c) Homologous organs perform different functions.
 (d) Analogous organs perform similar functions.

23. Why are small number of surviving tigers a cause of worry from the point of view of genetics? Explain. [SSLC July 2018-19]

Ans: (i) If any natural calamity occurs and kills these small number of surviving tigers, they can become extinct resulting in the loss of genes forever.
 (ii) Small number will lead to little recombination and lesser variations that are very important for giving better survival chances to the species.
 (iii) Less number of species means lesser extent of diversity and lesser number of traits which reduce the chances of adaptability with respect to the change in the environment.

24. A palaeontologist observes the jaw of an animal and concludes that it belong to mammals. Give reason for his conclusion. [SSLC April, 2017]

Ans: Teeth are of different types (heterodont) embedded in sockets in jaw bones (thecodont)

25. Differentiate between Caucasoid man and Mongoloid man based on their physical features. [SSLC April, June, 2016]

Ans:

They are generally characterised by light skin, blue or dark brown eyes and a high ridged nose with narrow nostrils.	They are characterized by yellowish or reddish skin, fairly thick lip and wider nose. Hair is straight.

26. Define the following with one example for each:

(i) Genetic Drift. (ii) Natural selection. (iii) Reproductive isolation.

Ans: (i) Genetic drift: It refers to the random change in gene frequencies in a small population, presumably owing to change rather than natural selection, thereby providing diversity without any adaptations.

(ii) Natural selection: In this new suitable traits are selected to live in the prevailing environment.

(iii) Reproductive isolation: When same members of a particular species are not able to mate with other members of the same species due to environmental barriers or due to other geographical barriers, it is known as reproductive isolation.

27. "Evolution should not be equated with progress". Why?

Ans: Evolution is simply the generation of diversity and the shaping of the diversity by environmental selection. Species adapt to the conditions available in their environment. Some older and simple species live on quite effectively. The only progressive trend in evolution seems to be that of more and more complex body designs have emerged over time. In fact, one of the simplest life forms like bacteria inhabit the most inhospitable habitats like hot springs, deep-sea thermal vents and the ice in Antarctica.

28. The modern human beings have originated in Africa.

(i) Which evidence suggests this fact?

(ii) If an animal is similar to its ancestors, what does this imply?

Ans: (i) This was shown by the help of fossil records of Homo erectus, according to which their cranial capacity had doubled. Homo erectus were the first leave Africa and spread through Africa, Asia, and Europe. One population of H. erectus, stayed Africa and evolved into Homo sapiens.

(ii) This implies that from the beginning of life on earth the inheritance of trait is going on, that result in the production of existing animals that look similar their ancestors because they have inherited traits from them and these trait that make them similar their ancestors have not gone under evolutionary change.

29. Define evolution. How does it occur? Describe how fossils provide us evidences in support of evolution.

Ans: Evolution the process of change from simple life forms to complex life forms by gradual change. It is generating diversity and shaping the diversity.

(i) It occurs over the course of time and generations by variation speciation, natural selection, genetic drift etc. fossil are the preserved traces of living organisms.

(ii) It helps us to find the intermediate forms in between two classes etc. For example fossil of Archaeopteryx helps us to know better about the intermediate form between reptiles and ayes.

(iii) It tells us about the extinct species through the fossil or their retained body impressions.

(iv) It helps to know the evolutionary relationships.

30. A man with blood group A marries a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits-blood group A or O - is dominant? Why or why not?

Ans: No, because either blood group A or O can be dominant.

Possibility I: Blood group A is dominant and blood group O is recessive

Possibility II: Blood group O is dominant and blood group A is recessive.

Textbook Exercises

1. A Mendelian experiment consisted of breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them were short. This suggests that the genetic make up of the tall parent can be depicted as

(a) TTWW

(b) TTww

(c) TtWW

(d) TtWw

Ans: (c) TtWW

2. An example of homologous organs is

(a) Our arm and a dog's fore-leg

(b) Our teeth and an elephant's tusk.

(c) Potato and runners of grass

(d) All of the above

Ans: (d) All of the above

3. In evolutionary terms, we have more in common with
 (a) A Chinese school boy (b) A chimpanzee (c) A spider (d) A bacterium
Ans: A Chinese school boy

4. A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?

Ans: No because we cannot say with certainty whether light eye colour is dominant or recessive. However, since both children and their parents have light eye colour, the possibility that light eye colour is recessive trait.

5. How are the area of study – evolution and classification-interlinked?

Ans: The area of study evolution and classification are interlinked because the more characteristics two species will have in common, the more closely they are related, the more recently they will have had a common ancestor.

6. Explain the terms analogous and homologous organs with examples.

Ans:

Homologous Organs		Analogous Organs	
(i)	They have same basic structural design.	(i)	They have different basic structural design.
(ii)	They perform different functions.	(ii)	They perform similar functions.
(iii)	Their appearances are different.	(iii)	They have similar appearances.

7. Explain the importance of fossils in deciding evolutionary relationships.

Ans: Fossils helps us know the following:

- (i) Fossils help to trace the racial history of organisms.
- (ii) They help to measure the geological time.

8. What evidence do we have for the origin of life from inanimate matter?

Ans: Miller and Urey in 1953 assembled an atmosphere similar to that thought to exist at early period over earth. This was maintained at a temperature just below 100°C and sparks were passed through the moisture of gases to simulate lighting. After one week 15% of the carbon had been converted into simple compounds of carbon including amino acids which make up protein molecules.

9. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

Ans: In sexual reproduction, male and female genes cross over and hence cause the variation.

10. How is the equal genetic contribution of male and female parents ensured in the progeny?

Ans: Both father and mother contribute practically equal amount of genetic material to the child. It means that each trait is influenced by both maternal and paternal DNA.

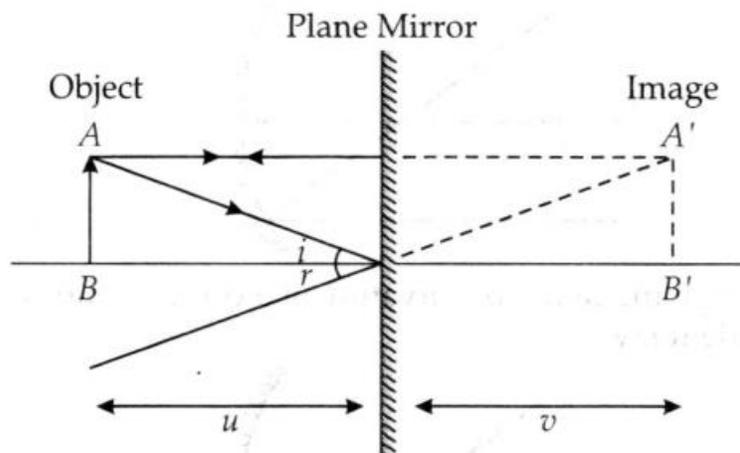
11. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

Ans: No, variations may not give advantage to an individual organisms in particular environmental conditions. They still persist and may confer an advantage to the individual in charged environmental condition.

10. LIGHT REFLECTION & REFRACTION

Quick Review

- When light falls on a body, it may be absorbed, may be transmitted or light may get reflected back to the same medium.
- Reflection of light means light waves are neither transmitted nor absorbed but are deflected from the surface of the medium back into the same medium.
- **Laws of Reflection:**
 - The incident ray, the normal to the surface at the point of incidence and the reflected ray, all lie in the same plane.
 - The angle of incidence is equal to the angle of reflection.
- Real image is obtained when the rays of light after reflection, actually converge at a point. It can be obtained on the screen and can be seen with the eye.
- Virtual image forms when rays of light do not actually meet, but appear to meet when produced backwards. It cannot be obtained on the screen.
- **Image Formed by plane Mirror**

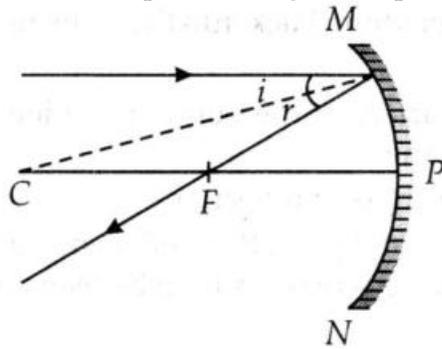


- **Characteristics of Image**
 - Virtual and erect.
 - Size of image is equal to the size of object.
 - Image is formed as far behind the mirror as the object is in front of it.
 - Laterally inverted.
- **Lateral Inversion:** The phenomenon due to which the right side of the object appears as left and the left side of the object appears as right. i.e., the image is inverted sideways.
- A spherical mirror whose reflecting surface is curved inwards and polished on the outer spherical surface is concave mirror.
- A spherical mirror whose reflecting surface is curved outwards and polished on the inner spherical surface is convex mirror.
- Concave mirror mostly forms real images, which can be received on the screen. Convex mirror always forms virtual images, which cannot be received on the screen.
- **Differentiating between a plane mirror, a concave mirror and a convex mirror, without touching them:**
 - If the image formed is erect and is of same size as in reality then it is a plane mirror.
 - If the image formed is still erect but smaller in size then it is a convex mirror.

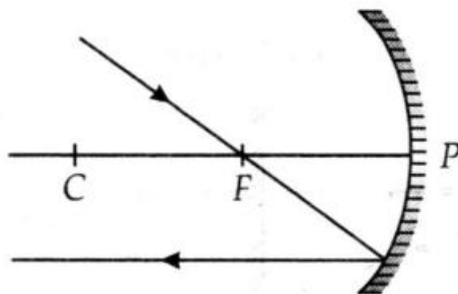
(iii) If the image formed is erect but magnified when the mirror is close to the object, then it is a concave mirror.

- Solar concentrations use huge concave mirrors to focus large amount of solar energy thereby producing high temperature conditions in a solar power plant.
- The centre of the reflecting surface of a spherical mirror is a point called the pole of the mirror and is usually represented by P
- The horizontal line passing through the centre of curvature and pole of the spherical mirror is known as principal axis.
- The centre of curvature of a spherical mirror is the centre of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by C.
- The radius of curvature of a spherical mirror is the radius of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by R.
- The diameter of the reflecting surface, i.e., twice the radius is called its aperture.
- Radius of curvature (R) = 2 x focal length (J).
- **Rules for making ray diagrams by concave mirror**

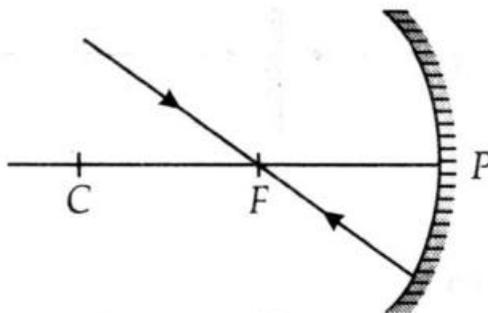
(i) A ray parallel to the principal axis will pass through the principal focus, after reflection.



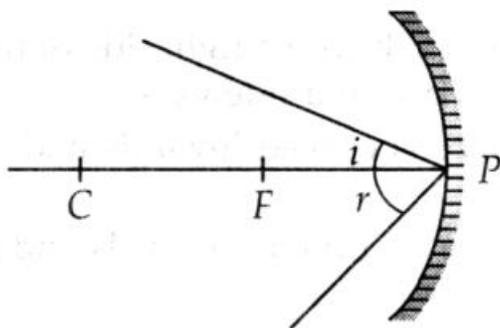
(ii) A ray passing through the principal focus of concave mirror will emerge parallel to principal axis after reflection.



(iii) A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path as it is a normally incident ray.



- (iv) A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angle.



➤ **Image formation by a concave mirror for different positions of the object:**

Position of Object	Position of image	Size of Image	Nature of Image
At infinity	At focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind mirror	Enlarged	Virtual and erect

➤ **Nature, position and relative size of the image formed by a convex mirror:**

Position of Object	Position of image	Size of Image	Nature of Image
At infinity	At focus F behind the mirror	Highly diminished, point-sized	Virtual and erect
Between infinity and pole of the mirror	Between P and F behind the mirror	Diminished	Virtual and erect

➤ **Mirror Formula:**

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

Where,

v = image distance

u = Object distance

f = Focal length

➤ **Magnification of Spherical Mirrors**

It is the ratio of the height of image to the height of object.

$$= \frac{\text{Height of image}}{\text{Height of object}}$$

$$= \frac{h_1}{h_2}$$

Also,

$$= - \frac{v}{u}$$

If 'm' is negative, image is real.
 If 'm' is positive, image is virtual.
 If $h_i = h_o$, then $m = 1$, i.e., image is equal to object.
 If $h_i > h_o$ then $m > 1$ i.e., image is enlarged.
 If $h_i < h_o$, then $m < 1$ i.e., image is diminished.

➤ **Magnification of plane mirror is always +1**

'+' sign indicates that virtual image.
 '1' indicates that image is equal to objects size.

- If 'm' is '+ve' and less than 1, it is a convex mirror.
- If 'm' is '+ve' and more than 1, it is a convex mirror.
- If 'm' is '-ve', it is a concave mirror.
- The phenomenon of change in the path of light from one medium to another is called refraction of light.
- The angle formed between the incident ray and the normal is called angle of incidence and the angle formed between the refracted ray and the normal is called angle of refraction.
- The cause of refraction is the change in the speed of light as it goes from one medium to another medium.
- Larger the difference in speed of light between the two media across the interface, the greater will be the angle of bending and vice-versa.
- When a ray of light passes from a rarer medium to a denser medium, it bends towards the normal. Also, the angle of incidence is greater than the angle of refraction.
- When a ray of light passes from a denser medium to a rarer medium, it bends away from the normal. Also, the angle of incidence is less than the angle of refraction.

➤ **Laws of refraction:**

First law: The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.

- **Refractive index (n):** The ratio of speed of light in a given pair of media

$$= \frac{\text{Velocity of light in medium 1}}{\text{Velocity of light in medium 2}}$$

n_{21} means refractive index of second medium with respect to first medium, and

$$n_{21} = \frac{1}{2}$$

n_{12} means refractive index of first medium with respect to second medium.

$$n_{12} = \frac{2}{1}$$

- **Absolute Refractive Index:** Refractive index of a medium with respect to vacuum or air.

$$= \frac{c}{v} = 3 \times 10^8 \text{ m/s}^{-1}$$

- Refractive index of one medium is reciprocal of others refractive index in a given pair.

$$n_{12} = \frac{1}{n_{21}}$$

If refractive index of medium 1 w.r.t. air is given as n_{air} and

If refractive index of medium 2 w.r.t. air is given as n_{air}

Then, refractive index of medium 1 w.r.t. medium 2 = $\frac{n_{\text{air}}}{n_{\text{air}}}$

➤ Refractive index of diamond is the highest till date. It is 2.42. It means speed of light is $\frac{1}{2.42}$ times less in diamond than in vacuum.

➤ Lens Formula: $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

➤ Magnification: $= \frac{h_2}{h_1}$

Also, $= -$

➤ **Power of a lens:**

It is defined as the reciprocal of focal length in meter.

The degree of convergence or divergence of light rays is expressed in terms of power.

Power = $\frac{1}{\text{focal length (in meter)}}$ or $P = \frac{1}{f}$

➤ SI unit of Power = dioptre = D

$$1 \text{ D} = 1 \text{ m}^{-1}$$

1 dioptre is the power of lens whose focal length is one meter.

Know the Terms

➤ **Ray and beam:** Light travels in a straight line—Rectilinear propagation. The straight line indicating the path of the light (arrow—direction) is called a ray. A bundle of rays originating from the same source of light in a particular direction is called a beam of light.

➤ **Parallel beam:** When the rays which constitute the beam are parallel to one—another, then it is called a parallel beam of light.

➤ **Convergent beam:** When the rays actually meet or appear to meet at a point, then the beam containing such rays are called convergent beam and rays are called convergent rays.

➤ **Divergent beam:** When the rays actually diverge or appear to diverge from a point, then the beam containing such rays are called divergent beam and rays are called divergent rays.

➤ **Image:** The point of convergence or the point from where the light appears to diverge after reflection or refraction is called image.

➤ **Aperture:** The width of the reflecting surface from which reflection takes place is called aperture.

➤ **Pole:** The central point of the reflecting spherical surface is called pole (F). It lies on the surface of the mirror.

- **Centre of curvature:** The centre of the hollow sphere of which the spherical mirror is a part, is called centre of curvature (C).
- **Radius of curvature:** The separation between the pole and the centre of curvature cut of the hollow sphere, of which the mirror is a part, is called radius of curvature (R).
- **Principal axis:** The straight line joining the pole and the centre of curvature is called principal axis.
- **Focus:** The point F on the principal axis, where a beam of light parallel to the principal axis actually meet after reflection or appear to come it from it is called its principal focus.
- **Focal length:** The length or separation between the pole and the focus is called focal length.

Questions:

1. What is virtual image?

Ans: If the rays of light do not actually meet after reflection or refraction, but appear to meet when produced backwards, then that point constitutes virtual image.

2. What makes things visible?

Ans: In a lighted room, when light falls on an object, it gets either partially or completely reflected. This reflected light when received by our eyes, enables us to see things.

3. Why are convex mirrors preferred over plane mirrors as rear view mirrors?

Ans: The field of view of convex mirror is wider in comparison to plane mirror. The convex mirror is preferred as a rear view mirror as it enables the driver to view much larger area than with a plane mirror.

4. Find the focal length of a convex mirror whose radius of curvature is 32 cm.

Ans: Radius of curvature,

$$R = 32 \text{ cm}$$

$$\text{Radius of curvature} = 2 \times \text{Focal length ()}$$

$$R = 2$$

$$\therefore \quad = \frac{R}{2} = \frac{32}{2} = 16 \text{ cm}$$

Hence, the focal length of the given convex mirror is 16cm.

5. List four specific characteristics of the images of the objects formed by convex mirrors.

Ans: Four specific characteristics of the image formed by convex mirror:

- (i) It is always formed behind the mirror, between the pole and its focus.
- (ii) The image is always virtual and erect.
- (iii) The size of image is always smaller than the object.
- (iv) Magnification is always positive.

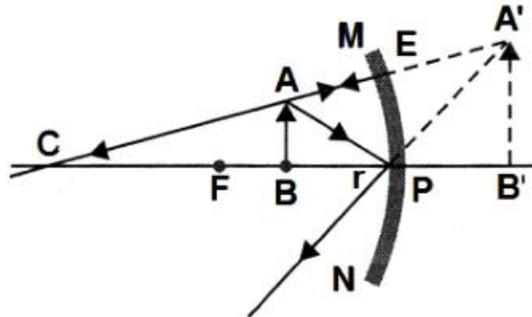
6. Differentiate a real image from a virtual image giving two points of difference.

Ans: Difference between Real Image and Virtual Image.

Real Image		Virtual Image	
(i)	Formed when reflected rays meet	(i)	Formed at a point from which the reflected rays appear to diverge
(ii)	Image is always inverted	(ii)	It is always erect

7. The linear magnification produced by a spherical mirror is +3. Analyse this value and state the (i) type of mirror and (ii) position of the object with respect to the pole of the mirror. Draw ray diagram to show the formation of image in this case.

Ans: (i) Concave mirror
(ii) Between the pole and focus.



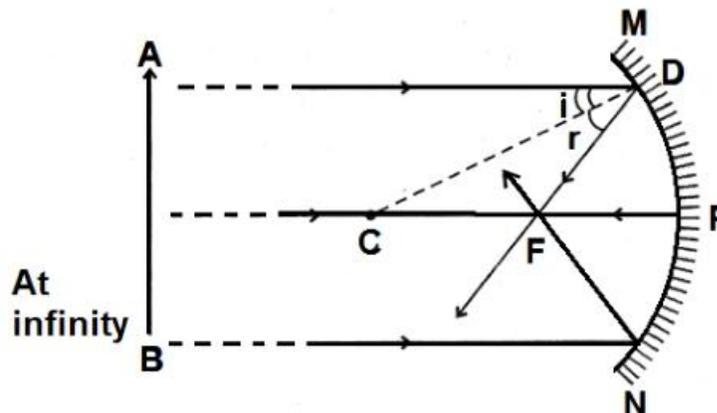
8. Name the type of mirrors used in the design of solar furnaces. Explain how high temperature is achieved by this device.

Ans: (i) Concave Mirrors/ Converging Mirrors.

(ii) When a solar furnace is placed at the focus of a large concave mirror/reflector, it focuses a parallel beam of light on the furnace, consequently a high temperature is achieved after some time.

9. Draw a ray diagram to show the path of the reflected ray corresponding to an incident ray which is directed parallel to the principal axis of a concave mirror. Mark on it the angle of incidence and the angle of reflection.

Ans:



10. An object is placed at a distance of 20 cm in front of convex mirror of radius of curvature 30 cm. Find the position and nature of the image.

Ans: Here, $u = -20$ cm, $r = 30$ cm

$$= \frac{R}{2} = \frac{30}{2} = 15 \text{ cm}$$

Using mirror formula and substituting the above values, we get

$$= \frac{60}{72} \text{ cm}$$

\therefore The image will be formed at a distance of $\frac{60}{72}$ cm behind the mirror.

Nature of image: Virtual and erect

11. (i) Name the spherical mirror used as:

- Shaving mirror
- Rear view mirror in vehicles
- Reflector in search-lights.

(ii) Write any three differences between a real and a virtual image.

- Ans:** (i) (a) Shaving mirror: Concave mirror
 (b) Rear view mirror: Convex mirror
 (c) Reflector in search-lights: Concave mirror
- (ii) (a) Real image can be obtained on screen but virtual image cannot be obtained.
 (b) Reflected / Refracted rays actually meet where real image is formed while for virtual image they only appear to meet.
 (c) Real image is always inverted while virtual image is always erect.

12. The image of an object formed by a mirror is real, inverted and is of magnification. If the image is at a distance of 40 cm from the mirror, where is the object placed, where would the image be if the object is moved 20cm towards the mirror? State reason and also draw ray diagram for the new position of the object to justify your answer.

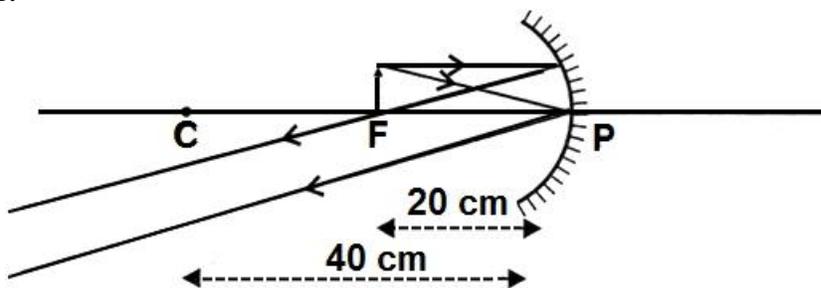
Ans: Object position: At C (Centre of curvature)

Object distance = 40 cm

Position of the image - at infinity

Reason: Focal length of the mirror = 20 cm

If the object is moved 20 cm towards the mirror then its new position would be at the focus of the mirror.



13. A student wants to project the image of a candle flame on a screen 60cm in front of a mirror by keeping the flame at a distance of 15 cm from its pole.

- (i) Write the type of mirror he should use.
 (ii) Find the linear magnification of the image produced.
 (iii) What is the distance between the object and its image?
 (iv) Draw a ray diagram to show the image formation in this case.

Ans: (i) He should use a concave mirror, as it forms a real image on the same side of the mirror.

(ii) Object distance, $u = -15$ cm

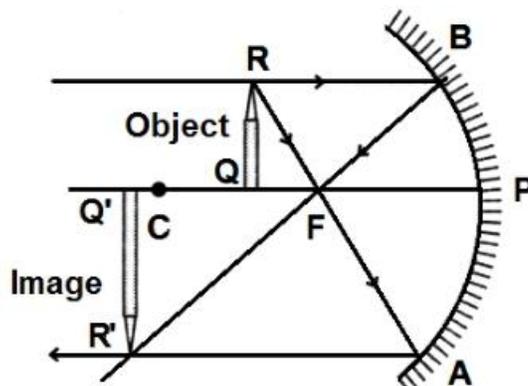
Image distance, $v = -60$ cm

Magnification, $m = -v/u = -(-60) / (-15) = -4$ cm,

The minus sign in magnification shows that the image formed is real and inverted.

(iii) The image is formed at a distance of 45 cm from the object.

(iv)



In this case, the image is formed beyond the centre of curvature. This image is real inverted and enlarged.

14. It is desired to obtain an erect image of an object, using concave mirror of focal length of 12 cm.

(i) What should be the range of distance of an object placed in front of the mirror?

(ii) Will the image be smaller or larger than the object.

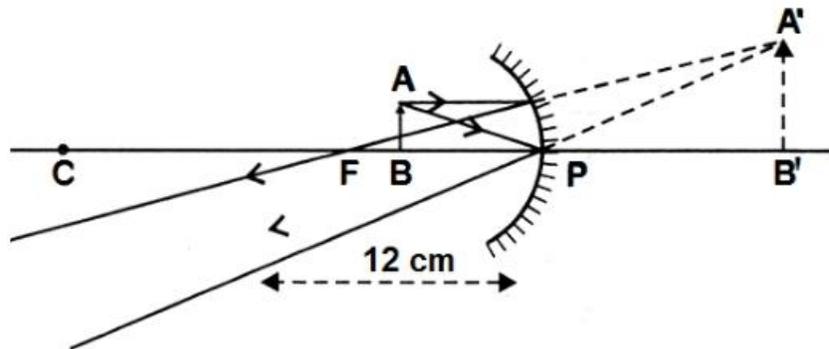
Draw ray diagram to show the formations of image in this case.

(iii) Where will the image of this object be, if it is placed 24 cm in front of the mirror?

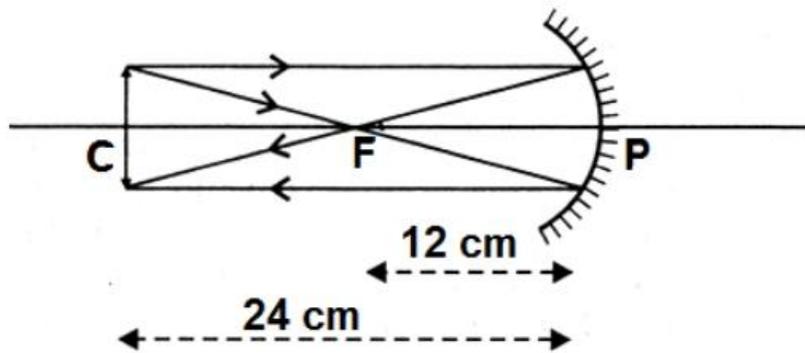
Draw ray diagram for this situation also to justify your answer. Show the positions of pole, principal focus and the centre of curvature in the above ray diagrams.

Ans: (i) Range of distance – between 0 cm – < 12 cm

(ii) Larger than the object



(iii) Image is at 24 cm in front of the mirror



15. (i) An object is placed at a distance of 60 cm from a convex mirror where the magnification produced is $\frac{1}{2}$. Where should the object be placed to get a magnification of $\frac{1}{3}$?

(ii) A small electric lamp is placed at the focus of a convex lens. State the nature of beam of light produced by the lens. Draw a diagram to show this.

Ans: (i) $u = -60$ cm

$$m = +\frac{1}{2}$$

$$m = -\frac{v}{u} = \frac{1}{2}$$

$$\frac{1}{2} = -\frac{v}{-60}$$

$$= 30 \text{ cm}$$

Using mirror formula

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f} = \frac{1}{60} + \frac{1}{60}$$

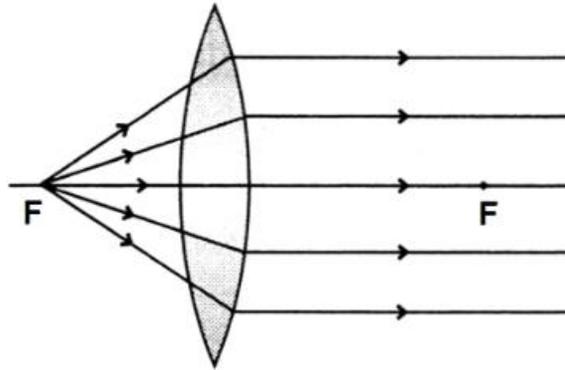
$$= \frac{2}{60}$$

$$\text{Now } m = \frac{1}{3} \therefore \frac{1}{-} + \frac{1}{u} = \frac{1}{60} \Rightarrow \frac{1}{-} + \frac{1}{u} = \frac{1}{60}$$

$$\therefore u = -60 \text{ cm}$$

- (ii) When a small electric lamp is placed at the focus of a convex lens, a parallel beam of light is produced by the lens.

Ray diagram:

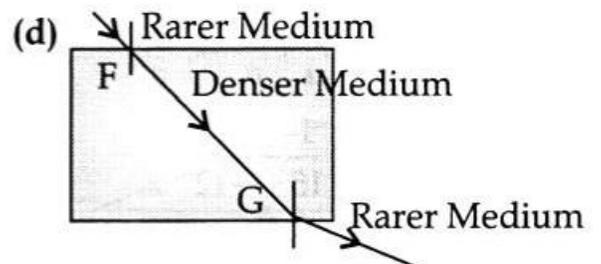
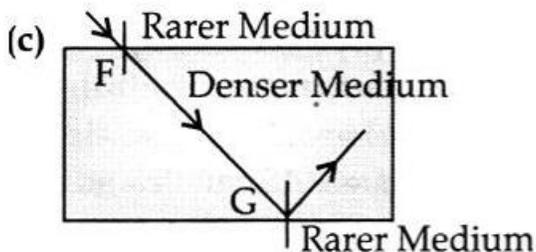
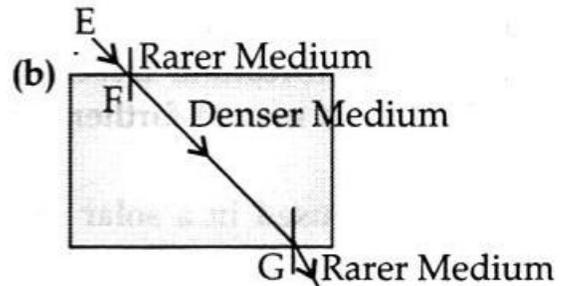
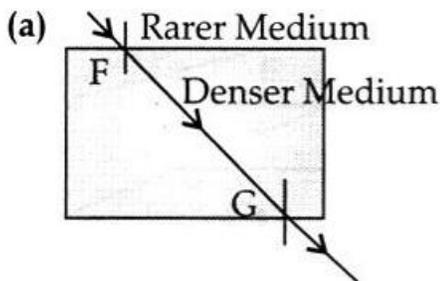
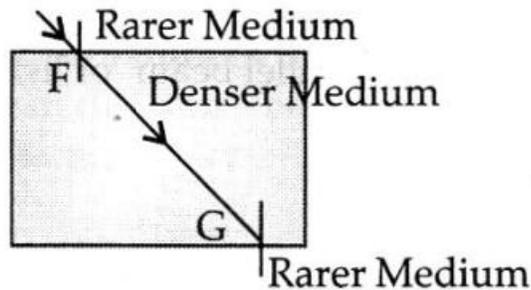


16. Red coloured light is used in traffic signals to indicate the vehicles to stop, because compared to other colours red light [SSLC July, 2018]

(a) Has high frequency (b) Has less wavelength (c) Scatters more (d) Scatters less

Ans: (d) scatters less

17. Observe the figure. The correct figure indicating the direction of the light ray FG after refraction is [SSLC July, 2018]



Ans: (d)

18. The refractive index of diamond is 2.42. What is the meaning of this statement?

[SSLC July, 2018]

Ans: The refractive index of diamond 2.42 suggests that the speed of light in diamond will reduce by a factor 2.42 as compared to its speed in air.

19. Why does light change its path as the medium changes during the transit?

Ans: Speed of light is different in different media. As the medium changes, the light has to choose a path of minimum time. Hence, the direction of the light changes. This phenomenon is known as refraction of light.

20. State two laws of refraction.

[NCERT Exemplar]

Ans: (i) The incident ray, the refracted ray and the normal all lie in the same plane.

(ii) The ratio of sine of angle of incidence in the first medium to the sine of angle of refraction in the second medium is a constant and is known as refractive index of the second medium with respect to the first medium.

21. The refractive indices of glass and water with respect to air are $\frac{3}{2}$ and $\frac{4}{3}$ respectively. If speed of light in glass is 2×10^8 m/s, find the speed of light in water.

Ans: Refractive index of a medium

$$= \frac{\text{Speed of light in air}}{\text{Speed of light in the medium}}$$

$$\frac{3}{2} = \frac{\text{Speed of light in air}}{2 \times 10^8 \text{ m/s}}$$

Speed of light in air

$$= 3 \times 10^8 \text{ m/s}$$

Speed of light in water

$$= \frac{3 \times 10^8 \text{ m/s}}{4/3} = 2.25 \times 10^8 \text{ m/s}$$

22. State the laws of refraction of light. If the speed of light in vacuum is 3×10^8 m/s, find the absolute refractive index of a medium in which light travels with a speed of 1.4×10^8 m/s. [SSLC July, 2018]

Ans: (i) There are two laws of refraction:

(a) The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant. This is known as Snell's law. Mathematically, it can be expressed as:

$$\sin i / \sin r = n_{12}$$

Here, n_{12} is the relative refractive index of medium 1 with respect to medium 2.

(b) The incident ray, the refracted ray and the normal to the interface of two media at the point of incidence lie on the same plane

(ii) Given $c = 3 \times 10^8$ m/s
 $= 1.4 \times 10^8$ m/s

Absolute refractive index

$$= \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}} \\ = \frac{3 \times 10^8 \text{ m/s}}{1.4 \times 10^8 \text{ m/s}} = 2.14$$

23. (a) An object is kept at a distance of 18 cm, 20 cm, 22 cm and 30 cm, from a lens of power + 5D.

(i) In which case or cases would you get a magnified image?

(ii) Which of the magnified image can we get on a screen?

(b) List two widely used applications of a convex lens.

Ans: (a) (i) $P = \frac{1}{f}$, $f = \frac{100}{5} = 20$ cm

Object at 18cm, 22cm, and 30 cm, image can be magnified.

(ii) At 22cm and 30cm, image can be obtained on a screen.

(b) Film projectors and telescopes.

24. (a) Define focal length of a divergent lens.

(b) A divergent lens of focal length 30 cm forms the image of an object of size 6 cm on the same side as the object at a distance of 15 cm from its optical centre. Use lens formula to determine the distance of the object from the lens and the size of the image formed.

Ans: (a) The distance between the principal focus and the optical centres of the concave lens or diverging lens is called the focal length of a diverging lens.

(b) $f = -30$ cm, $h = 6$ cm, $v = -15$ cm, $u = ?$, $h_1 = ?$

Lens Formula :

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \text{or} \quad \frac{-1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\frac{-1}{15} - \frac{1}{u} = \frac{-1}{30} \quad \text{or} \quad \frac{-1}{u} = \frac{-1}{30} - \left(\frac{-1}{15}\right)$$

$$\frac{-1}{u} = \frac{-1}{30} + \frac{1}{15}$$

$$\frac{-1}{u} = \frac{-15+30}{450}$$

$$\frac{-1}{u} = \frac{1}{30}$$

$$-u = 30$$

$$u = -30 \text{ cm}$$

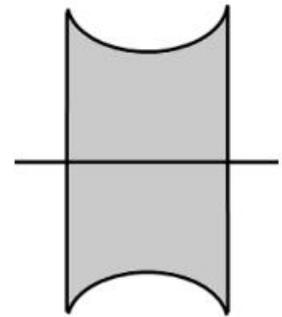
The object distance is -30 cm

$$v = -15 = \frac{h_1}{h}$$

$$\frac{+15}{+30} = \frac{h_1}{6} \quad \text{or} \quad \frac{6}{2} = h_1$$

$$h_1 = 3 \text{ cm}$$

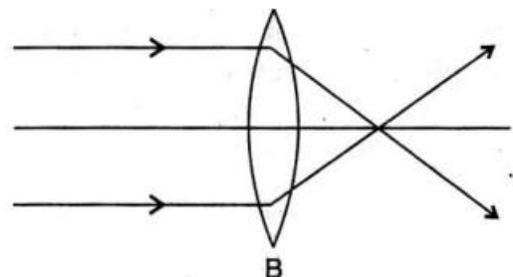
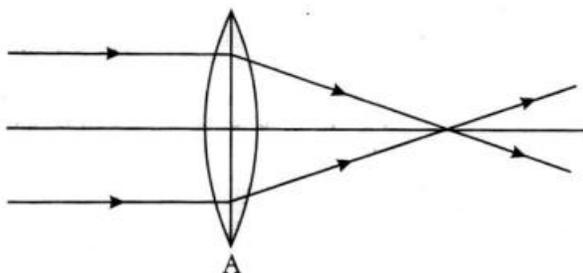
The height of the image is 3 cm



25. (i) Two convex lenses A and B have powers P_1 and P_2 , respectively and P_2 is greater than P_1 . Draw a ray diagram for each lens to show which one will be more converging. Give reason for your answer.

(ii) A 2.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 10 cm. The distance of the object from the lens is 15 cm. Find the nature, position and size of the image. Also find its magnification.

Ans: $P_2 > P_1 \therefore F_2 < F_1$



B is more converging because rays are refracted more.

Text Book Exercises:

1. Which one of the following materials cannot be used to make a lens?

- (a) Water (b) Glass (c) Plastic (d) Clay

Ans: (d) Clay

2. The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of the object?

- (a) Between the principal focus and the centre of curvature
(b) At the centre of curvature
(c) Beyond the centre of curvature
(d) Between the pole of the mirror and its principal focus.

Ans: (d) Between the pole of the mirror and its principal focus.

3. Where should be an object be placed in front of a convex lens to get a real image of the size of the object?

- (a) At the principal focus of the lens
(b) At twice the focal length
(c) At infinity
(d) Between the optical centre of the lens and its principal focus.

Ans: (b) At twice the focal length

4. A spherical mirror and a thin spherical lens have each of a focal length of -15 cm. The mirror and the lens are likely to be

- (a) Both concave
(b) Both convex
(c) The mirror is concave and the lens is convex.
(d) The mirror is convex, but the lens is concave.

Ans: (a) Both concave

5. No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

- (a) Plane (b) Only concave (c) Convex (d) Either plane or convex

Ans: (d) Concave

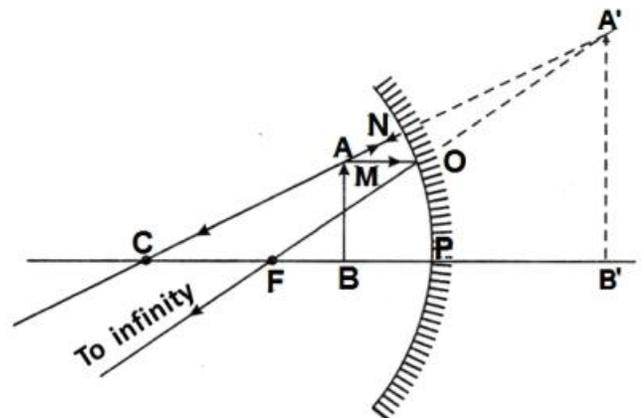
6. Which of the following lenses would you prefer to use while reading small letters found in a dictionary?

- (a) A convex lens of focal length 50 cm. (b) A concave lens of focal length 50 cm.
(c) A convex lens of focal length 5 cm. (d) A concave lens of focal length 5 cm.

Ans: (c) A convex lens of focal length 5 cm.

7. We wish to obtain an erect image of an object, using a concave mirror of focal length 15 cm. What should be the range of distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.

Ans: Object must be placed between pole and focus of the mirror. So, range of distance object from the mirror is less than 15 cm from the pole of the mirror. Image will be virtual, erect and larger than the size of the object.



8. Name the type of mirror used in the following situations.
 (a) Headlights of a car (b) Side/rear-view mirror of a vehicle (c) Solar furnace.
 Support your answer with reason.

Ans: (i) A convex mirror always forms an erect, virtual and diminished image of an object placed anywhere in front of it. Thus, convex mirrors enable the driver to view much larger traffic behind him that would not be possible with a plane mirror.

(ii) A concave mirror is used as a shaving or make-up mirror because it forms an erect and enlarged image of the face when it is held closer to the face.

9. One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally?

Ans: When one half of a convex lens is covered with a black paper, the lens will produce a complete image of the object but the intensity of the image is reduced because rays from the top portion of the lens only are refracted and forms the image.

10. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and nature of the image formed.

Ans:

$$\begin{aligned} h_1 &= 5\text{cm} \\ u &= -25\text{ cm} \\ &= 10\text{ cm} \\ &= ? \\ h_2 &= ? \end{aligned}$$

$$\frac{1}{v} = \frac{1}{u} - \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{-25} + \frac{1}{10}$$

$$= \frac{1}{10} + \frac{1}{-25}$$

$$= \frac{250}{15}$$

$$= \frac{50}{3}$$

$$= 16.67\text{ cm}$$

$$\frac{h_2}{h_1} = -$$

$$h_2 = - \times h_1$$

Or

$$\frac{h_1}{5} = \frac{16.7}{-25}$$

$$h_2 = -3.34\text{ cm}$$

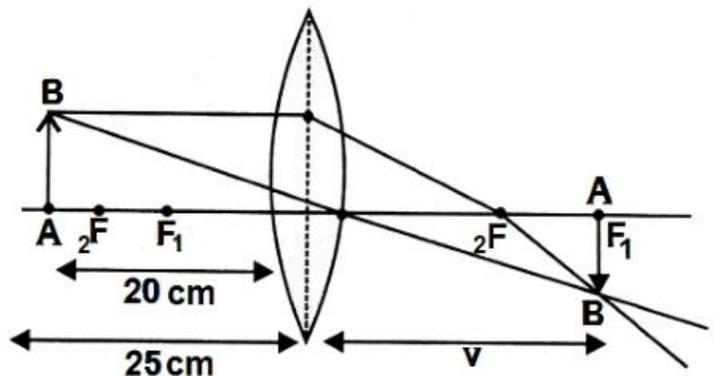
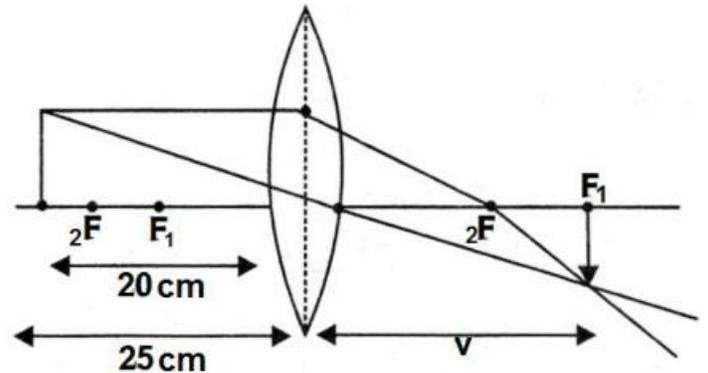


Image is real and inverted.

11. A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens? Draw the ray diagram.

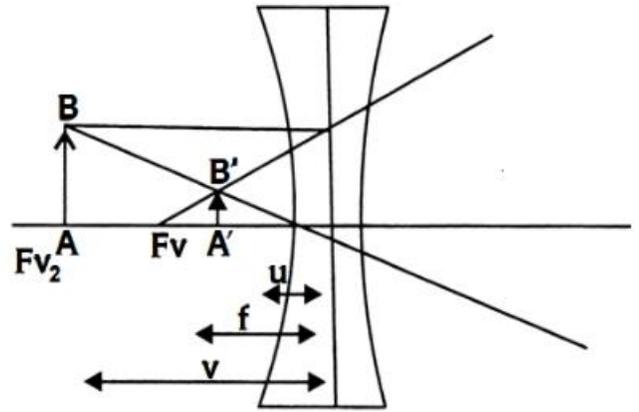
Ans: $u = -15$ cm, $v = -10$ cm, $f = ?$

$$\frac{1}{v} = \frac{1}{u} - \frac{1}{f}$$

$$\frac{1}{-10} = \frac{1}{-15} - \frac{1}{f} = \underline{\quad}$$

$$= \frac{-}{-} = \frac{(-15) \times (-10)}{-15 - (-10)} = \frac{150}{-5} = -30 \text{ cm}$$

$$= -30 \text{ cm}$$



12. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image.

Ans: $u = -10$ cm, $f = 15$ cm, $v = ?$

$$\frac{1}{v} = \frac{1}{u} - \frac{1}{f} = \frac{1}{-10} - \frac{1}{15} = \frac{1}{15} + \frac{1}{10} - \frac{25}{150}$$

$$= \frac{150}{25} = 6 \text{ cm}$$

Image is virtual erect, small in size and behind the mirror.

13. The magnification produced by a plane mirror is +1. What does this mean?

Ans: It indicates that the size of image is equal to size of object and image formed is virtual and erect.

14. An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.

Ans: $h_1 = -5$ cm, $u = -20$ cm, $R = 30$ cm

$$= ?, h = ?$$

$$= \frac{1}{\quad}$$

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$$

$$= \frac{-}{-} = \frac{-300}{-35}$$

$$= \frac{60}{7} = 8.57 \text{ cm}$$

$$= \frac{h_2}{h_1} = \underline{\quad}$$

$$h_2 = \frac{15}{7} = 2.14 \text{ cm}$$

Image formed is virtual, erect and reduced

15. An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focused image can be obtained? Find the size and the nature of the image.

Ans: $h_1 = 7$

$$= -27$$

$$= -18$$

$$= ?$$

$$h_2 = ?$$

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$$

$$= \frac{1}{v}$$

$$= \frac{(-27) \times (-18)}{-27 - (-18)}$$

$$= \frac{486}{-9}$$

$$= -54 \text{ cm}$$

$$\frac{h_2}{h_1} = \frac{v}{u}$$

$$h_2 = \frac{v}{u} \times h_1$$

$$= \left(\frac{-54}{-27} \right) \times 7$$

$$h_2 = -14 \text{ cm}$$

16. Find the focal length of a lens of power - 2.0 D. What type of lens is this?

Ans: $P = -2 \text{ D}, f = ?$

$$= \frac{1}{P}$$

$$= \frac{1}{-2}$$

$$= -0.5 \text{ m}$$

$$= -50 \text{ cm}$$

Since f is negative, the lens is concave lens

17. A doctor has prescribed a corrective lens of power + 1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging?

Ans: $P = +1.5 \text{ D}$

$$= ?$$

$$= \frac{1}{P} = \frac{1}{1.5} = \frac{10}{15} = 0.6667 \text{ m}$$

$$= 66.67 \text{ cm}$$

Since P is positive, lens is convex (converging lens)

11. HUMAN EYE AND COLOURFUL WORLD

Quick Review

- Eye is a natural optical device using which man could see objects around him. It forms an inverted, real image on a light sensitive surface called retina.
- Rods and cones are the cells in retina, which are light sensitive. Rods respond to the intensity of light. Cones respond to the illumination colours. There are around 125 million cells-rods and cones. The cells generate signals which are transmitted to the brain through optical nerve.

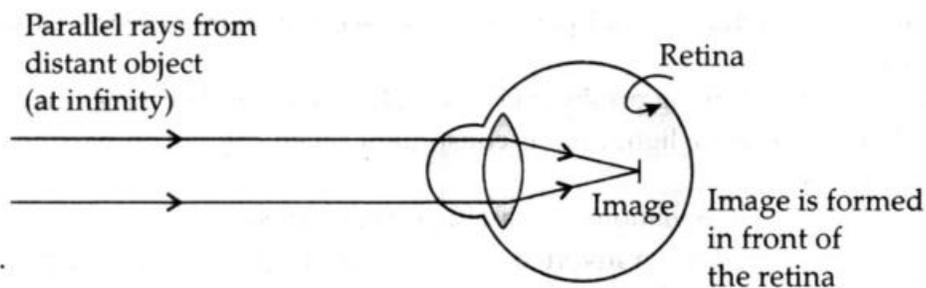
Parts of Human Eye

Cornea: It is the outermost, transparent part. It provides most of the refraction of light.

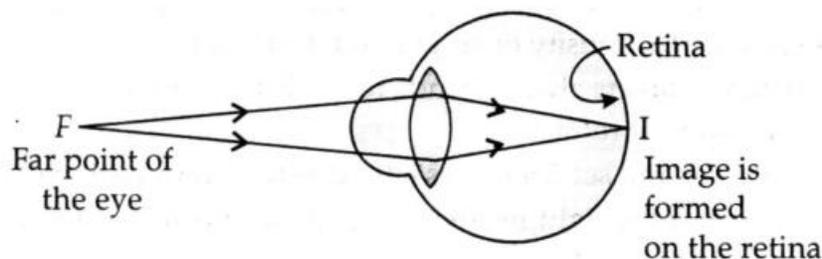
- **Lens:** It is composed of a fibrous, jelly like material. Provides the focused real and inverted image of the object on the retina. This convex lens that converges light at retina.
- **Iris:** It is a dark muscular diaphragm that controls the size of the pupil.
- **Pupil:** It is the window of the eye. It is the central aperture in iris. It regulates and controls the amount of light entering the eye.
- **Retin:** It is a delicate membrane having enormous number of light sensitive cells.
- **Far point:** The maximum distance at which object can be seen clearly is far point of the eye. For a normal adult eye, its value is infinity.

Near point or Least distance of distinct vision

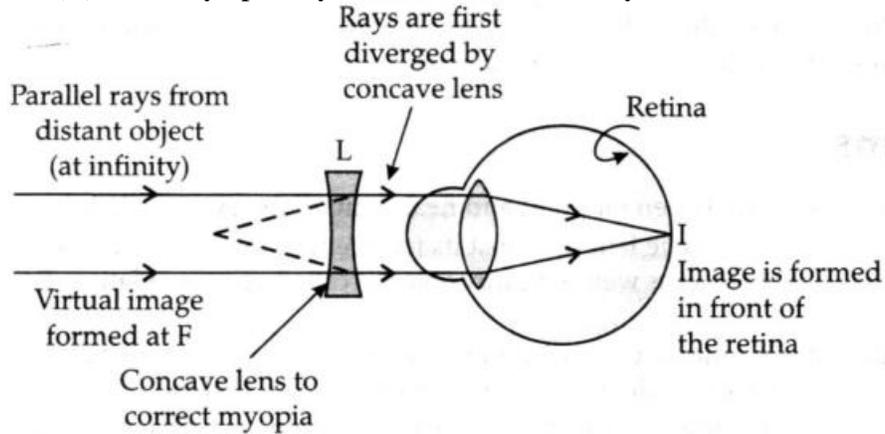
- The minimum distance at which objects can be seen most distinctively without strain.
 - For a normal adult eye, its value is 25 cm.
 - Range of human vision -25 cm to infinity.
- **Accommodation:** The ability of the eye lens to adjust its focal length is called accommodation. Focal length can be changed with help of ciliary muscles.
- **Myopia (Near Sightedness):** Distant objects are not clearly visible. It is corrected by using concave lens.



(a) In a myopic eye, image of distance object is formed in front of the retina (and not on the retina)



(b) The far point (F) of a myopic eye is less than infinity.



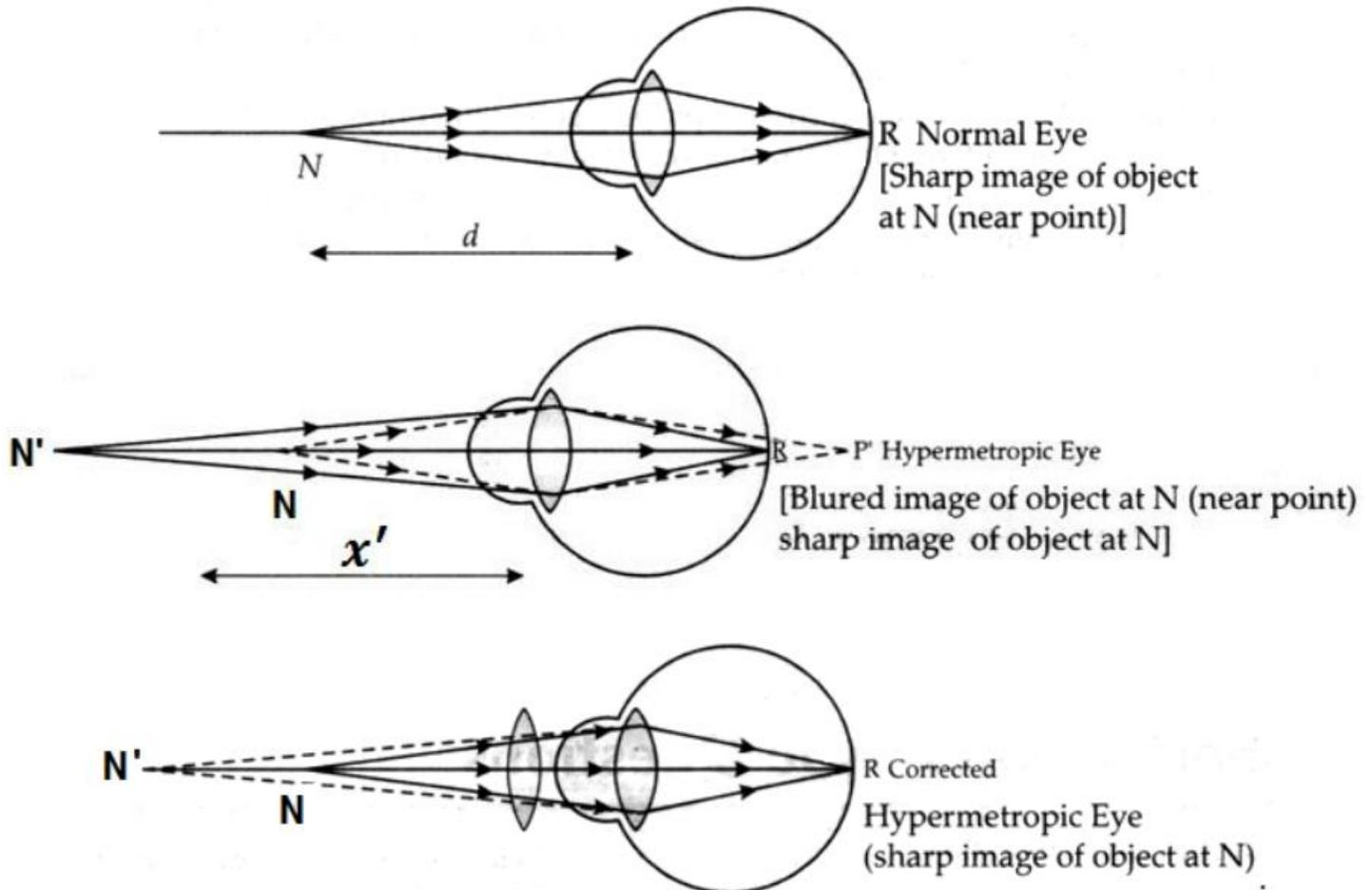
(c) Correction of myopia. The concave lens placed in front of the eye forms a virtual image of distant object at far point (F) of myopic eye.

Hypermetropia (Far sightedness)

- Affected person can see far objects clearly but cannot see nearby objects clearly.
- The near point of the eye moves away.
- Image is formed behind the retina.

Correction

- Use of convex lens of suitable power can correct the defect.



Presbyopia (Old age Hypermetropia)

- It is the defect of vision due to which an old person cannot see the nearby objects clearly due to less power of accommodation of the eye.
 - The near-point of old person having presbyopia gradually recedes and becomes much more than 25 cm away.
- The phenomenon of splitting of white light into its constituent seven colours on passing through a glass prism is called **dispersion of light**.
- Different colours undergo different deviations on passing through prism.
- If a second identical prism is placed in an inverted position with respect to the first prism, all the seven colours recombine to form white light.
- **Atmospheric refraction** is the phenomenon of bending of light on passing through earth's atmosphere.
- As we move above the surface of earth, density of air goes on decreasing.
- light travelling from rarer to denser layers always bends towards the normal.
- Stars twinkle on account of atmospheric refraction.
- Sun appears to rise 2 minutes earlier and set 2 minutes later due to atmospheric refraction.
- The phenomenon in which a part of the light incident on a particle is redirected in different directions is called **scattering of light**.
- Very small particles scatter light of shorter wavelengths better than longer wavelengths.
- The scattering of longer wavelengths of light increases as the size of the particle increases.
- Larger particles scatter light of all wavelengths equally well.

Know the Terms

- **Range of Vision:** The distance between far point and near point of the eye is called the range of vision.
- **Accommodation:** The ability of an eye lens to adjust its focal length by the action of ciliary muscles to get a clear and sharp image of the distant object as well as nearby object is called accommodation. For a person having normal vision, it is about 4 dioptries.
- **Power of Accommodation:** The maximum variation in the converging power (focal length) of eye lens so that the far—off and nearby objects are viewed clearly is called power of accommodation.
- **Persistence of vision:** The time for which the impression or sensation of an object continues in the eye is called the persistence of vision. It is about $\frac{1}{16}$ th of a second.
- **Prism:** Prism is a homogenous, transparent, refracting material, such as glass, enclosed by two inclined plane refracting surfaces, at some fixed angle, called refracting angle or angle of prism. It has two triangular bases and three rectangular lateral surfaces which are inclined to each other.
- **Angle of Refraction:** The angle between the refracted ray and the normal is called angle of refraction ($\angle n$).

- **Angle of Emergence:** The angle between the emergent ray and normal at the second refracting face of the prism is called angle of emergence ($\angle e$).
- **Angle of Deviation:** The angle formed between the incident ray produced in the forward direction and emergent ray produced in the backward direction in the refraction through the prism is called angle of deviation ($\angle \delta$).
- **Dispersion:** The splitting up of white light into its constituent colours is called dispersion. It occurs because refraction or bending differs with the colour.
- **Atmospheric Refraction:** Change in the direction of propagation of light rays travelling through the atmosphere due to change in density of the different layers of air is called atmospheric refraction.
- **Scattering of Light:** The phenomenon of change in the direction of propagation of light caused by the large number of molecules, such as smoke, tiny water droplets, suspended particles of dust and molecules of air present in the earth's atmosphere is called scattering of light.
- **Tyndall effect:** The phenomenon of scattering of light by the colloidal particles is known as Tyndall effect.

Questions:

1. No image is formed on the blind spot of human eye because [SSLC April, 2016]
 - (a) Cones are absent
 - (b) Rods are absent
 - (c) Rods and cones are absent
 - (d) Optic nerve is absent

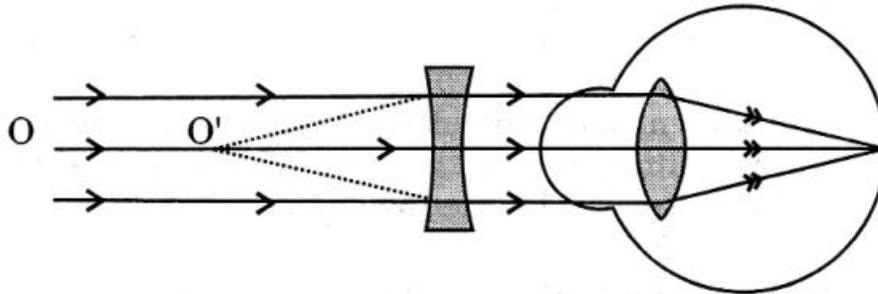
Ans: Rods and cones are absent
2. A student wears spectacles with concave lenses for proper vision. When he is not using the spectacles the image of object is formed [SSLC June, 2016]
 - (a) In front of the retina
 - (b) On the blind spot
 - (c) Behind the retina
 - (d) On the yellow spot

Ans: (a) In front of the retina
3. Define power of accommodation.
Ans: The ability of the eye to focus the distant objects as well as the nearby objects on the retina by changing the focal length of the eye lens is called power of accommodation.
4. What is the principle of the working of the human eye?
Ans: It is like a camera having a lens system forming an inverted, real image on the light sensitive screen, retina inside the eye.
5. How is a normal eye able to see distinctly distant as well as nearer objects? What is the distance of distinct vision?
Ans: Eye lens is made up of fibrous material. Its curvature can be changed by ciliary muscles which changes its focal length. When muscles are relaxed, the lens becomes thin and focal length increases and the eye is able to see distant objects. Similarly when ciliary muscles contract, focal length decreases and eye is able to see nearer objects. The minimum distance at which objects can be seen distinctly is called distance of distinct vision. It is 25 cm.
6. (i) What is meant by 'least distance of distinct vision' ?
 (ii) How does iris control the size of the pupil in bright light and dim light?
Ans: (i) The minimum distance at which objects can be seen most distinctly without strain is called the least distance of distinct vision.

(ii) In bright light, the iris contracts the pupil to allow less light to enter the eye. In dim light, the iris expands the pupil to allow more light to enter the eye.

7. (i) Make a ray diagram to show how the eye defect- myopia is corrected by using a suitable lens.
 (ii) State two reasons due to which this eye defect may be caused.
 (iii) A person with myopic eye cannot see objects beyond a distance of 1.5 m. What is the power of the lens required to correct the problem?

Ans: (i)



- (ii) (a) Elongation of the eye ball
 (b) Decrease in focal length of eye lens.

(iii) $u = \infty$, $v = -1.5$ m

$$P = \frac{1}{v} = \frac{1}{-1.5}$$

$$= \frac{1}{-1.5} = -0.66 \text{ D}$$

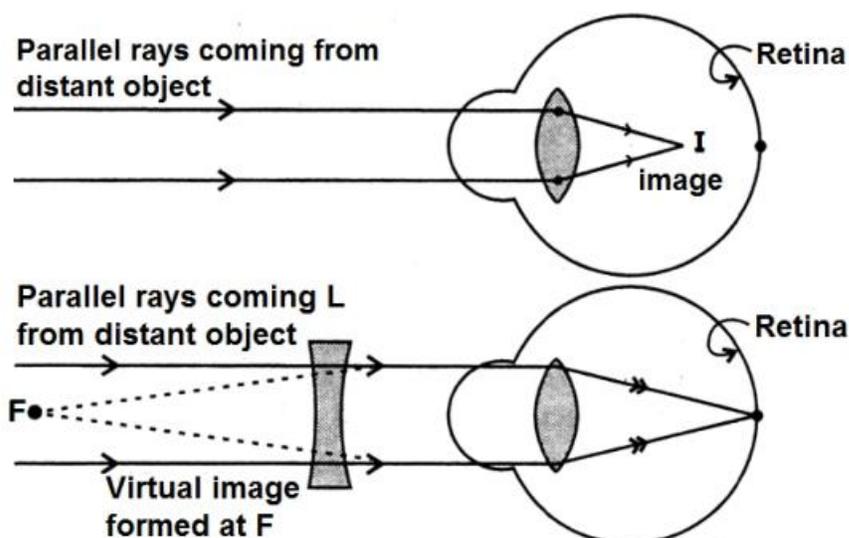
8. A student is unable to see clearly the words written on the blackboard placed at a distance of approximately 4 m from him. Name the defect of vision the boy is suffering from. Explain the method of correcting this defect. Draw ray diagram for the:

- (i) Defect of vision and (ii) For its correction. [SSLC July, 2018]

OR

A student has difficulty reading the blackboard while sitting in the last row. What could be the defect the child suffering from? How can it be corrected?

Ans: Myopia or short-sightedness: Inability of an eye in viewing long distance objects. The image in this case falls before the retina. For every myopic eye, there exists a far point beyond which clear image cannot be seen. The short-sightedness is corrected by using a concave lens which diverges and shifts the image to the retina.

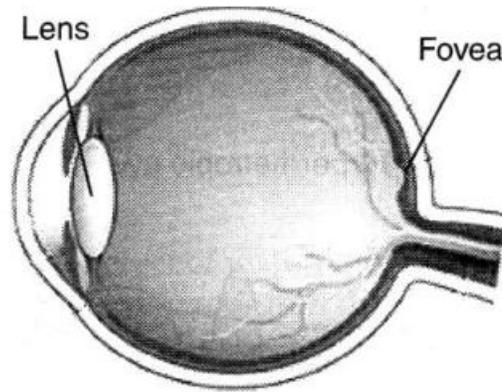


9. Draw the vertical section of the human eye and label the following parts:

(a) Lens

(b) Fovea

[SSLC April, 2017]



10. (i) What type of spectacles should be worn by a person having the defect of myopia as well as hypermetropia?
 (ii) The far point of a myopic person is 150 cm. What is the nature and the power of lens required to correct the defect?
 (iii) With the help of ray diagrams, show the formation of image by (i) a myopic eye (ii) correction of myopic eye by using an appropriate lens.

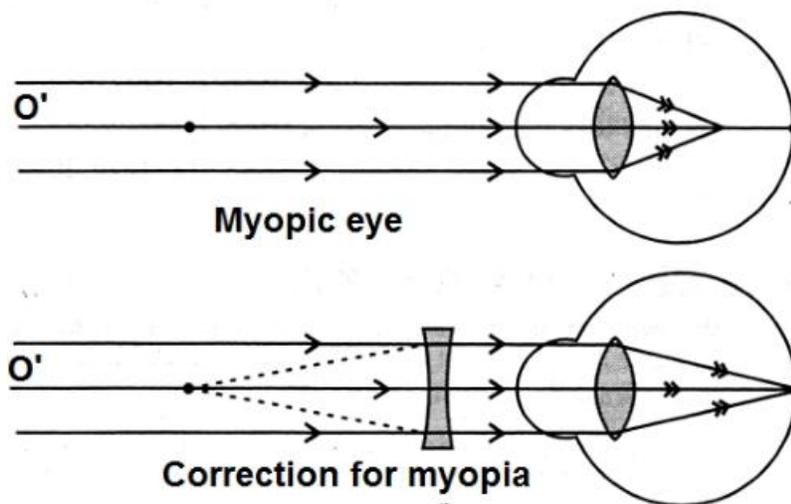
Ans: (i) Spectacle having bifocal lens

(ii) ∞ , -150 cm

$$\Rightarrow \frac{1}{150} = \frac{1}{150} - \frac{1}{\infty} \quad \therefore = -150 \text{ cm}$$

Power of lens $P = \frac{1}{150} = \frac{-100}{150}$
 $= -0.67 \text{ D}$

Nature of lens: Concave



11. Red coloured light is used in traffic signals to indicate the vehicles to stop, because compared to other coloured red light [SSLC July, 2018]

- (a) Has high frequency (b) Scatters more (c) Has less wavelength (d) Scatters less

Ans: (d) Scatters less

12. What is the cause of dispersion of light on passing through a prism?

Ans: The refractive index of the material of a prism is different for different colours of light as different colours have different speed in the material of a prism. Also, prism has non—parallel surfaces.

13. What is dispersion? What happens when light is passed through a glass prism.

Ans: The process of splitting up of white light into its constituent colour as it passes through a refracting medium is known as dispersion of light. It bends towards the base of the prism after passing through it.

14. Why do different colours get separated when white light passes through a prism? How can we recombine the components of white light after a prism has separated them. Explain.

Ans: A spectrum is the band of distinct colours we obtain when the white light is splitted by a prism. We can recombine the component of white light by passing them through a prism placed upside down near the given prism. When we pass white light through two identical prisms held side by side with their refracting edges in opposite directions; the first prism disperses white light but the second prism recombines them. Thus light emerging from second prism is white.

15. Why did the clear sky appear blue?

[NCERT Exemplar]

OR

Why is the colour of the clear sky blue?

Ans: The molecules of air and other fine particles in the atmosphere have size smaller than the wavelength of the visible light.

These are more effective in scattering light of shorter wavelength at the blue end than the light of longer wavelength at the red end. Thus, the blue colour is due to the scattering of sunlight through fine particles in air.

16. What is meant by scattering of light? The sky appears blue and the sun appears reddish at sunrise and sunset. Explain these phenomena with reason.

OR

What is the difference of colours of the sun observed during sunrise/sunset and noon? Give explanation of each?

[NCERT Exemplar]

Ans: (i) Scattering of light: Phenomenon of spreading of light (diffused reflection) by minute particles in a medium.

(ii) The sky appears blue because the blue colour of sunlight scatters much more strongly than the red colour by particles in atmosphere/air due to its shorter wavelength.

(iii) At sun-rise and sun-set most of the blue light and shorter wavelengths are scattered away by the particles in the atmosphere as the light from the sun near the horizon passes through thick layers of air and larger distance. The light that reaches us is of longer wavelength (red colour) giving a reddish appearance.

17. Enlist atleast six phenomena observed in nature subsequent to the scattering of light.

Ans: The various phenomena observed in nature due to scattering of light are the following:

(i) Sun appears red near the horizons (during sunrise and sunset) and white when seen overhead.

(ii) Bluish colour of the sky.

(iii) Visible path of light as it enters a dark room.

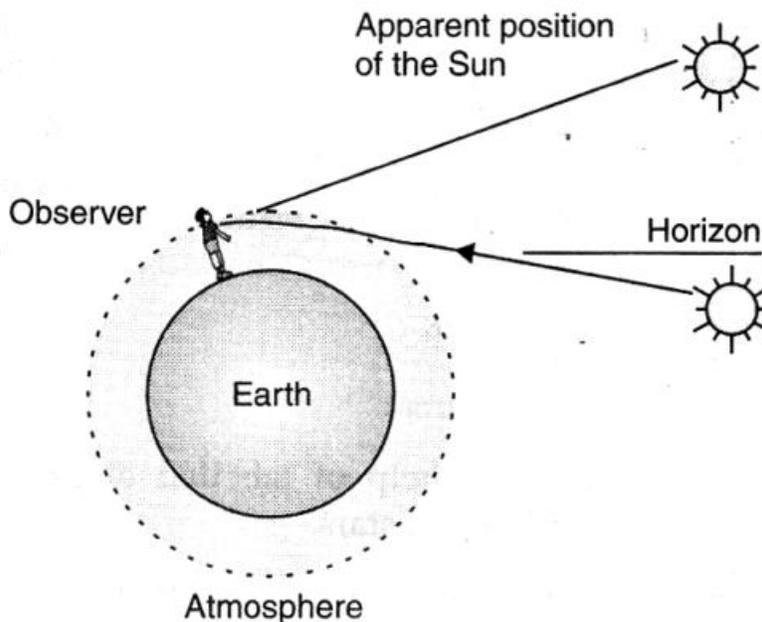
- (iv) Danger signals or stop signals are usually red.
- (v) Blueness of distant mountains.
- (vi) Sunlight filtering through clouds.

18. Explain in brief the reason for each of the following:

- (i) Advanced sun-rise
- (ii) Delayed sun-set
- (iii) Twinkling of stars

Ans:(i) Advanced sun-rise : When the sun is slightly below the horizon, light rays coming from the sun travel from the rarer to denser medium layers of air because of atmospheric refraction of light, light appears to come from a higher position above the horizon. Thus the sun appear earlier than actual sunrise.

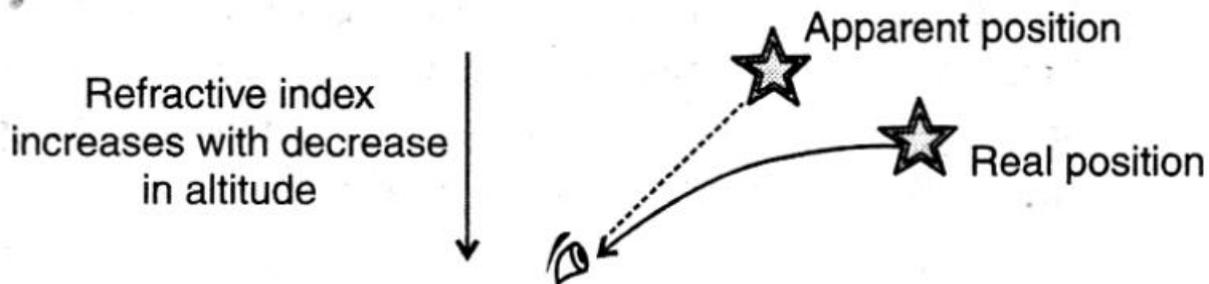
(ii) Delayed sun-set: Same reason as similar refraction occurs at the sunset.



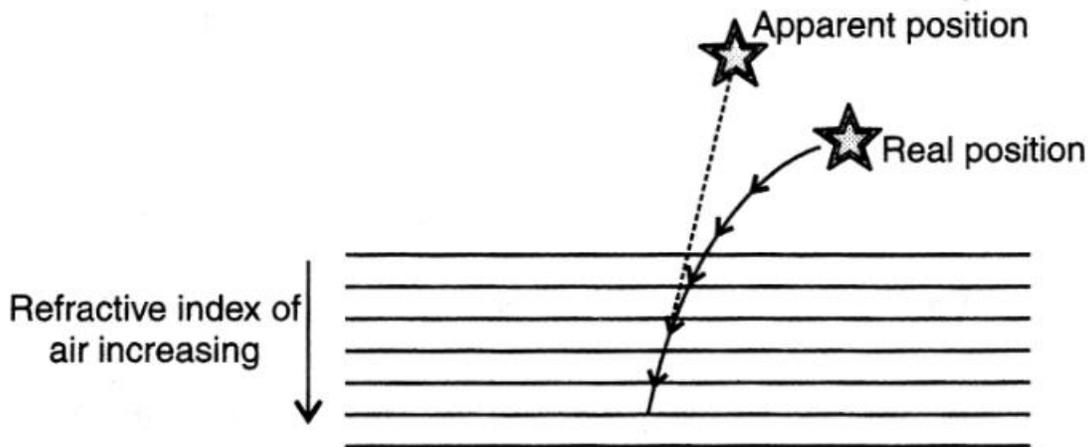
(iii) Twinkling of stars The light coming from the stars gets refracted several times before reaching the observer's eye. Due to change in physical condition of the atmosphere the light sometimes reaches the observer and sometimes it doesn't, hence they appear to twinkle.

19. Explain with the help of labelled diagram, the cause of twinkling of stars.

Ans: Light coming from the stars undergoes refraction on entering the Earth's atmosphere. This refraction continues until it reaches the Earth's surface. This happens because of uneven heating of atmospheric air. Hence, the atmospheric air has changing refractive index at various altitudes. In this case, starlight continuously travels from a rarer medium to a denser medium. Hence, it continuously bends towards the normal.



The refractive index of air medium gradually increases with a decrease in altitude. The continuous bending of starlight towards the normal results in a slight rise of the apparent position of the star.



Since the physical conditions of the Earth's atmosphere keeps changing, the apparent position of the star is not stationary. The star changes its position continuously, which makes it twinkle. This happens because starlight travels a very large distance before reaching the observer. However, the path varies continuously because of uneven atmospheric conditions. Hence, the stars seem to be fluctuating, sometimes appearing brighter and sometimes fainter. All this together, gives rise to the twinkling effect of stars.

20. (a) Write an activity for observing scattering of light in colloidal solution.

(b) On the basis of this activity explain why sky appears red at sunrise or sunset.

Ans: (a) (i) Place a strong source of white light at the focus of converging lens.

(ii) Allow the light beam to pass through a transparent glass tank containing clear water.

In that clear water, dissolve 200g of sodium thiosulphate in about 2 L of clean water in the tank and add 1 to 2 mL of conc H_2SO_4 acid.

(iii) Allow the beam of light to pass through a circular hole made in a cardboard. Obtain a sharp image of circular hole on screen by using converging lens.

(b) At sunrise or sunset light travels long distance through thick layers of atmosphere. Blue and other lower wavelength get scattered and only red light reaches earth.

Textbook Exercises:

1. The human eye can focus object at different distances by adjusting the focal length of eye lens. This is due to

(a) Presbyopia (b) Accommodation (c) Near sightedness (d) Far sightedness

Ans: (b) Accommodation

2. The human eye forms the image of an object at its

(a) Cornea (b) Iris (c) Pupil (d) Retina

Ans: (d) Retina

3. The least distance of distance vision for a young adult with normal vision is about.

(a) 25m (b) 2.5 cm (c) 25 cm (d) 2.5 m

Ans: (c) 25 cm

4. The change in focal length of an eye lens is caused by the action of the

(a) Pupil (b) Retina (c) Ciliary muscles (d) Iris

Ans: (c) Ciliary muscles

5. A person needs a lens of power - 5.5 dioptres for correcting his distant vision. For correcting his near vision he needs a lens of power + 1.5 dioptr. What is the focal length of the lens required for correcting (i) distant vision, and (ii) near vision?

Ans: (i) For distant vision

$$\begin{aligned} P &= -5.5 \text{ D} \\ &= \frac{1}{-5.5} = -0.182 \text{ m} \\ &= -18.2 \text{ cm} \end{aligned}$$

(ii) For distant vision

$$\begin{aligned} P &= 1.5 \text{ D} \\ &= \frac{1}{1.5} = 0.667 \text{ m} \\ &= 66.7 \text{ cm} \end{aligned}$$

6. The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Ans: = -80

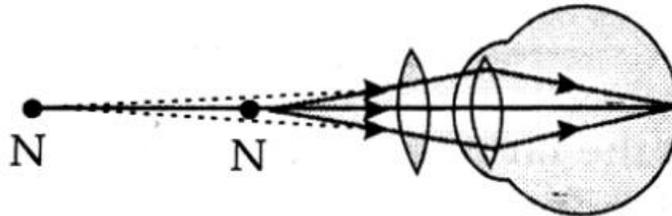
$$\begin{aligned} P &= \frac{1}{-80} \\ &= -1.25 \text{ D} \end{aligned}$$

$$P = -1.25 \text{ D}$$

Nature of the lens is concave.

7. Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is 100 cm. What is the power of the lens required to correct this defect? Assume that the near point of the normal eye is 25 cm.

Ans: The diagram is as shown below



$$\begin{aligned} &= \frac{1}{100 - 25} \\ &= \frac{1}{75} \\ &= \frac{100}{75} = +1.33 \text{ D} \end{aligned}$$

8. Why is a normal eye not able to see clearly the objects placed closer than 25 cm?

Ans: Because focal length of eye lens cannot be decreased below a certain value.

9. What happens to the image distance in the eye when we increase the distance of an object from the eye?

Ans: For a normal eye, image distance remains fixed, whatever be the object distance.

10. Why do stars twinkle?

Ans: Because of atmosphere refraction.

11. Explain why the planets do not twinkle.

Ans: Refraction is not noticeable due to the small variation in the brightness of light coming from the planet. Thus, planets do not appear to twinkle.

12. Why does the Sun appear reddish early in the morning?

Ans: Since blue colour has a shorter wavelength and red colour has a longer wavelength, the red colour is able to reach our eyes after the atmospheric scattering of light. Therefore, the Sun appears reddish early in the morning.

13. Why does the sky appear dark instead of blue of an astronaut?

Ans: The sky appears dark to an astronaut because there is no atmosphere in the outer space that can scatter the sunlight. As the sunlight is not scattered, no scattered light reach the eyes of the astronauts and the sky appears black to them.

12. ELECTRICITY

Quick Review

- Electric charge is the property of matter due to which it produces and experience electrical and magnetic effects. There exist two types of charge in nature:
(i) Positive charge (ii) Negative charge SI unit of charge is coulomb (C).
- **Fundamental law of electrostatics:** Like charges repel and unlike charges attract each other.
- **Coulomb's Law:** The force of attraction or repulsion between two point charges is
(i) directly proportional to the product ($q_1 q_2$) of the two charges and
(ii) inversely proportional to the square of the distance (r) between them.
Mathematically,
$$F = \frac{K q_1 q_2}{r^2}$$
- The value of K depends on the nature of the medium between the two charges and the system of units chosen. For charges in vacuum, $K = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$.
- **Law of Conservation of Charge:** Electric charges can neither be created nor destroyed, they can only be transferred from one body to another.
- **Static and Current Electricity:** Static electricity deals with the electric charges at rest while the current electricity deals with the electric charges in motion.
- **Electric Current:** The electric current is defined as the rate of flow of electric charge through any section of a conductor.

$$\text{Electric current} = \frac{\text{Charge}}{\text{Time}} \text{ or } I = \frac{Q}{t}$$

Electric current is a scalar quantity.

- **Ampere:** It is the SI unit of current. If one coulomb of charge flows through any section of a conductor in one second, then current through is said to be of one ampere.
- **Electric circuit:** The closed path along which an electric current flows is called an 'electric circuit'.
- **Conventional direction of current:** Conventionally, the direction of motion of positive charges through the conductor is taken as the direction of current. The direction of conventional current is opposite to that of the negatively charged electrons.

➤ **Electric field:** It is the region around a charged body within which its influence can be experienced.

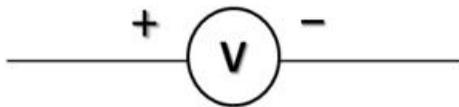
➤ **Potential Difference (V):** Work done to move a unit charge from one point to another.

$$V = \frac{W}{Q}$$

➤ **1 Volt:** When 1 joule work is done in carrying one Coulomb charge then potential difference is called 1 volt. S. I. unit of Potential difference = Volt (V)

$$1 \text{ V} = 1 \text{ J/C}$$

➤ Voltmeter has high resistance and always connected in parallel. Symbol is



➤ **Potential difference between two points:** The potential difference between two points in an electric field is the amount of work done in bringing a unit positive charge from one point to another.

$$\text{Potential difference} = \frac{\text{Work done}}{\text{Charge}} \quad \text{or} \quad V = \frac{W}{Q}$$

➤ **One volt potential difference:** The potential difference between two points in an electric field is said to be one volt if one joule of work has to be done in bringing a positive charge of one coulomb from one point to another.

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}} \quad \text{or} \quad 1 \text{ V} = \frac{1 \text{ J}}{1 \text{ C}}$$

➤ **Electrochemical or voltaic cell:** It is a device which converts chemical energy into electrical energy.

➤ **Galvanometer:** It is a device to detect current in an electric circuit.

➤ **Ammeter:** It is a device to measure current in a circuit. It is a low resistance galvanometer and is always connected in series in a circuit.

➤ **Voltmeter:** It is a device to measure the potential difference. It is a high resistance galvanometer and is always connected in parallel to the component across which the potential difference is to be measured.

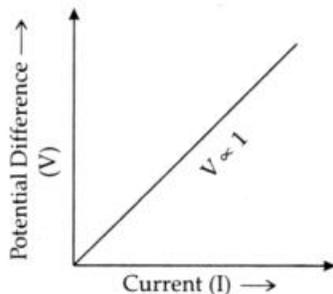
➤ **Ohm's Law:** Potential difference across the two points of a metallic conductor is directly proportional to current through the circuit provided that temperature remains constant.

(i) **Mathematical expression for Ohm's law**

$$V \propto I \qquad V = IR$$

R is a constant called resistance for a given metal.

(ii) **V-I graph for Ohm's law:**



- **Resistance (R):** It is the property of a conductor to resist the flow of charges through it.
 - (i) **Ohm ():** S. I. unit of resistance.
 - (ii) $\text{ohm} = \frac{1 \text{ volt}}{1 \text{ ampere}}$
- When potential difference is 1 V and current through the circuit is 1 A, then resistance is 1 ohm.
- **Rheostat:** Variable resistance is a component used to regulate current without changing the source of voltage.
- **Factors on which the Resistance of a Conductor depends:** Resistance of a uniform metallic conductor is
 - (i) Directly proportional to the length of conductor,
 - (ii) Inversely proportional to the area of cross-section,
 - (iii) Directly proportional to the temperature and
 - (iv) Depend on nature of the material.
- **Resistivity (P):** It is defined as the resistance offered by a cube of a material of side 1 m when current flows perpendicular to its opposite faces.
 - (i) Its S.I. unit is ohm-metre (Ωm).
 - (ii) Resistivity does not change with change in length or area of cross-section but it changes with change in temperature.
 - (iii) Range of resistivity of metals and alloys is 10^{-8} to $10^{-6} \Omega\text{m}$.
 - (iv) Range of resistivity of insulators is 10^{12} to $10^{17} \Omega\text{m}$.
 - (v) Resistivity of alloy is generally higher than that of its constituent metals.
 - (vi) Alloys do not oxidize (burn) readily at high temperature, so they are commonly used in electrical heating devices.
 - (vii) Copper and aluminium are used for electrical transmission lines as they have low resistivity.
- **Resistances in series:** When two or more resistances are joined end to end so that same current flows through each one of them in turn, they are said to be connected in series. Here, the total resistance is equal to the sum of the individual resistances.

$$R_s = R_1 + R_2 + R_3 + \dots$$
- **Resistances in parallel:** When two or more resistances are connected across two points so that each one of them provides a separate path for current, they are said to be connected in parallel. Here the reciprocal of their combined resistance is equal to the sum of the reciprocals of the individual resistances.

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$
- **Heating effect of current:** When an electric current is passed through a conductor, heat is produced in it. This is known as heating effect of current.
- **Joule's law of heating:** It states that the heat produced in a conductor is directly proportional to (i) the square of the current I through it, (ii) its resistance R and (iii) the time t, for which current is passed. Mathematically, it can be expressed as

$$H = I^2 R t \text{ joule} = \frac{I^2 R t}{4.18} \text{ cal}$$

or
$$H = V I t \text{ joule} = \frac{V I t}{4.18} \text{ cal}$$

➤ **Practical application of the heating effect of electric current:**

It is utilised in the electrical heating appliances such as electric iron, room heaters, water heaters etc. The electric heating is also used to produce light as in an electric-bulb.

- **Electric energy:** It is the total work done in maintaining an electric current in an electric circuit for a given time.

Electric energy,
$$W = V I t = I^2 R t \text{ joule}$$

- **Electric Fuse:** It is a safety device that protects our electrical appliances in case of short circuit or overloading.

- (i) Fuse is made up of pure tin or alloy of copper and tin.
- (ii) Fuse is always connected in series with live wire.
- (iii) Fuse has low melting point.
- (iv) Current capacity of fuse is slightly higher than of the appliance.

- **Electric Power:** The rate at which electric energy is consumed or dissipated in an electric circuit.

$$P = V I$$

$$P = I^2 R = \frac{V^2}{R}$$

- S.I. unit of power = Watt (W)

$$1 \text{ Watt} = 1 \text{ Volt} \times 1 \text{ ampere}$$

- Commercial unit of electric energy = Kilo Watt hour (KWh)

$$1 \text{ KWh} = 3.6 \times 10^6 \text{ J}$$

$$1 \text{ KWh} = 1 \text{ unit of electric energy}$$

- **Electrical power:** Electrical power is the rate at which electric energy is consumed by an appliance.

$$P = \frac{W}{t} = V I = I^2 R = \frac{V^2}{R}$$

- **Watt:** It is the SI unit of power. The power of an appliance is 1 watt if one ampere of current flows through it on applying a potential difference of 1 volt across its ends.

$$1 \text{ watt} = \frac{1 \text{ joule}}{1 \text{ second}} = 1 \text{ volt} \times 1 \text{ ampere}$$

or
$$1 \text{ W} = \text{Js}^{-1} = 1 \text{ VA}$$

$$1 \text{ kilowatt} = 1000 \text{ W.}$$

- **Kilowatt hour:** It is the commercial unit of electrical energy. One kilowatt hour is the electrical energy consumed by an appliance of 1000 watts when used for one hour.

$$1 \text{ kilowatt hour (kWh)} = 36 \times 10^6 \text{ J}$$

- **Power rating:** The power rating of an appliance is the electric energy consumed per second by the appliance when connected across the marked voltage of the mains.

- **Efficiency of an electrical device:** It is the ratio of the output power to the input power

$$\text{Efficiency,} = \frac{\text{Output power}}{\text{Input power}}$$

Know the Terms

- **Frictional Electricity:** It is the electricity produced by rubbing two suitable bodies and flow of electrons from one body to other.
- **Electricity:** A fundamental form of energy observable in positive and negative forms that occurs naturally (as in lightning) or is produced (as in a generator) and that is expressed in terms of the movement and interaction of electrons.
- **Positive and Negative Charges:** The charge acquired by a glass rod when rubbed with silk is called positive charge and the charge acquired by an ebonite rod when rubbed with wool is called negative charge.
- **Charge Conservation:** When a glass rod is rubbed on silk, the glass rod acquires positive charge. But it is not created. The negative charges from glass rod are shifted to silk leaving a net positive charge on glass rod. The net charge in them remains the same. So, charges are not created or destroyed but can be transferred from one place to another or remain conserved.
- **Coulomb:** It is the SI unit of charge. One coulomb is defined as that amount of charge which repels an equal and similar charge with a force of 9×10^9 N when placed in vacuum at a distance of 1 meter from it. Charge on an electron = 1.6×10^{-19} coulomb.
- **Conductor:** A substance which allows passage of electric charges through it easily is called a conductor. A conductor offers very low resistance to the flow of current. For example, Copper, Silver, Aluminium etc.
- **Insulator:** A substance that has infinitely high resistance does not allow electric current to flow through it. It is called insulator.
- **Electric Potential Energy:** It is defined as the work required to be done to bring the charges to their respective location against the electric field with the help of a source of energy. This work done gets stored in the form of potential energy of charge.
- **Ohm:** It is the SI unit of resistance. A conductor has a resistance of one ohm if a current of one ampere flows through it on applying a potential difference of 1 volt across its ends.

$$1 \text{ ohm} = \frac{1 \text{ volt}}{1 \text{ ampere}} \quad \text{or} \quad 1 = \frac{1 \text{ V}}{1 \text{ A}}$$

- **Resistor:** A conductor which has some appreciable resistance is called a resistor.
- **Resistivity:** It is defined as the resistance offered by a cube of a material of side 1m when current flows perpendicular to its opposite faces Its SI unit is ohm-metre (Ωm).
Resistivity, $1 = \frac{RA}{L}$
- For a material irrespective of length and area, the resistivity is constant. It is otherwise called specific resistance of the material. It is also defined as the resistance offered by a cube of a material of side 1m when current flows perpendicular to the opposite faces.
- Rheostat is a device which changes the magnitude of current in the circuit, by changing the resistance. It is connected in series in the circuit. It is also used as a potential divider in the circuit.
- **Semiconductors:** Materials having resistivity between that of an insulator and a conductor are called semiconductors. They are used in making integrated circuits.

- **Superconductors:** These are certain materials that lose their resistivity at low temperature. Such materials are called as superconductors. The phenomenon of complete loss of resistivity by substances below a certain temperature is called superconductivity.
- **Fuse Wire:** The wire which melts, breaks the circuit and prevents the damage of various appliances in the household connections. It is connected in series and its thickness determines the maximum current that can be drawn. It is made of an alloy of Aluminium, Copper, Iron and Lead.

Questions:

1. The SI unit of electric current is: [SSLC July, 2018-19]
 (a) Ampere (b) Ohm (c) Volt (d) Watt
Ans: (a) Ampere

2. Define the SI unit of potential difference.
Ans: If amount of work done in bringing one coulomb charge from one point to the other is 1 joule then potential difference between two points is said to be 1 volt.

3. State the relationship between 1 ampere and 1 coulomb.

Ans: $1 \text{ ampere} = \frac{1 \text{ coulomb}}{1 \text{ second}}$

4. 12.400 J of heat is produced in 4 s in a 4Ω resistor. Find potential difference across the resistor.

Ans: $\frac{V^2}{R} \times t = 400$

Or $V^2 = 400$

Or $V = 20 \text{ volt}$

5. State the factors on which at a given temperature the resistance of a cylindrical conductor depends. State the SI unit of resistivity. [SSLC July, 2018-19]

Ans: Factors on which the resistance of a cylindrical conductor depends:

- (i) Area of cross-section of the conductor.
- (ii) Nature of the material.

SI unit of resistivity is ohm-m

6. State the physical quantity which is equal to the ratio of potential difference and current. Define its SI unit.

Ans: Electrical Resistance, $R = \frac{V}{I}$

The resistance of a conductor is said to be one ohm if the potential difference applied across its ends is 1 volt and a current of 1 A flows through it. Its SI unit is ohm (Ω)

$$1 \text{ ohm} = \frac{1 \text{ volt}}{1 \text{ ampere}}$$

7. Calculate the work done in moving a charge of 2 coulombs across two points having a potential difference of 12 V.

Ans: $q = 2\text{C}$

$V = 12\text{V}$

$W = V \times q$

$= 12\text{V} \times 2\text{C}$

$= 24\text{J}.$

8. List in a tabular form two differences between a voltmeter and an ammeter.

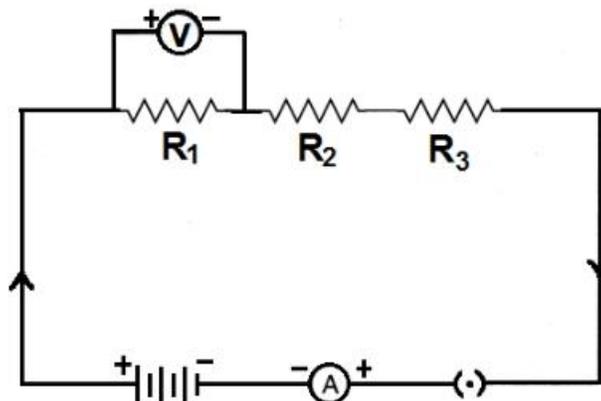
Ans: Difference between voltmeter and Ammeter:

Voltmeter		Ammeter	
(i)	Used to measure the potential difference,	(i)	Used to measure the current.
(ii)	Connected in parallel in the electric circuit.	(ii)	Connected in series in the electric circuit.
(iii)	Has high resistance.	(iii)	Has low resistance.

9. Draw a schematic circuit diagram for a circuit in which three resistors R_1 , R_2 and R_3 a plug key under closed condition, an ammeter are joined in series with a 5V battery. Also a voltmeter is connected to measure the potential difference across the resistor R_1 .

Ans: Circuit diagram to show R_1 , R_2 and R_3 connected in series with a battery, ammeter and a key. Voltmeter V is connected parallel to R_1 .

Direction of current.



10. Name and define S.I. unit of resistance. Calculate the resistance of a resistor if the current flowing through it is 200 mA, when the applied potential difference is 0.8 V.

Ans: The SI unit of resistance is ohm.

One ohm is the resistance offered, by a conductor when the current passing through it is one ampere and the potential difference across its ends is volt.

By Ohm's law, $V = IR$

$$R = \frac{V}{I} = \frac{0.8 \text{ V}}{0.2 \text{ A}} = 4 \text{ ohm}$$

11. In an electric field the work done in bringing a 2 coulomb charge from infinity to a point A is 10 joules and in bringing the same charge to some another point B is 20 joules. Find the potential difference between two points A and B. What would be the work done if the same charge is brought directly from A to B?

Ans: Work done = 10 Joule

Charge = 2 Coulomb

$$\text{Potential of point A} = V_A = \frac{20 \text{ J}}{2 \text{ C}} = 10 \text{ V}$$

Given, work done = 20 Joule

Charge = 2 coulomb

$$\text{Potential of point B} = V_B = \frac{20 \text{ J}}{2 \text{ C}} = 10 \text{ V}$$

Potential difference between two points A and B is

$$V = V_B - V_A$$

$$= 10 \text{ V} - 5 \text{ V} = 5 \text{ V}$$

Work done directly from A to B

$$\begin{aligned} \text{Work done} &= \text{Potential difference} \times \text{charge} \\ &= 5 \text{ V} \times 2 \text{ C} \\ &= 10 \text{ Joule} \end{aligned}$$

- 12.** What does an electric circuit mean? Name a device that helps to maintain a potential difference across a conductor in a circuit. When do we say that the potential difference across a conductor is 1 volt? Calculate the amount of work done in shifting a charge of 2 coulombs from a point A to B having potentials 110 V and 25 V respectively.

Ans: Electric circuit: The closed path along which an electric current flows is called an 'electric circuit'. The device that helps to maintain a potential difference across a conductor in a circuit are –

Electric cell, electric battery, electric generator

1 Volt: The potential difference between two points in an electric field is said to be one volt if one joule of work has to be done in bringing a positive charge of one coulomb from one point to another.

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}} \text{ or } 1 \text{ volt} = \frac{1 \text{ J}}{1 \text{ C}}$$

Work done = V (Potential difference) × Q (Coulomb)

$$\begin{aligned} W &= V \times Q \\ &= 85 \times 2 \\ &= 170 \text{ Joule} \end{aligned}$$

- 13.** (a) Two identical resistors each of resistance 10 ohm are connected in:
 (i) series, (ii) parallel. in turn to a battery of 6V. Calculate the ratio of power consumed by the combination of resistor in the two cases.
 (b) List two factors on which the resistance of a conductor depends.
 (c) Write a difference between an ammeter and voltmeter.

Ans: (a) $R_1 = R_2 = 10$

(i) When connected in series

$$R_s = R_1 + R_2 = 20 \Omega$$

$$P_s = \frac{V^2}{R_s} = \frac{6 \times 6}{20} = 1.8 \text{ W}$$

(ii) When connected in parallel

$$R_p = \frac{R_1 R_2}{R_1 + R_2} = \frac{10 \times 10}{10 + 10} = 5 \Omega$$

$$P_p = \frac{V^2}{R_p} = \frac{6 \times 6}{5} = 7.2 \text{ W}$$

$$\frac{P_s}{P_p} = \frac{1.8 \text{ W}}{7.2 \text{ W}} = \frac{1}{4} = 1 : 4$$

(b) Resistance of a conductor depends on:

- (i) Length of the conductor (ii) Area of cross section

(c)

Ammeter		Voltmeter	
(i)	It is used to measure the, current.	(i)	It is used to measure the potential difference.
(ii)	It is connected in series in the circuit.	(ii)	It is always connected in parallel in the circuit.

14. Three resistances of 4Ω , 5Ω and 20Ω are connected in parallel. Their combined resistance is:

- (a) 2Ω (b) 4Ω (c) 5Ω (d) 6Ω

Ans: (a) 2Ω

15. On what principle is an electric bulb based?

[NCERT Exemplar]

Ans: Heating effect of current.

16. Find the minimum resistance that can be made using five resistors, each of 5Ω .

[NCERT Exemplar]

Ans: By connecting resistors in parallel, resistance 1Ω is obtained

$$R_{eq} = \frac{R}{n} = \frac{5\Omega}{5} = 1\Omega$$

17. A potential difference of 220 V is applied across a resistance of 440 Q in an electrical appliance. Calculate the current drawn and heat energy produced in 20 seconds.

[SSLC July, 2018-19]

Ans: $V = 220\text{ V}$

$R = 440$

$I = ?$

$H = ?$

$V = IR$

$$I = \frac{V}{R}$$

$$= \frac{220}{440}$$

$$= \frac{1}{2} = 0.5\text{ A}$$

$I = 0.5\text{ A}$

$H = I^2Rt$

$$= (0.5)^2 \times 440 \times 20$$

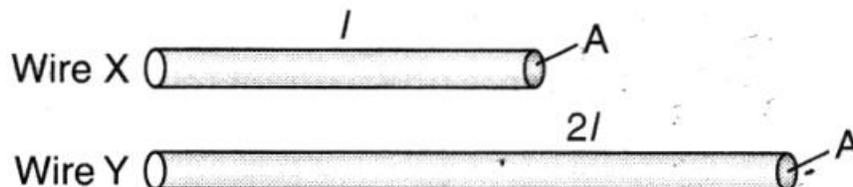
$H = 2200\text{ J}$

18. Explain two disadvantages of series arrangement for household circuit.

Ans: (i) Current is constant in series combination, so it impractical to connect a bulb and an electric heater in series.

(ii) When one component fails, the circuit is broken and none of the components work.

19. Out of the two wires X and Y shown below, which one has greater resistance & Justify your answer.



Ans: Wire Y, because $R \propto l$

Resistance of a conductor is directly proportional to the length of the conductor, whose area of cross-section is the same.

20. Explain the following:

[SSLC 2018-19, July]

(i) The elements of electric heating devices such as bread-toasters and electric iron are made of an alloy rather than of a pure metal.

(ii) Series arrangement is not used for domestic circuits.

(iii) Copper and aluminium wires are usually employed for electricity transmission.

- Ans:** (i) Resistivity of an alloy is generally higher and it does not oxidize easily.
(ii) In series arrangement, same current will flow through all the appliances which is not required and the equivalent resistance becomes higher, hence the current drawn becomes less.
(iii) They are extremely good conductors having a low value of resistivity.

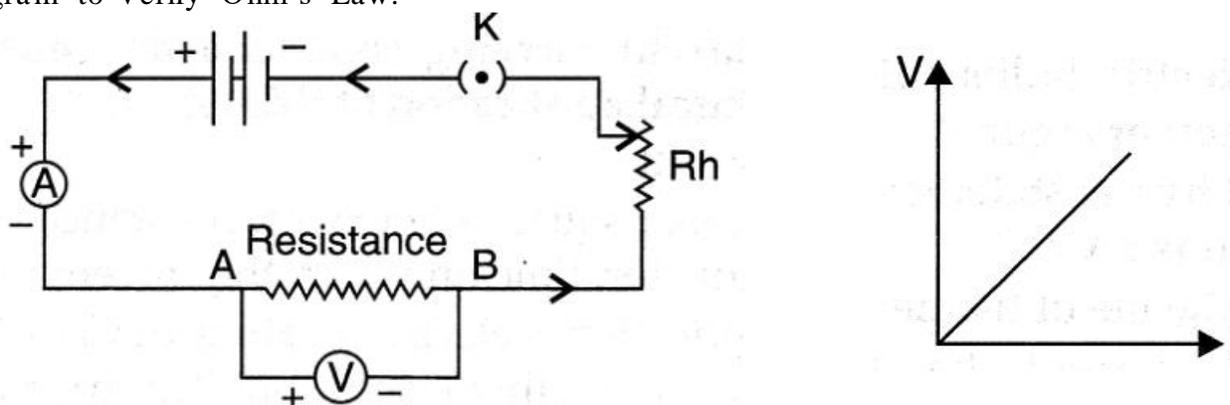
21. State Ohm's Law. Draw a circuit diagram to verify this law indicating the positive and negative terminals of the battery and the meters. Also show the direction of current in the circuit.

Ans: Ohm's Law: It states that "Physical conditions remaining same, the current flowing through a conductor is directly proportional to the potential difference across its two ends".

i.e $V \propto I$
 $V = IR$

where the constant of proportionality R is called the electrical resistance or resistance of the conductor.

Diagram to Verify Ohm's Law:



22. Two devices of ratings 44W; 200V and 11W; 220V are connected in series. The combination is connected across a 440V mains. The fuse of which of the two devices is likely to burn when switch is on? Justify your answer.

Ans: The fuse of device of rating 11W; 220V will burn.

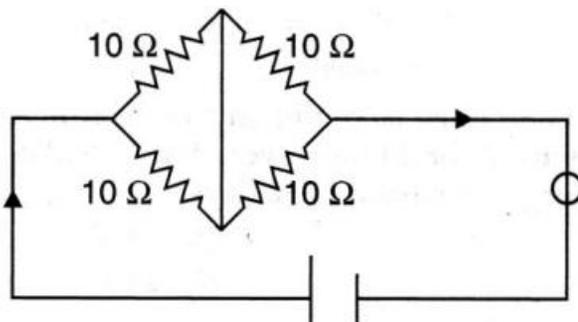
$R = \frac{V^2}{W}$ ∴ Resistance of 11W device will be four times than that of the device of 44W.

∴ Voltage across 11W = 352V

∴ Voltage across 44W = 88V

352V across the device of 11W; 220V rating is sufficient to burn the fuse of the device.

23. Find the current drawn from the battery by the network of four resistors shown in the figure.



Ans: Two combinations of two parallel resistors of 10 Ω each connected in series.

$$\frac{1}{R_5} = \frac{1}{R_1} + \frac{1}{R_1} = \frac{1}{10} + \frac{1}{10} = \frac{1+1}{10} = \frac{2}{10}$$

$$\frac{2}{10} = \frac{1}{5} \Omega$$

$$R_5 = 5 \Omega$$

$$\frac{1}{R_6} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{10} + \frac{1}{10} = \frac{1+1}{10} = \frac{2}{10}$$

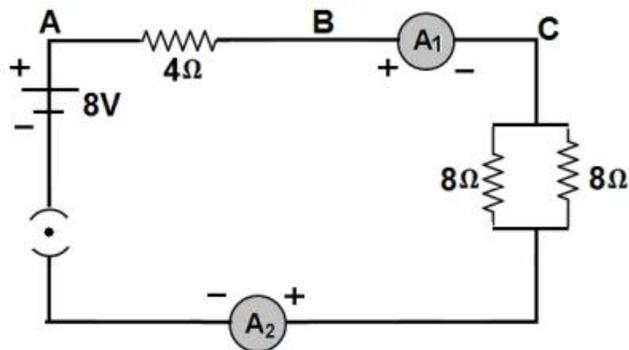
$$R_6 = 5 \Omega$$

$$R_{eq} = R_5 + R_6 = 5 \Omega + 5 \Omega = 10 \Omega$$

$$\text{Potential } V = 3 \text{ V}$$

$$I = \frac{V}{R} = \frac{3}{10} = 0.3 \text{ Amp}$$

24. Find out the following in the electric circuit given in the figure.



- (i) Effective resistance of two 8Ω resistors in the combination
- (ii) Current flowing through 4Ω resistor
- (iii) Potential difference across 4Ω resistor
- (iv) Power dissipated in 4Ω resistor
- (v) Difference in reading of ammeter A_1 and A_2 (if any).

Ans: (i) Effective resistance of two 8Ω resistors

$$\frac{1}{R} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8}$$

$$R = 4 \Omega$$

(ii) Current flowing through the circuit = current flowing through 4Ω

$$\begin{aligned} \text{Equivalent resistance of the circuit} &= 4 + 4 \\ &= 8 \Omega \end{aligned}$$

$$\text{Current flowing in the circuit} = \frac{V}{R} = \frac{8 \text{ V}}{8 \Omega} = 1 \text{ A}$$

(iii) Potential difference across $4 \Omega = V_1 = IR_1$

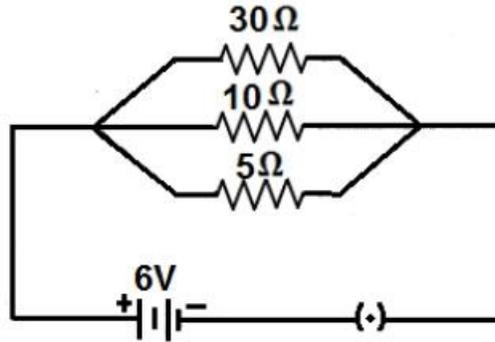
$$= 1 \text{ A} \times 4 \Omega = 4 \text{ V}$$

(iv) Power dissipated in $4 \Omega = P = VI = 4 \text{ V} \times 1 \text{ A}$

$$= 4 \text{ watt}$$

(v) Both A_1 and A_2 show same reading because current remains same in series combination.

25. Two wires X and Y are of equal length and have equal resistances. If the resistivity of X is more than that of Y, which wire is thicker and why? For the electric circuit given below calculate:



- (i) Current in each resistor
 (ii) Total current drawn from the battery and
 (iii) Equivalent resistance of circuit Ans. $V = IR$ wire A is thicker
Ans: $V = IR$ wire A is thicker

(i) For $30\ \Omega$, $I = \frac{6}{30} = \frac{1}{5}$ Ampere or 0.2 A

For $10\ \Omega$, $I = \frac{6}{10} = 0.6$ Ampere

For $5\ \Omega$, $I = \frac{6}{5} = 1.2$ Ampere

(ii) $\frac{1}{R} = \frac{1}{30} + \frac{1}{10} + \frac{1}{5} = \frac{1}{3} \Rightarrow R = 3$

$V = IR \Rightarrow I = \frac{V}{R} = \frac{6}{3} = 2$ Ampere

- (iii) Equivalent Resistance = 3

Textbook Exercises:

1. A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R' , then the ratio $\frac{R'}{R}$ is:

(a) $\frac{1}{25}$

(b) $\frac{1}{5}$

(c) 5

(d) 25

Ans: (d) 25

2. Which of the following terms does not represent electrical power in a circuit?

(a) I^2R

(b) IR^2

(c) VI

(d) $\frac{V^2}{R}$

Ans: IR^2

3. An electric bulb is rated 220V and 100 W. When it is operated on 110 V, the power consumed will be—

(a) 100W

(b) 75W

(c) 50W

(d) 25W

Ans: (d) 25 W

4. Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combination

(a) 1 : 2

(b) 2 : 1

(c) 1 : 4

(d) 4 : 1

Ans: (c) 1 : 4

5. How is a voltmeter connected in the circuit to 'measure the potential difference between two points?

Ans: Voltmeter is connected in parallel to the resistor.

6. A copper wire has diameter 0.5 mm and resistivity of $1.6 \times 10^{-8} \Omega \text{ m}$. What will be the length of this wire to make its resistance 10Ω ? How much does the resistance change if the diameter is doubled?

Ans: $d = 0.5 \text{ mm} = 0.5 \times 10^{-3} \text{ m}$; $\rho = 1.6 \times 10^{-8} \Omega \text{ m}$; $R = 10 \Omega$; $l = ?$

$$A = \frac{\pi d^2}{4}$$

$$R = \rho \frac{l}{A} \Rightarrow l = \frac{RA}{\rho} = \frac{R\pi d^2}{4\rho}$$

$$l = \frac{(10 \times 3.14 \times (0.5 \times 10^{-3})^2)}{4 \times 1.6 \times 10^{-8}} = 122.7 \text{ m}$$

$$R = \frac{4\rho l}{\pi d^2}$$

$$R \propto \frac{1}{d^2}$$

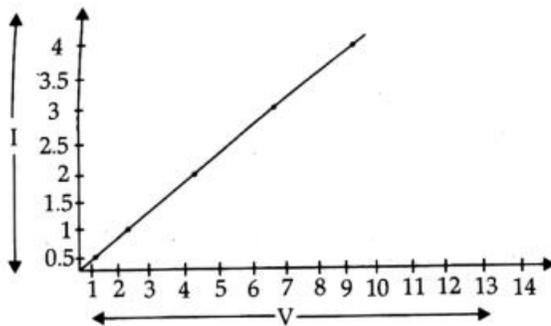
If diameter gets doubled, resistance will become $\frac{1}{4}$ time, i.e., $\frac{1}{4} \times 10 = 2.5 \Omega$.

7. The values of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below—

I (amperes)	0.5	1.0	2.0	3.0	4.0
V (volts)	1.6	3.4	6.7	10.2	13.2

Plot a graph between V and I and calculate the resistance of the resistor.

Ans:



$$R = \frac{V}{I} = \frac{13.2}{4} = 3.3 \Omega.$$

8. When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

Ans: $V = 12 \text{ V}$; $I = 2.5 \text{ mA} = 2.5 \times 10^{-3} \text{ A}$; $R = ?$

$$R = \frac{V}{I} = \frac{12}{2.5 \times 10^{-3}} = 4800 \Omega$$

9. A battery of 9 V is connected in series with of 0.2Ω , 0.3Ω , 0.4Ω , 0.5Ω , and 12Ω , respectively. How much current would flow through the 12Ω resistor?

Ans: $R = 0.2 + 0.3 + 0.4 + 0.5 + 12 = 13.4 \Omega$

$$I = \frac{V}{R} = \frac{9}{13.4} = 0.67 \text{ A}$$

Since, all resistors are in series hence the current in 12Ω resistor will also be 0.67 A .

10. How many 176Ω resistors (in parallel) are required to carry 5 A on a 220 V line?

Ans: $I = 5 \text{ A}$; $V = 220 \text{ V}$

$$R_p = \frac{V}{I} = \frac{220}{5} = 44 \Omega$$

Now, if n resistors, each of resistance 176Ω are connected in parallel to give equivalent resistance of 44Ω , i.e. R_p

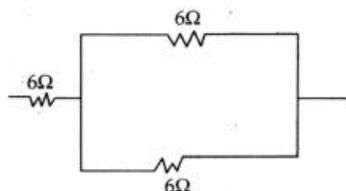
$$R_p = -$$

$$44 = \frac{176}{n}$$

$$= \frac{176}{44} = 4$$

11. Show how you would connect three resistors, each of resistors 6Ω , so that the combination has a resistance of (i) 9Ω , (ii) 4Ω .

Ans: (i)

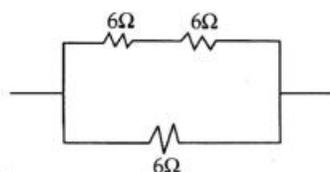


Parallel Combination of 6Ω and 6Ω

$$\frac{1}{R} = \frac{1}{6} + \frac{1}{6} = \frac{1+1}{6} = \frac{2}{6} = \frac{1}{3}$$

Resultant $3 \Omega + 6 \Omega = 9 \Omega$

(ii)



$$\text{Resultant} \Rightarrow \frac{1}{\frac{1}{12} + \frac{1}{6}} = \frac{1}{\frac{1+2}{12}} = \frac{12}{3} = 4$$

$$R = 4 \Omega$$

12. Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W . How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A ?

Ans: $V = 220 \text{ V}$; $P = 10 \text{ W}$;

$$P = \frac{V^2}{R}$$

$$R = \frac{V^2}{P} = \frac{220 \times 220}{10} = 4840 \Omega$$

$$V = IR$$

$$R_p = \frac{V}{I} = \frac{220}{5} = 44 \Omega$$

$$R_p = \frac{R}{n} \Rightarrow n = \frac{R}{R_p} = \frac{4840}{44} = 110$$

13. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Ans: $V = 220 \text{ V}$; $R = 24 \Omega$

(i) When two coils are connected separately

$$I = \frac{V}{R} = \frac{220}{24} = 9.2 \text{ A}$$

(ii) When two coils are connected in series

$$R_s = 24 + 24 = 48 \Omega$$

$$I = \frac{V}{R_s} = \frac{220}{48} = 4.6 \text{ A}$$

(iii) When two coils are connected in parallel, the resistance of the combination is

$$\frac{1}{R_P} = \frac{1}{24} + \frac{1}{24} = \frac{1+1}{24} = \frac{2}{24} = \frac{1}{12}$$

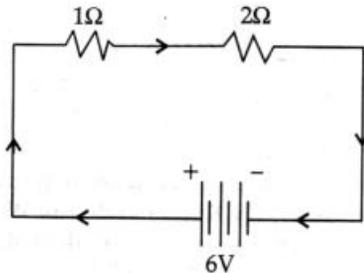
$$= 12\Omega$$

$$I = \frac{V}{R_P} = \frac{220}{12} = 18.3A$$

14. Compare the power used in the 2Ω resistor in each of the following circuits: (i) a 6 V battery in series with 1Ω and 2Ω resistors, and (ii) a 4 V battery in parallel with 12Ω and 2Ω resistors.

Ans:

(i)

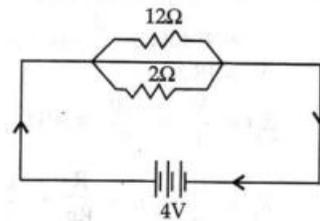


(ii) $R = 1 + 2 = 3\Omega$

$$I = \frac{4}{3} = 2A$$

$$P = I_2 R = (2)^2 \times 2 = 8W$$

$$P = \frac{V_2}{R} = \frac{(4)^2}{2} = 8W$$



15. Two lamps, one rated 100W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?

Ans: $P_1 = 100 W$ (For first lamp)

$$V = 220 V$$

$$P_1 = VI_1$$

$$I_1 = \frac{100}{220} = 0.45A$$

Current in second lamp of power $P_2 = 60 W$

$$I_2 = \frac{P_2}{V} = \frac{60}{220} = 0.27A$$

$$I = I_1 + I_2 = 0.45 + 0.27 = 0.72A$$

16. Which uses more energy, a 250 W TV set in 1 hr or a 1200 W toaster in 10 minutes?

Ans: For TV set $E = P \times t = 0.25 \times 1 = 0.25 \text{ kwh}$

For Toaster $E = 1.2 \times \frac{1}{6} = 0.2\text{kwh}$

\therefore TV set consumes more energy than a toaster.

17. An electric heater of resistance 8Ω draws 15 A from the service mains 2 hours. Calculate the rate at which heat is developed in the heater.

Ans: $R = 8\Omega$, $I = 15A$, $t = 2h = 2 \times 60 \times 60 \text{ s}$

$$H = I_2 R t = (15)^2 \times 8 \times 2 \times 60 \times 60$$

$$\text{Rate at which heat produced:} = \frac{H}{t} = \frac{(15)^2 \times 8 \times 2 \times 60 \times 60}{2 \times 60 \times 60} = 1800 W$$

18. Explain the following.

- (a) Why is the tungsten used almost exclusively for filament of electric lamps?
- (b) Why are the conductors of electric heating devices, such as bread-toaster and electric irons, made of an alloy rather than a pure metal?
- (c) Why is the series arrangement not used for domestic circuits?
- (d) How does the resistance of a wire vary with its area of cross-section?
- (e) Why are copper and aluminium wires usually employed for electricity transmission?

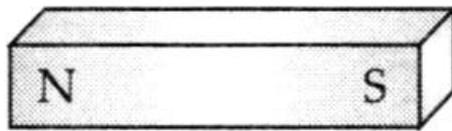
- Ans:** (a) Because tungsten is a metal of very high melting point and it does not oxidise even at high temperature.
- (b) As alloy has high melting point so it can be heated to a large amount till getting red hot without melting.
- (c) In series combination
- (i) Equivalent resistance is maximum, hence, less current flows in the circuit.
 - (ii) If one appliance is switched off then all other appliances will also stop working.
 - (iii) The voltage of external power supply is divided among the various appliances.
 - (iv) Same current flows in all appliances. Hence, high rating appliances can't draw more current from the circuit.
- (d) Resistance is inversely proportional with the cross-sectional area of wire, R
- (e) Because they have low resistivity.

13. MAGNETIC EFFECTS OF ELECTRIC CURRENT

- The black ore of iron (Fe_3O_4) called magnetite, capable of attracting similar pieces of iron is called lodestone. They are naturally existing magnets used by man to find the directions.
- There are two basic laws of magnetism. There are two poles of a magnet namely North pole and South pole. Like poles repel each other, while unlike poles attract each other.
- H.C. Oersted, a Danish physicist first noticed the magnetic effect of electric current. According to him, a needle kept near the wire carrying current will deflect due to the magnetic field produced. Any change in the direction of current will show variation in the deflection.
- Magnet is any substance that attracts iron or iron-like substances.

Properties of magnet

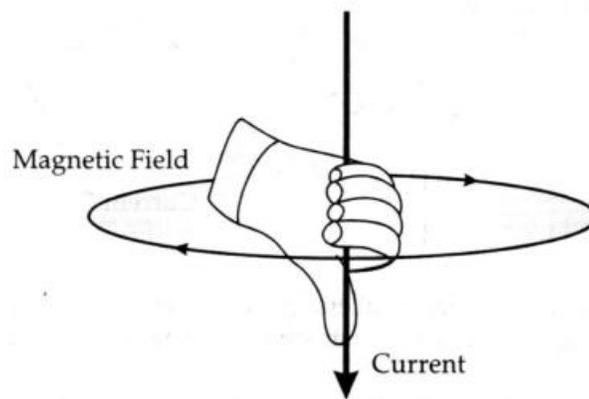
- Every magnet has two poles i.e., North and South.
- Like poles repel each other.
- Unlike poles attract each other.
- A freely suspended bar magnet aligns itself in nearly north-south direction, with its north pole towards north direction.



- The substances which are attracted by a magnet are called magnetic substances. Examples: Iron, nickel, cobalt, steel. The substances which are not attracted by a magnet are called non-magnetic substances. Examples wood, glass, copper, aluminium, brass, paper etc.
- **Magnetic Field:** The area around a magnet in which its magnetic force can be experienced
 - Its SI unit is tesla (T).
 - Magnetic field has both magnitude and direction.
 - Magnetic field can be described with help of a magnetic compass.
 - The needle of a magnetic compass is a freely suspended bar magnet.
- **Characteristics of Field Lines**
 - Field lines arise from North pole and end into South pole of the magnet.
 - Field lines are closed curves.
 - Field lines are closer in stronger magnetic field.
 - Field lines never intersect each other as for two lines to intersect, there must be two north directions at a point, which is not possible.
 - Direction of field lines inside a magnet is from South to North.
 - The relative strength of magnetic field is shown by degree of closeness of field lines.

Right Hand Thumb Rule

- Imagine you are holding a current carrying straight conductor in your right hand such that the thumb is pointing towards the direction of current. Then the fingers wrapped around the conductor give the direction of magnetic field.



Magnetic Field Due to Current Through a Straight Conductor

- It can be represented by concentric circles at every point on conductor.
- Direction can be given by right hand thumb rule or compass.
- Circles are closer near the conductor.
- Magnetic field \propto Strength of current
- Magnetic field $\propto \frac{1}{\text{Distance from conductor}}$

Magnetic Field Due to Current Through a Circular Loop

- It can be represented by concentric circle at every point.
- Circles become larger and larger as we move away.
- Every point on wire carrying current would give rise to magnetic field appearing as straight line at centre of the loop.
- The direction of magnetic field inside the loop is same.

Factors affecting magnetic field of a circular current carrying conductor

- Magnetic field \propto Current passing through the conductor

$$\text{Magnetic field} \propto \frac{1}{\text{Distance from conductor}}$$

$$\text{Magnetic field} \propto \text{No. of turns in the coil}$$

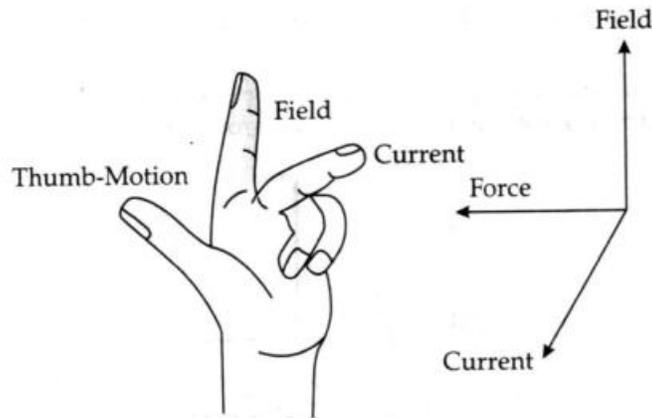
Magnetic field is additive in nature i.e., magnetic field of one loop adds up to magnetic field to another loop. This is because the current in each circular turn has some direction.

- A coil of large number of turns closely wound on a hollow cylinder of insulated material or otherwise is called a **solenoid**. The end of the solenoid having clockwise current will act as south pole-field enters into, while on the other hand having anti-clockwise current will act as north pole-field comes out. Thus, a solenoid acts as a normal magnet.
- **Permanent magnets** are made of carbon steel, chromium steel, tungsten steel and some alloys like Alnico and Nipermag. Alnico is an alloy of aluminium, nickel and cobalt.
- When a material is placed inside a coil carrying current, it will get magnetised. A bunch of nails or an iron rod placed along the axis of the coil can be magnetised by the current allowed to pass through the coil. Such magnets are called electromagnets.

- Ampere suggested that when a current I passes through a conductor of length l placed in a perpendicular magnetic field B , then the force experienced is given by $F = IBl \sin\theta$, where θ is the angle between the length of the conductor and magnetic field.

Fleming's Left Hand Rule

- Stretch the thumb, fore finger and middle finger of your left hand such that they are mutually perpendicular. If fore finger points in the direction of magnetic field, middle finger in the direction of current then thumb will point in the direction of motion or force.

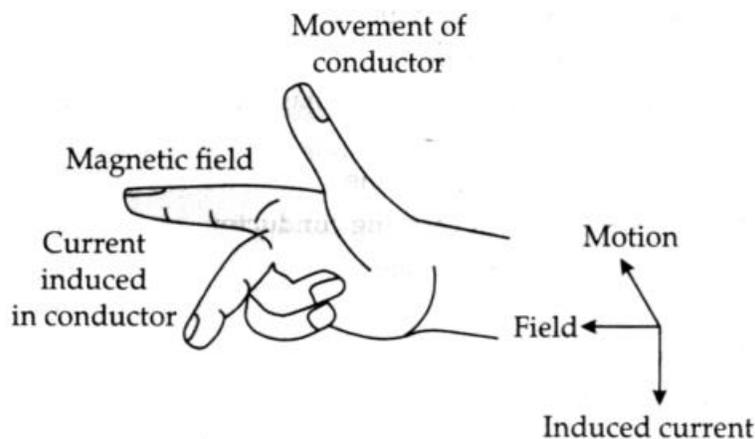


- **Electric motor** is a device used to convert electrical energy to mechanical energy. It works on the principle of force experienced by a current carrying conductor in a magnetic field. The two forces in the opposite sides are equal and opposite.
- **Faraday's Law:** The rate at which the magnetic flux linked with a coil changes, produces the induced emf or current. More the rate, more the current and vice-versa.

$$I = \frac{e}{R \times t} = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}}$$

Fleming's Right Hand Rule

- Hold the thumb, the fore finger and the middle finger of right hand at right angles to each other. If the fore finger is in the direction of magnetic field and the thumb points in the direction of motion of conductor, then the direction of induced current is indicated by middle finger.
 - Working principle of electric generator.
 - Used to find direction of induced current.



- Generator works on the principle of Electromagnetic Induction. It converts the mechanical energy available into electrical energy. A.C. Generator produces potential which reverses after every 180° rotation of the coil. D.C. Generator means the generator which produces unidirectional current.

Domestic Electric Circuits

- An electric circuit consist of three main wiring components:
 - (i) Live wire (positive) with red insulation cover.
 - (ii) Neutral wire (negative) with black insulation cover.
 - (iii) Earth wire with green insulation cover.
- The potential difference between live and neutral wire in India is 220 V.
- Pole → Main supply → Fuse → Electricity meter → Distribution box → To separate circuits.

Know the Terms

- When a bar magnet is placed on a cardboard and iron-filings are sprinkled, they will arrange themselves in a pattern of lines known as **magnetic field lines**.
- The area around a magnet in which its effect can be experienced is called **magnetic field**
- When electric current flows through a conductor, a magnetic field is produced around it. This is called **magnetic effect of current**.
- An **electromagnet** is a solenoid coil that attains magnetism due to the flow of current. It works on the principle of magnetic effect of current.
- The production of electric current due to relative motion between a conductor and a magnetic field is called **electromagnetic induction**. Electric current produced due to this phenomenon is called **induced current**.
- When the current flowing through a coil changes, then the current is induced in the coil itself. This phenomena is called **self induction**.
- **Magnetic flux** is defined as the product of the magnetic field and the area through which magnetic field passes perpendicularly. $\phi = NBA$, when field passes perpendicular to the plane of the coil. It is measured in weber. If B and A are at angle θ $\phi = NBA \cos \theta$, where N is the number of turns.
- If the current always flows in the same direction, it is called **direct current**. DC can be obtained from a cell or a battery. The positive and negative polarities of DC are fixed.
- If the current changes direction after equal intervals of time it is called **alternating current**. The positive and negative polarities of AC are not fixed.
- Connecting the outer frame of an appliance to earth to avoid any shock caused by fault or current leakage is called **earthing**.
- The coil having many turns used in electric motor or generator is called armature.
- **Fuse** is a safety device commonly used in electric circuits. It is connected in the live wire

Questions:

1. The magnetic is effect of current was discovered by:
(a) Faraday (b) Henry (c) Oersted (d) Maxwell

Ans: (c) Oersted

2. Match the column below:

Column A	Column B
1. Concentric field lines are seen	(a) Electromagnet
2. Force experienced by a moving charge	(b) around a straight current carrying wire
3. Moving charge	(c) $\sin \theta$
4. Soft iron	(d) produce magnetic field

Ans: 1. (b), 2. (c), 3. (d), 4. (a).

3. Why does a compass needle show deflection when brought near a current carrying conductor?

Ans: Due to production of magnetic field around the current carrying conductor.

4. State the observation made by Oersted on the basis of his experiment with current carrying conductors.

Ans: Every current carrying conductor has a magnetic field around it.

5. How will the magnetic field intensity at the centre of a circular coil carrying current change, if the current through the coil is doubled and the radius of the coil is halved?

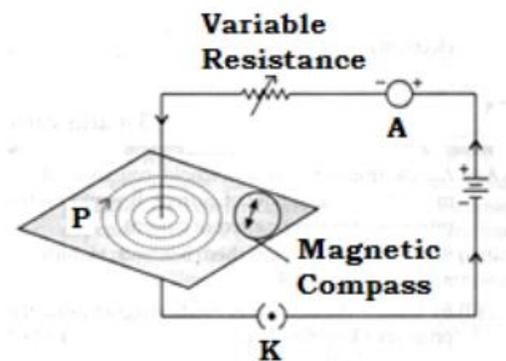
Ans: Magnetic field at centre of a coil, $B \propto \frac{I}{R}$, when current I is doubled and radius R is halved; the magnetic field becomes four times the original field.

6. Name and state the rule which determine the direction of magnetic field around a straight current carrying conductor.

Ans: Right Hand Thumb Rule: Imagine holding the current carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then the fingers of right hand wrap around the conductor in the direction of field lines of the magnetic field.

7. Draw magnetic field lines produced around a current carrying straight conductor passing through cardboard. How will the strength of the magnetic field change, when the point where magnetic field is to be determined, is moved away from the straight wire carrying constant current? Justify your answer.

Ans: Using compass needle. When we move away from the straight wire, the deflection of the needle decreases which implies the decreasing strength of the magnetic field.



8. In the experiment to show that a current carrying conductor when placed in the uniform magnetic field experiences a force. What happens when:

(i) You reverse the terminals of the battery?

(ii) The direction of current is perpendicular to the direction of magnetic field? State your observation.

Ans: (i) On reversing the terminals of the battery, the deflection of rod will be in opposite direction.

(ii) When the direction of current is perpendicular to the direction of magnetic field, then the rod will experience maximum force.

9. (i) What is meant by a magnetic field? Mention two parameters that are necessary to describe it completely.

(ii) If field lines of a magnetic field are crossed at a point, what does it indicate?

Ans: (i) The space around the magnet or current carrying conductor within which its influence can be felt by the magnetic substance is known as magnetic field. Magnitude and direction.

(ii) It would mean that at the point of intersection, compass needle would point to two directions which is impossible.

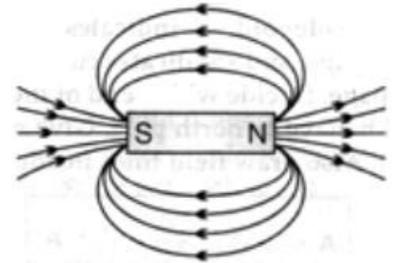
10. Name, state and explain with an example the rule used to determine the direction of force experienced by a current carrying conductor placed in a uniform magnetic field.

Ans: Fleming's Left Hand Rule: The direction of force which acts on the current carrying conductor placed in a magnetic field is given by Fleming's left hand rule. It states that if the forefinger, thumb and middle finger of left hand are stretched mutually perpendicular and the forefinger point along the direction of external magnetic field, middle finger indicates the direction of current, then thumb points along the direction of force acting on the conductor.

Example: When an electron enters a magnetic field at right angles, the direction of force on electron is perpendicular to the direction of magnetic field and current according to this rule.

11. Draw a diagram to show the magnetic field lines around a bar magnet. List any two properties of magnetic field lines.

Ans: (i) Two magnetic field lines never intersect each other.
(ii) Outside the magnet, the magnetic field lines are directed from North pole of magnet towards South pole.



12. Explain whether an alpha particle will experience any force in a magnetic field if:

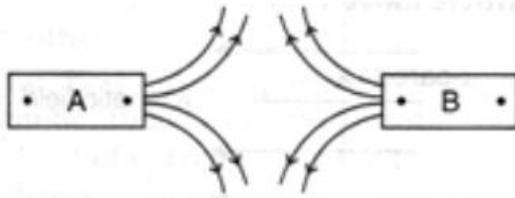
- (i) it is placed in the field at rest.
- (ii) it moves in the magnetic field parallel to field lines.
- (iii) it moves in the magnetic field perpendicular to field lines.

Ans: (i) No, because, a charged particle at rest does not interact with magnetic field.

(ii) No, because, the force is zero if current and field are in the same direction.

(iii) Yes, because, the force is maximum when current and magnetic field are maximum.

13. (a) Magnetic field lines of two bar magnets A and B are as shown below. Name the poles of the magnets facing each other.



(b) Two magnetic field lines never intersect each other. Why?

(c) How does the strength of the magnetic field at the centre of a current carrying circular coil depend on the

(i) radius of the coil, (ii) number of turns in the coil, and (iii) strength of the current flowing in the coil?

Ans: (a) North poles.

(b) Intersection of magnetic field lines at a point means that the compass needle would point towards two directions at that point, which is not possible.

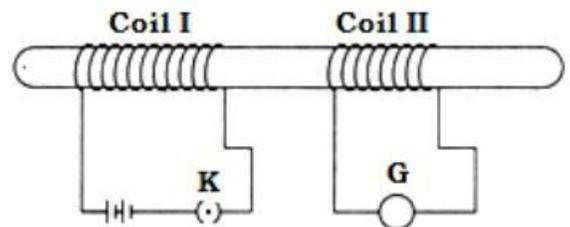
(c) (i) Inversely proportional; more radius less strong magnetic field.

(ii) Directly proportional; more turns more strong magnetic field.

(iii) Directly proportional; more strength of current more strong magnetic field.

14. Two coils of insulated copper wire are wound over a non conducting cylinder as shown. Coil I has larger number of turns.

- (i) Write your observations when,
 - (a) key K is closed;
 - (b) key K is opened;



17. In Fleming's right hand rule, middle finger indicates the direction of: [SSLC April, 2016]

- (a) magnetic field (b) induced electric current
(c) mechanical energy (d) motion of the conductor

Ans: (b) induced electric current

18. Name the device used to prevent damage to the electrical appliances and the domestic circuit due to overloading.

Ans: Electric fuse.

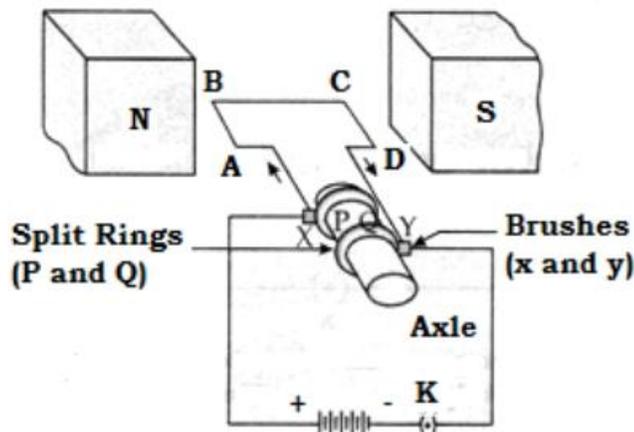
19. Draw the diagram of an electric motor and label the following parts.

(i) Split rings

(b) Brushes

[SSLC July, 2018-19]

Ans:



20. Mention the provision of two different current ratings in our domestic circuits. Explain with reason, the advantage of such a provision.

Ans: The two different current ratings provided in domestic circuits are 5A and 15A. This is because different electrical appliances have different power ratings, so they draw different currents when connected in the mains. Some appliances need smaller currents, while some other need heavy currents.

21. State Faraday's laws of electromagnetic induction.

[SSLC June, 2016]

Ans: **I Law:** Whenever a magnetic field linked with a conductor changes, an induced e.m.f. of is generated in the conductor.

II Law: The magnitude of induced e.m.f of is directly proportional to the rate of change of magnetic field.

22. Distinguish between alternating current and direct current. Explain why alternating current is preferred over direct current for transmission over long distances.

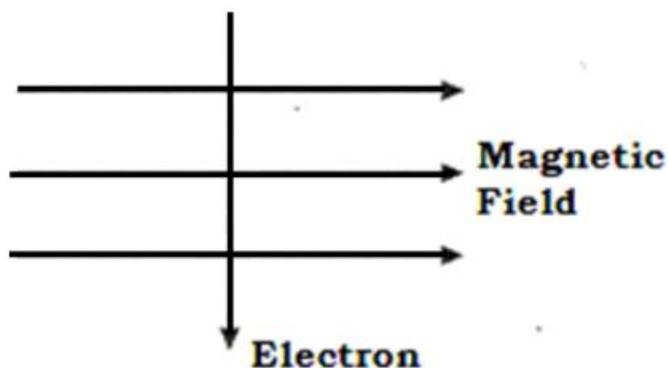
Ans: **Alternating Current:** If the current changes direction after equal intervals of time, it is called alternating current. The positive and negative polarities of AC are not fixed.

Direct Current: If the current always flows in the same direction, it is called direct current. It can be obtained from a cell or a battery.

The positive and negative polarities of DC are fixed for long distance transmission. AC is preferred as it causes minimum loss of energy during transmission.

23. An electron enters a magnetic field at right angles to it as shown in fig. The direction of the force acting on the electron will be:

- (a) to the right, (b) to the left, (c) out of the page, (d) into the page.



Ans: When a force conductor carrying current is placed perpendicular to the direction of magnetic field, the magnetic field acting on it is given by Fleming's left hand rule. Since the direction of current is the same as that of the motion of a positive charge, the direction of force acting on it when moving perpendicular to the direction of magnetic field is the same as that acting on a current-carrying conductor placed perpendicular to the direction of magnetic field. Obviously, the force acting on an electron is opposite to that. Therefore in this case it is into the page.

24. (i) Define electromagnetic induction. [SSLC July, 2018-19]

- (ii) Two coils P and S are wound over the same iron core. Coil P is connected to battery and key and the coil S is connected to galvanometer. Write your observations when:
- Current in the coil P is started by closing the key.
 - Current continues to flow in coil P.
 - Current in coil P is stopped by removing the key. Explain the reason for such observation.

Ans: (i) **Electromagnetic Induction:** The process by which a change in magnetic field in a conductor induces a current in another conductor.

- (ii) (a) There is deflection in galvanometer connected with coils, due to induced current.
 (b) Deflection becomes zero.
 (c) Deflection in galvanometer is in opposite direction.

Reason:

- E.M. induction takes place because field is changing.
- Since current becomes stationary, no change in field takes place. So no EM induction.
- E.M. induction takes place but induced current is in opposite direction.

25. (i) Explain what is the difference between a direct current and an alternating current. Write one important advantage of using alternating current.

- (ii) An air conditioner of 2kW is used in an electric circuit having a fuse of 10A rating. If the potential difference of the supply is 220 V, will the fuse be able to withstand, when the air conditioner is switched on? Justify your answer.

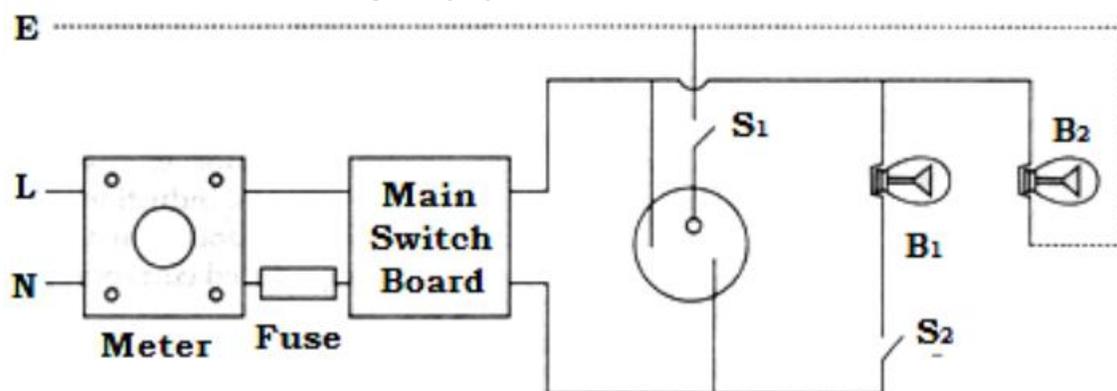
Ans: (i) The current whose direction gets reversed after every half cycle is called an alternating current or AC. There is no change in the direction of DC. The most important advantage of using AC over DC is that in the AC mode electric power can be transmitted over long distances with less loss of power.

(ii) Here $P = 2\text{kW} = 2000\text{W}$, $V = 220\text{ Volt}$

$$P = VI, \text{ the current } I = \frac{P}{V} = \frac{2000}{220} = 9.09 \text{ A}$$

As the current is 9.09 A, below the rating of fuse, the fuse will withstand i.e., it will not blow off when AC is on.

26. (i) The given figure shows a domestic electric circuit. Study this circuit carefully. List any two errors in the circuit and justify your answer.



- (ii) Give one difference between the wires used in the element of an electric heater and in a fuse.
 (iii) List two advantages of parallel connection over series connection.

Ans: (i) Two errors are:

- (a) Fuse is incorrectly connected to the neutral wire (N), it must be connected to the live wire (L).
 (b) Bulb B2 is not connected to the neutral, wire.
 (c) Two switches S1 and S2 in both B1 circuit and no switch in bulb B2 circuit.

- (ii) Element of electric heater - high melting point
 Element of fuse wire - low melting point

- (iii) (a) Each appliance has equal potential difference.
 (b) Each appliance has separate switch to ON/OFF the flow of current through it.

27. Why don't two magnetic lines of force intersect each other?

Ans: Magnetic field lines do not intersect each other because there can't be two directions of magnetic field at any one point.

28. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

Ans: Current in the coil is clockwise. Using right hand thumb rule at every point of the wire, the direction of magnetic field inside the loop is found to be into the plane of table and outside the loop as out from the plane of table.

29. An electric oven of 2 KW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

Ans: $P = 2\text{KW} = 2000\text{W}$, $V = 220\text{V}$

$$P = VI$$

$$I = \frac{P}{V} = \frac{2000}{220} = 9.091\text{ A}$$

The circuit will break and the fuse will blow off.

30. What precaution should be taken to avoid the overloading of domestic electric circuits?

Ans: Provide fuses with proper rating and do not connect appliances exceeding the total load capacity of the circuit.

Textbook Exercises:

- Which of the following correctly describes the magnetic field near a long straight wire?
 - The field consists of straight lines perpendicular to the wire.
 - The field consists of straight lines parallel to the wire.
 - The field consists of radial lines originating from the wire.
 - The field consists of concentric circles centred on the wire.

Ans: (d) The field consists of concentric circles centred on the wire.
- The phenomenon of electromagnetic induction is
 - The process of charging a body.
 - The process of generating magnetic field due to a current passing through a coil.
 - Producing induced current in a coil due to relative motion between a magnet and the coil.
 - The process of rotating a coil of an electric motor.

Ans: (c) Producing induced current in a coil due to relative motion between a magnet and the coil.
- The device used for producing electric current is called a
 - generator
 - galvanometer
 - ammeter
 - motor.

Ans: (c) ammeter
- The essential difference between AC generator and a DC generator is that
 - AC generator has an electromagnet while a DC generator has permanent magnet
 - DC generator will generate a higher voltage
 - AC generator will generate a higher voltage
 - AC generator has slip rings while the D.C generator has a commutator.

Ans: (d) AC generator has slip rings while the DC generator has a commutator.
- At the time of short-circuit, the current in the circuit
 - reduces substantially
 - does not change
 - increases heavily
 - varies continuously

Ans: (c) increases heavily.
- State whether the following statements are true or false.
 - An electric motor converts mechanical energy into electrical energy:
 - An electric generator works on the principle of electromagnetic induction.
 - The field at the centre of a long circular coil carrying current will be parallel straight lines.
 - A wire with a green insulation is usually the live wire.

Ans: (a) False: An electric motor converts electric energy into mechanical energy.
(b) True
(c) True
(d) False: A wire with a green insulation is usually the earth wire.
- List two methods of producing magnetic fields.

Ans: Magnetic field can be produced by
 - a natural magnet
 - a current carrying conductors
- How does a solenoid behave like a magnet? Can you determine the north and south poles of a current solenoid with the help of a bar magnet? Explain.

Ans: Current carrying solenoid behaves as a magnet. The end in which the current is anti clockwise acts as north pole and other end in which current is clockwise acts as south pole.

Suspend a current carrying solenoid. Bring North Pole of the bar magnet towards one end of the solenoid. If the solenoid is attracted towards its north pole then this end of solenoid is south pole and vice-versa.

9. When is the force experienced by a current – carrying conductor, placed in a magnetic field largest?

Ans: When the conductor is placed perpendicular to the direction of magnetic field.

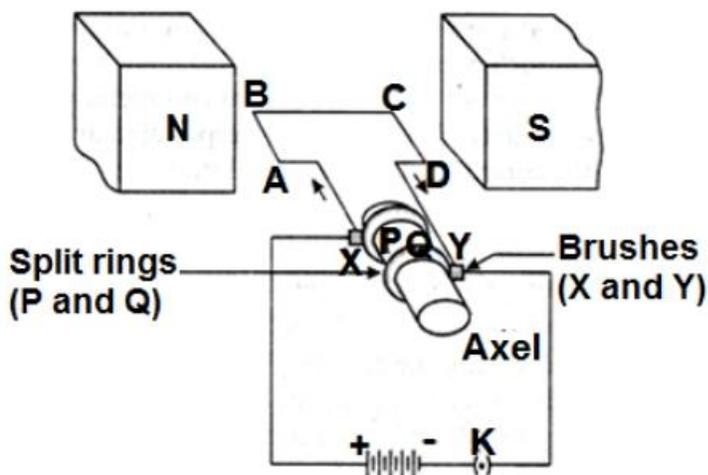
10. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

Ans: Vertically downwards.

11. Draw a labelled diagram of an electric motor. Explain its principle and working. What is the function of a split ring in an electric motor?

Ans: Principle of Electric Motor: A current-carrying conductor, when placed in a magnetic field, experiences a force. If the direction of the field and that of the current are mutually perpendicular then force acting on the conductor will be perpendicular to both and will be given by Fleming's left-hand rule. Due to this force the conductor begins to move.

Working of Electric Motor: Current in the coil ABCD enters from the source battery through conducting brush X and flows back to the battery through brush Y. The current in arm AB of the coil flows from A to B. In arm CD it flows from C to D, that is, opposite to the direction of current through arm AB. We find that the force acting on arm AB pushes it downwards while the force acting on arm CD pushes it upwards. Thus the coil and



the axle O, mounted free turn about an axis, rotate anticlockwise. At half rotation, Q makes contact with the brush X and P with brush Y. Therefore the current in the coil gets reversed and flows along the path DCBA. The reversal of current also reverses the direction of force acting on the two arms AB and CD. Thus the arm AB of the coil that was earlier pushed down is now pushed up and the arm CD previously pushed up is now pushed down. Therefore the coil and the axle rotate half a turn more in the same direction. The reversing of the current is repeated at each half rotation, giving rise to a continuous rotation of the coil and to the axle.

Role of split ring: To change the direction of current flowing through the coil after each half rotation.

12. Name some devices in which electric motors are used.

Ans: Electric fans, water-pumps, coolers, refrigerators, mixers, blenders, washing machines.

13. A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is (i) pushed into the coil, (ii) withdrawn from inside the coil, (iii) held stationary inside the coil?

Ans: (i) When a bar magnet is pushed into the coil of insulated copper wire connected to a galvanometer, an induced current is set-up in the coil due to change of magnetic field through it. As a result, galvanometer gives a deflection (say towards left).

(ii) When the bar magnet is withdrawn from inside the coil, again an induced current is set up in the coil due to change of magnetic field through it. As a result galvanometer gives a deflection in the reverse direction. (say towards right).

(iii) If the bar magnet is held stationary inside the coil, then there is no induced current in the coil, because there is no change in magnetic field through it. As a result, galvanometer does not show any deflection.

- 14.** Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

Ans: Due to change in magnetic field, an electric current is induced in coil B.

- 15.** State the rule to determine the direction of a (i) magnetic field produced around a straight conductor- carrying current, (ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it and (iii) current induced in a coil due to its rotation in a magnetic field.

Ans: (i) Right hand thumb rule

(ii) Fleming's left hand rule

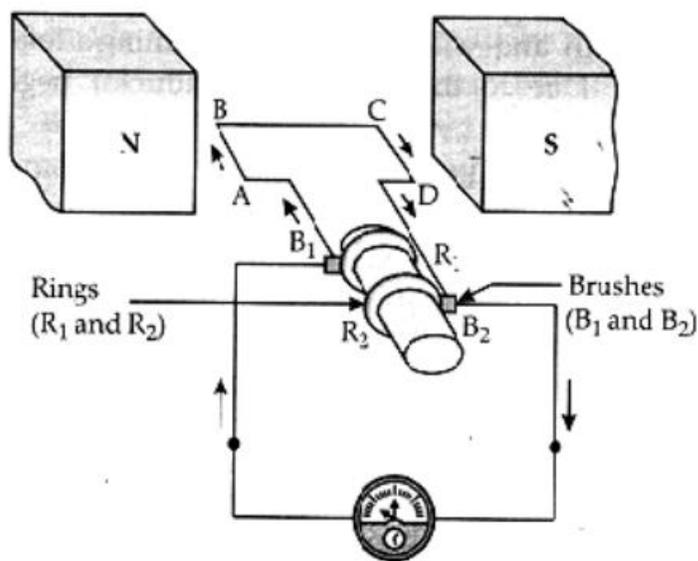
(iii) Fleming's right hand rule

- 16.** Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

Ans: An electric generator works on the principle of electromagnetic induction. According to it, whenever a coil is rotated between the poles of a magnet, an induced current is set up in the coil, whose direction is given by Fleming's right-hand rule.

Working: When the axle attached to the two rings is rotated such that the arm AB moves up (and the arm CD moves down) in the magnetic field produced by the permanent magnet. The coil ABCD is rotated clockwise in the arrangement. By applying Fleming's right-hand rule, the induced currents are set up in these arms along the directions AB and CD. Thus an induced current flows in the direction ABCD. If there are larger numbers of turns in the coil, the current generated in each turn adds up to give a large current through the coil. This means that the current in the external circuit flows from B₂ to B₁. After half a rotation, arm CD starts moving up and AB moving down. As a result, the directions of the induced currents in both the arms change, giving rise to the net induced current in the direction DCBA. The current in the external circuit now flows from B₁ to B₂. Thus after every half rotation the polarity of the current in the respective arms changes. Such a current, which changes direction after equal intervals of time, is called an alternating current (abbreviated as AC). This device is called an AC generator.

Function of brushes: It helps in transferring current from the coil ABCD to the external circuit.



17. When does an electric short circuit occur?

Ans: When live wire and neutral wire may come in direct contact or insulation of wires used in an electrical circuit is damaged or there is a fault in the appliance, then the current in the circuit abruptly rises and short-circuiting occurs.

18. What is the function of an earth wire? Why is it necessary to earth metallic appliances?

Ans: The metallic body of electric appliances is connected to the earth by means of earth wire so that any leakage of electric current is transferred to the ground. This prevents any electric shock to the user.

14. SOURCES OF ENERGY

Quick Review

- Any system from where energy can be trapped is called a source of energy. Source of energy is capable of providing adequate amount of energy. It should be convenient to use and easy to store and transport.
- **Law of conservation of energy:** Energy can neither be created nor be destroyed, but can be transformed from one form to another.
- **Qualities of a Good Source of Energy:**
 - (i) Which would do a large amount of work unit mass.
 - (ii) Cheap and easily available.
 - (iii) Easy to store and transport.
 - (iv) Safe to handle and use.
 - (v) Does not cause environmental pollution.
- **Fuel:** The material which are burnt to produce heat energy are known as fuels. E.g., wood, coal, LPG, kerosene.
- **Characteristics of a Good Fuel:**
 - (i) High calorific value (give more heat per unit mass).
 - (ii) Burn without giving out any smoke or harmful gases.
 - (iii) Proper ignition temperature.
 - (iv) Easy to handle, safe to transport.
 - (v) Convenient to store.
 - (vi) Burn smoothly.

Sources of Energy

S. No.	Conventional Sources of Energy	Non-conventional Sources of Energy
(a)	Fossil fuels (Coal, Petroleum)	Solar energy (e.g, solar cooker, solar cell panel)
(b)	Thermal power plant	Energy from the sea (tidal wave, OT energy)
(c)	Hydro power plants	Biomass-plant
(d)	Geothermal energy	Nuclear energy

Conventional Sources of Energy

- Sources of energy which are known to most of the people e.g., fossil fuels, biomass etc.

I. Fossil Fuels:

- Fuels developed from the fossils e.g., coal, petroleum.
- Take million of years to form.
- Available in very limited amount.
- These are non-renewable sources of energy.
- India has about 60% share in the world reserved coal, that may last 250 years more at the present rate of consumption.
- In power stations, one needs energy to run turbines. Large quantity of fossil fuels like coal are burnt to produce heat energy. This produces steam which is used to rotate turbines to produce electricity. The flow of energy is as listed below

Fossil fuels—Heat Energy—Mechanical Energy—Electrical Energy.

- The energy of water flowing through rivers or stored in dam is another potential source of energy. It is also indirect source of solar energy. It is the solar energy which recycles water in nature from oceans and the earth's surface through rain and snow. The energy of water flowing through rivers has been used for rotating the wheels of watermills which are still operating in remote hilly areas.
- The material contained in the bodies of plants and animals is called biomass. It act as a fuel. It includes waste from tree and grass crops, forestry agricultural and urban wastes. The excreta of living organisms and their bodies after death also contribute to the biomass.
- The dead part of plants and trees and the waste materials of animals and man are called Biomass.

(1) Wood: It is a biomass and used as a fuel for a long time.

Disadvantages:

- Produces a lot of smoke on burning.
- Do not produce much heat.

(2) Charcoal: When wood is burnt in limited supply of air, then water and other volatile materials gets removed and charcoal is formed.

Wood \rightarrow Limited Supply of O₂ Charcoal

Charcoal is better fuel than wood because:

- (i) It has higher calorific value than wood.
- (ii) Does not produce smoke while burning.
- (iii) It is a compact fuel, easy to handle and convenient to use.

(3) Cowdung: It is a biomass but it is not good to burn cowdung directly as fuel because:

- It produces lot of smoke.
- Cowdung does not burn completely, produces lot of ash as residue.
- Low calorific value.
- By making bio gas (or gobar gas) from cow dung, we get a smokeless fuel.

(4) Bio gas: It is produced in a biogas plant. Anaerobic micro organisms decomposes the complex compound of the cow dung + water slurry. It takes few day for the decomposition process and generate gases like methane, CO₂, hydrogen and hydrogen sulphide. Bio gas is stored in the gas tank above the digester from which they are drawn through pipes of use.

Alternate or Non-conventional Sources of Energy

- Day by day, our demand for energy is increasing, so there is a need for another sources of energy.

Reasons for alternate source of energy

- (i) The fossil fuel reserves in the earth are limited which may get exhausted soon if we use them at the current rate.
- (ii) To reduce the pressure on fossil fuels making them last for a much longer time.
- (iii) To reduce the pollution level and to save the environment.

I. Solar Energy:

- Sun is the ultimate source of energy.
- Energy obtained from the sun is called solar energy.
Solar constant = 1.4 KJ/s/m^2
Outer edge of the earth receives solar energy equal to 1.4 KJ/s/m^2 or 1.4 KW/m^2 [$1 \text{ KJ/s} = 1 \text{ KW}$]
- Electrical energy is one of the widely used energies. It is generated by harnessing different sources of energy. In any conventional power plant, turbines of generators are rotated by using steam arrived by heating water from one source of energy.
- Indirectly or directly all forms of energy originate from the solar energy. Besides heat energy, ultraviolet, gamma rays and visible light also come from solar energy.
- Solar cell is a device which converts solar energy i.e., light energy directly into electricity. They are made up of semi-conductors like—silicon, germanium and selenium.
- **Solar cell panel** comprises of a large number of solar cells and can provide much higher power for many uses.
- The blowing wind has energy which is called wind energy. Wind is associated with kinetic energy. Solar energy is responsible for the blowing of the wind. The three factors which help in blowing of wind are:
 - (i) The uneven heating of equatorial region and polar region of earth by sun rays.
 - (ii) Rotation of earth.
 - (iii) Local conditions.
- **Ocean Thermal Energy (OTE):** There is always a temperature difference between water at the surface and at deeper level up to 20°C . This form of energy is called ocean thermal energy which can be converted into electricity.
- Energy from oceans is also available in the form of sea-waves. Due to blowing of wind on the surface of ocean, very fast sea-waves move on its surface. It has lot of kinetic energy due to high speed.
- The rise of ocean water due to attraction of moon is called 'high tides' whereas fall of ocean water is called 'low tides'. The tidal waves rise and fall twice a day. Tidal energy can be harnessed by constructing a tidal barrage or tidal dam.
- The heat from inside the earth heats up the water below the surface. This hot water can be used under favourable conditions as a source of energy. This energy with hot water below the earth is called geothermal energy.
- Atomic mass unit is defined as $\frac{1}{12}$ th of the mass of carbon atom ^{12}C $1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$
- Unit for energy is associated with electrons accelerated through a potential of 1 volt.
 $1 \text{ eV} = 1.6 \times 10^{-19} \text{ joule}$, $1 \text{ MeV} = 1.6 \times 10^{-13} \text{ joule}$

- According to Einstein, the mass and energy are inter-convertible. They are related by the relation $E = mc^2$, where c is the velocity of light. ($3 \times 10^8 \text{ ms}^{-1}$)
- When nuclear fission reaction takes place, it also releases neutrons which are capable of creating further fission. For continuous production of energy, fission should be continuous. The neutrons released are made to bombard other uranium nuclei to produce more fission. Such self-sustained reactions are called chain reactions.
- In order to make a chain reaction possible there should exist sufficient ^{235}U nuclei. The minimum mass of fissionable material required in order to make a chain reaction possible is called critical mass.

Know the Terms

- The fuels which are obtained from the remains of plants and animals are called fossil fuels, e.g., coal, petroleum and natural gas.
- The material contained in the bodies of plants and animals is called biomass. It acts as a fuel.
- **Bagasse** is the residue of sugarcane after extracting (taking out) juice from them. It is used as fuel in industries.
- **Conventional or Non-Renewable Sources:** Energy sources which are used traditionally for many years and are to deplete over a period of time are called conventional or non-renewable sources. e.g., coal, petroleum, natural gas etc.
- **Non-Conventional or Renewable Sources:** Energy sources which do not deplete and are scarcely used by the population are called non-conventional or renewable sources e.g., Solar energy, wind energy etc.
- The amount of solar energy received per square meter per second on the surface of earth is called solar constant. It is approximately $1.4 \text{ (kJ/m}^2\text{s)}$.
- **Wavelength:** Length of a wave or separation between two points in successive waves which are in same phase is called wavelength. It is expressed in meter. λ
- **Frequency:** The number of wave motions in one second is called frequency. It is expressed in Hertz (Hz).
- The light of wavelength which is greater than the wavelength of red are called Infra-red (IR) radiations. They are not visible to human eye but have the property to heat the bodies on its way. All hot bodies radiate infra-red radiations.
- **Semiconductors** are those substances which have very low electrical conductivity. They are between the good conductors and insulators. If certain impurities are added, their electrical conductivity is increased when sunlight falls on semi-conducting material, their conductance increases.
- An electric motor is a rotating device that converts electrical energy to mechanical energy.
- A generator is the machine that converts mechanical energy into electrical energy. It works on the basis of electromagnetic induction.
- The concentration of salts in water of different seas is different. The difference in concentration of salts in the water of two different seas is called '**salinity gradient**'.
- The projectile (say neutron) should have some minimum energy, in order to create fission. This minimum energy is called **threshold energy**.
- There action in which a heavy nucleus splits into two or more smaller nucleus, with the evolution of large amount of energy when it is bombarded with slow moving neutron is called **nuclear fission**.

- A nuclear reaction in which the bombarding particle is obtained as one of the product, due to which the reaction once initiated proceeds on its own is called a **chain reaction**.
- In order to make a chain reaction possible there should exist sufficient ^{235}U nuclei. The minimum mass of fissionable material required in order to make a chain reaction possible is called **Critical mass**. The Critical mass of ^{235}U is approximately 1 kg.
- A reaction in which two or more lighter nuclei fuse to form a heavy nucleus and large amount of energy is given out is called nuclear **fusion reaction**.
- The phenomena of emission of α , β particles and γ rays by unstable heavier nuclei is called **radioactivity**.

Questions:

1. Name the two major components present in the left-over slurry of a biogas plant.
Ans: Nitrogen and phosphorus.

2. What is a wind energy farm?

Ans: A number of windmills erected over a large area.

3. Write any two advantages of bio-energy.

[SSLC April 2016]

Ans: (i) It maintains an unpolluted environment.

(ii) Reduces the carbon dioxide content in the atmosphere.

4. Name any two elements that are used in fabricating solar cells.

Ans: Silicon / Gallium / Silver.

5. Define the term-biomass. Name any two biomass energy sources.

Ans: The materials obtained from plants and animals, used as fuels are called biomass. Coal, wood etc., are the sources of biomass energy.

6. What should be the minimum wind speed to maintain the required speed of the turbine in a wind energy farm?

Ans: 15km/h.

7. What are the two disadvantages of burning fossil fuels?

Ans: Disadvantages are air pollution and acid rain which affects soil and water.

8. Mention any one reason due to which most of the thermal power plants are set up near coal or oil fields.

Ans: Because fuel is used to produced heat energy by burning.

9. Write two disadvantages of Nuclear Energy.

Ans: (i) Used for production and proliferation of nuclear weapons.

(ii) Its generation is very expensive.

10. Why are black surfaces, and not the white surfaces, used for making solar cookers?

Ans: Black surfaces absorb more heat as compared to white surfaces. Therefore, for making solar cookers, black surfaces are used.

11. What is a nuclear fusion reaction? List any two advantages of nuclear fusion reactions.

Ans: A reaction in which two nuclei of lighter elements combine to form a heavy nucleus with a liberation of tremendous amount of energy is nuclear fusion reaction.

Two advantages are:

(i) Large amount of energy is produced from a very small amount of fuel.

(ii) Produces nonpolluting waste/does not produce gases which pollute the environment/cause green house effect.

12. Mention the main use of slurry left behind in the biogas of plant. State the characteristics of the slurry, on which this use is based.

Ans: (i) Slurry is used as a manure. 1

(ii) Slurry is rich in nitrogen and phosphorus.

13. Give two advantages of using nuclear energy.

Ans: Two advantages of using nuclear energy are:

(i) Very small mass of Uranium yields tremendous energy.

(ii) The released energy can be used to produce steam and further generate electricity.

14. Name the major constituent of biogas. List three characteristics to prove it as an excellent fuel.

Ans: Methane is the major constituent of biogas.

Three characteristics to prove it as an excellent fuel are:

(i) Smokeless

(ii) Leaves no residue

(iii) Higher heat of combustion.

15. Large scale use of nuclear energy becomes prohibitive due to some hazards. State any two major hazards associated with a nuclear power plant.

Ans: (i) Storage and disposal of spent or used fuels which decay into sub-atomic particles with harmful radiations.

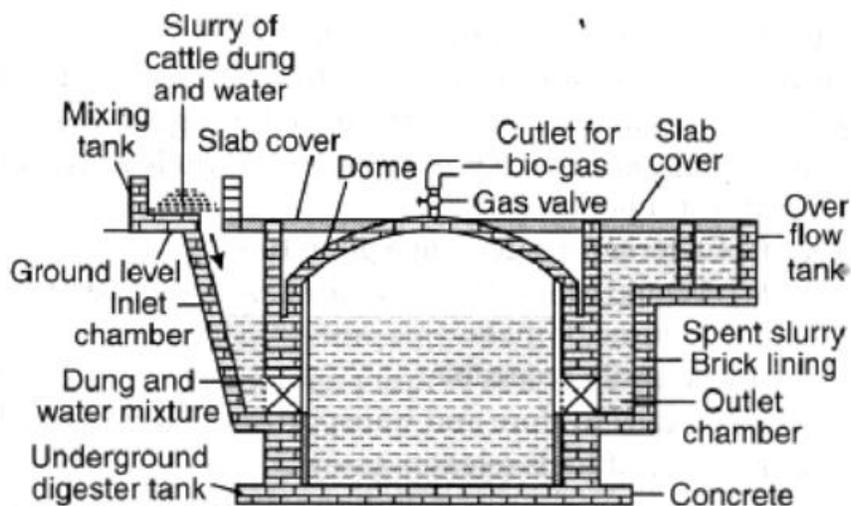
(ii) Nuclear waste storage and disposal result in environment contamination or accidental leakage of nuclear radiations.

16. Why does a car parked in sunlight remains hot from inside even when there is no sunlight in the car?

Ans: The glass windows have the peculiar property to pass radiations which have wavelength near to the visible light or shorter wavelength. It does not allow infra-red radiations of higher wavelength. Since the sun sends in fra-red radiations of lower wavelengths, it gets trapped inside the car in the form of heat. This heat or infra-red radiations can not pass out and thus gets trapped in the car for longer time, making it hot from inside.

17. Draw a neat diagram of a biogas plant and label (i) inlet of slurry, (ii) digester and (iii) gas outlet. [SSLC July, 2018-19]

Ans:



18. Explain the principle and working of a biogas plant.

Ans: The waste of living organisms like cow dung, various plant materials like the residue after harvesting of crops, vegetable waste and sewage etc. form biomass. During the decay of biomass, in the absence of oxygen, biogas is produced in the biogas plant. Slurry of cow dung and water is made in the mixing tank from where it is fed into the digester. In the digester tank, anaerobic micro-organisms decompose complex molecules of cow dung slurry and produce biogas.

19. List two ways in which animal dung can be utilized as a fuel. Out of these two which one do you think is better? Justify your answer.

Ans: Two ways:

(i) as cow dung cakes, (ii) as biogas. Biogas is better than cow dung cakes because it has high heating capacity and are non-polluting as it burns without smoke and leaves no residue like ash. Slurry left in the biogas plant is a good manure for fields.

20. Differentiate between renewable and non-renewable sources of energy. Give two examples of each.

Ans: Difference between renewable and non-renewable sources of energy:

S. No	Renewable Energy	Non-Renewable Energy
(i)	Sources that can be regenerated.	Sources that will get depleted.
(ii)	These are inexhaustible sources. eg. energy from sun, wind.	These are exhaustible as they are limited. e.g. coal, petroleum.

21. If energy can neither be created nor destroyed, explain with an example why we should worry about our energy resources?

Ans: Energy used is dissipated in less usable form. The energy used is consumed and cannot be used again.

Example: Burning of candle \rightarrow light + heat but products cannot produce chemical energy.

22. What is a solar cell? Why and how is a solar cell application and panel prepared? List two limitations of these panels.

Ans: Solar cell is a device that converts solar energy into electricity. Since the output of a single solar cell is quite small, a large number of solar cells are combined using silver for the interconnection. This arrangement of solar cell is called solar panel that can deliver enough electricity for practical use.

Uses:

- (i) Artificial satellites
- (ii) Traffic lights, calculators
- (iii) Radio and wireless transmission
- (iv) At TV relay station.

Limitations:

- (i) Highly expensive
- (ii) Fabrication is a complex process
- (iii) Low efficiency.

23. Explain the term 'geothermal energy'. How can it be exploited? Though it is economical yet it is not harnessed in most of the countries. Why?

OR

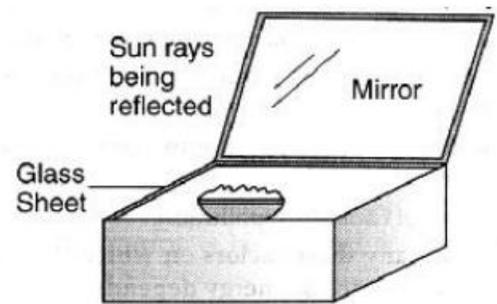
Explain geothermal energy. How can it be harnessed to produce electrical energy?

29. Draw a well labelled diagram of a solar cooker. Identify two components in its structure that helps in maximizing heat absorption in it.

Ans: Plane mirror, glass sheet, painted black inside the cooker.

A Solar Cooker:

- (i) Its black surface absorbs more heat
- (ii) Focused mirror.



30. Can any source of energy be pollution-free?

Ans: No source of energy can be called pollution free. It is because; the use of any source of energy will disturb the environment in one or the other way. For example, solar cell. It is free of pollution but its installation may cause some damage to the environment.

Textbook Exercises:

1. A solar water heater cannot be used to get hot water on:

- (a) a sunny day (b) a cloudy day (c) a hot day (d) a windy day

Ans: (b) a cloudy day

2. Which of the following is not an example of a biomass energy source?

- (a) Wood (b) Gobar gas (c) Nuclear energy (d) Coal

Ans: (c) Nuclear energy

3. Most of the sources of energy we use represent stored solar energy. Which of the following is not ultimately derived from the sun's energy?

- (a) geothermal energy (b) wind energy (c) nuclear energy (d) biomass

Ans: (a) geothermal energy

4. Compare and contrast fossil fuels and the Sun as direct source of energy.

Ans:

Fossil fuels	Solar energy
1. These are limited, i.e exhaustible.	These are available forever, i.e, inexhaustible.
2. They cause pollution on burning.	It is pollution free.
3. It provides energy at any required me.	It becomes unavailable when the sky is covered with clouds.

5. Compare and contrast biomass and hydro electricity as sources of energy.

Ans:

Biomass	Hydro electricity
1. Causes pollution	Does not cause pollution
2. It is renewable source of energy	It is not a renewable source of energy

6. What are the limitations of can be shown in single me energy from:

- (i) The wind (ii) Waves (iii) Tides

Ans: (i) Limitations of extracting energy from the wind:

Wind flowing with a sufficient speed is not available everywhere and all the time.

- (ii) Limitations of extracting energy from ocean waves: Wave energy would be commercially viable only at places where the waves are strong. The energy produced from waves has to be transmitted through long distances at the possible of use.
- (iii) Limitations of extracting energy from tides : There are very few sites suitable for harnessing tidal energy. The rise and fall of water during tides is not very large. So, large scale generation of electricity is not possible.

7. On what basis would you classify energy sources as:

- (i) Renewable and non-renewable?
- (ii) Exhaustible and inexhaustible?

Are the options given in (a) and (b) the same?

Ans: (i) Energy sources can be classified as renewable and non-renewable on the following basis:

- (a) Quantity available in nature
- (b) Mode of replenishment
- (c) Rate of consumption

(ii) Energy source can be classified as exhaustible and inexhaustible sources of energy on the basis of the rate of consumption and replenishment:

- (a) If the rate of consumption is higher than the rate of replenishment, then the source of energy is exhaustible.
- (b) If the rate of consumption is lower than the rate of replenishment, then the source of energy is inexhaustible.

Thus the options given in (a) and (b) are essentially the same.

8. What are the qualities of an ideal source of energy? **Ans:** An ideal source of energy is one which:

- (i) Provides a large amount of energy per unit volume or mass.
- (ii) Is easy to store and transport

9. What are the advantages and disadvantages of using a solar cooker? Are there places where solar cookers would have limited utility?

Ans: Advantages of solar cooker:

- (i) Solar cooker causes no pollution.
- (ii) Solar cooker saves fuel like wood, LPG, kerosene oil etc.

Disadvantages of solar cooker:

- (i) Food cannot be cooked on a cloudy day and at night.
- (ii) Large amount of food cannot be cooked using solar cooker.

Solar cooker will have limited utility at the places where sun shines for a shorter period of time.

10. What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

Ans: (i) Burning of fossil fuels to meet increasing demand of energy results in air pollution.

(ii) Construction of dams on rivers to generate hydro electric energy which leads to the destruction of ecosystem.

In order to reduce energy consumption:

- (i) Use fossil fuels with Care and Caution.
- (ii) Use fuel saving devices like, solar cooker.
- (iii) Consumers energy economically as energy saved in energy produced_

15. OUR ENVIRONMENT

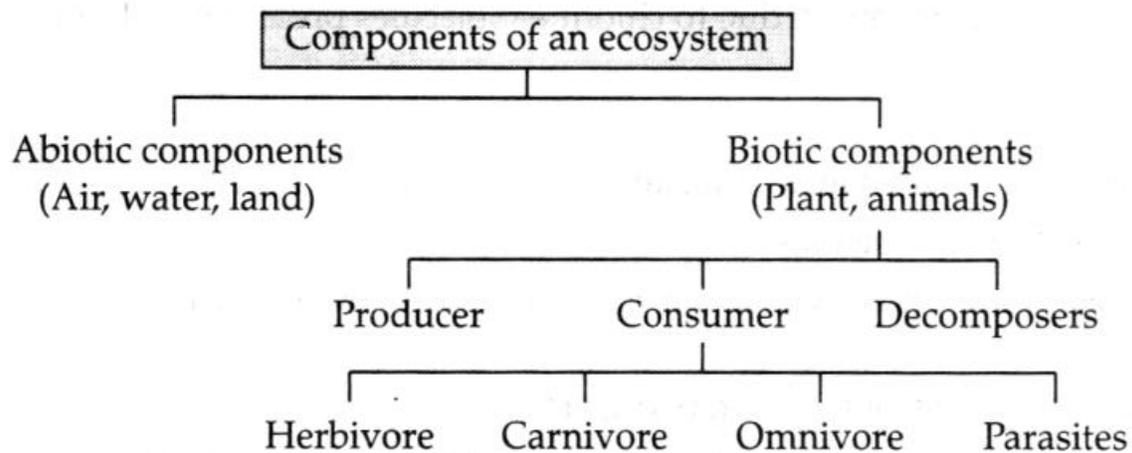
- Everything that surrounds us is environment. It includes both living (biotic) and non-living (abiotic) components.
- Interaction between these biotic and abiotic components form an ecosystem.
- In an ecosystem living components depend on each other for their food which give rise to food chains and food webs in nature.
- Human activities lead to environment problems such as depletion of ozone layer and production of huge amount of garbage.

Ecosystem

- All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. E.g., forest, pond etc.

Types of ecosystem: It is of two types:

- Natural ecosystem:** The ecosystem which exist in nature on its own. e.g., forest, lake, ocean.
- Artificial ecosystem:** Man-made ecosystem are called artificial ecosystem. e.g., crop field, aquarium, garden.



- Herbivores, carnivores, omnivores and parasites are the various type of consumers.
- **Consumers** are those organisms which depend upon the producers for food, either directly or indirectly by feeding on other consumers for their sustenance. They are also called heterotrophs.
- **Parasites** are those organisms that live on (ectoparasites) or in (endoparasites) the body of another organism, i.e., host from which it obtain its nutrients, e.g., parasites of man includes fleas and lice.
- **Decomposers** are those micro-organisms that obtain energy from the chemical break down of dead organisms or animals or plant wastes. Decomposers break down the complex organic substances into simple inorganic substances that go into the soil and are used up once more by the plants.
- **Food chain** is sequence of organisms through which energy is transferred in the form of food by the process of one organism consuming the other.

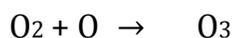
Examples:

Grass → Grasshopper → Frog → Snake → Eagle
(Producer) (Herbivore) (Carnivore) (Carnivore) (Top Carnivore)

- **Trophic levels** are the various steps or levels in the food chain where transfer of food or energy takes place. Producers are the first trophic level, herbivores are second trophic level, carnivores or secondary consumers are third trophic level and large carnivores or tertiary consumers are the fourth trophic level.
- **Food web** is the network of various food chains which are interconnected at various trophic levels. Since an organism can occupy position in more than one food chain, in a food web it occupies more than one trophic level.
- The flow of energy through different steps in the food chain is unidirectional. This means that energy captured by autotroph does not revert back to the solar input and it passes to the herbivores.

Flow of energy between trophic levels

- Flow of energy in a food chain is unidirectional.
- Green plants capture 1% of sunlight and convert it into food energy.
- **10 percent law:** Only 10% of energy is transferred to the next trophic level. The remaining 90% energy is used in life processes (digestion, growth, reproduction etc.) by present trophic level.
- Due to this gradual decrease in energy, food chains contain 3–4 trophic levels.
- **Biological magnification:** The concentration of harmful chemicals increases with every next trophic level in a food chain. This is called biological magnification.
- Maximum concentration of such chemicals get accumulated in human bodies as humans occupy the top level in any food chain.
- Ozone (O₃) is an isotope of oxygen i.e., it is a molecule formed by three atoms of oxygen. Ozone performs an essential function of shielding the surface of the earth from ultraviolet radiation of the sun.



- Ozone layer is a layer of the earth's atmosphere in which most of the atmosphere's Ozone is concentrated.
- Ozone layer protects the earth from harmful radiations.
- There are several reasons for depletion of ozone layer.
- The foremost is the use of chlorofluorocarbons (CFCs). The other factor responsible for ozone destruction is the pollutant nitrogen monoxide (NO).
- When the harmful chemicals like chlorofluorocarbons (CFCs) are released into the air, it accumulates in the upper atmosphere and reacts with ozone resulting in reduction in thickness of the ozone layer.
- Thus, the ozone layer in the atmosphere becomes thinner and gets depleted allowing more ultraviolet rays to pass through it.
- The Antarctic hole in ozone layer is caused due to chlorine molecules present in chlorofluorocarbons (CFCs), that are used by human beings.

Garbage disposal

- Improvements in lifestyle have resulted in accumulation of large amounts of waste materials.
- Garbage contains following type of materials:
 - a) **Biodegradable wastes:** Substances which can be decomposed by the action of micro-organisms are called biodegradable wastes.
E.g., fruit and vegetable peels, cotton, jute, dung, paper, etc.
 - b) **Non-biodegradable wastes:** Substances which cannot be decomposed by the action of micro-organisms are called non-biodegradable wastes.
E.g., plastic, polythene, metals, synthetic fibres, radioactive wastes, pesticides etc. Micro-organisms release enzymes which decompose the materials but these enzymes are specific in their action that's why enzymes cannot decompose all the materials.

Some methods of waste disposal

- a) **Biogas plant:** Biodegradable waste can be used in biogas plant to produce biogas and manure.
- b) **Sewage treatment plant:** The drain water can be cleaned in sewage treatment plant before adding it to rivers.
- c) **Land fillings:** The wastes are buried in low lying areas and are compacted by rolling with bulldozers.
- d) **Composting:** Organic wastes are filled in a compost pit and covered with a layer of soil, after about three months garbage changes to manure.
- e) **Recycling :** Non-biodegradable waste are recycled to make new items.
- f) **Reuse:** It is a conventional technique to use an item again e.g., newspaper for making envelopes.

Know the Terms

- **Environment:** It is the sum total of all external conditions and influences that affect the life and development of an organism, i.e. the environment includes all the physical or abiotic and biological or biotic factors.
- **Biodegradable substances** are those substance which are broken down into simpler, harmless substances in nature in due course of time by the biological processes such as action of micro-organisms.
- **Non—biodegradable substances** are those substance which cannot be broken down into simpler, harmless substances in nature. These substances may be in solid, liquid or gaseous form and may be inert and accumulate in the environment or may concentrate in the food chain and harm the organisms.
- **Ecosystem:** It is the structural and functional unit of biosphere, comprising of all the interacting organisms in an area together with the non—living constituents of the environment. Thus, an ecosystem is a self sustaining system where energy and matter are exchanged between living and non-living components.
- **Producers:** Those organisms which produce food by photosynthesis i.e. organisms which can make organic compounds like sugar and starch from inorganic substances using the radiant energy of the sun in presence of chlorophyll.

- **Consumers:** Those organisms which depend upon the producers for food, either directly or indirectly by feeding on other consumers for their sustenance. Consumers therefore, feed upon those below it in a food chain and are called heterotrophs.
- **Decomposers:** They are those micro-organisms that obtain energy from the chemical breakdown of dead organisms or animals or plant wastes. These micro-organisms are decomposers as they breakdown the complex organic substances into simple inorganic substances that go into the soil and are used up once more by the plants.
- **Food Chain:** It is the sequence of organisms through which energy is transferred in the form of food by the process of one organism consuming the other. It shows the relationship of producer and consumer i.e. 'who eats whom'. Thus, it is a series of organisms taking part at various biotic level from the producer and ends in consumer.
- **Trophic Levels:** These are the various steps or levels in the food chain where transfer of food or energy takes place. The producers or autotrophs are the first trophic level, the herbivores or primary consumers are the second trophic level, the carnivores or secondary consumers are the third trophic level and the large carnivores or tertiary consumers are the fourth trophic level of the food chain.
- **Food Web:** It is the network of various food chains which are interconnected at various trophic levels. Since, an organism can occupy position in more than one food chain, in a food web it occupies more than one trophic level.
- **Flow of Energy:** The flow of energy through different steps in the food chain is unidirectional. This means that energy captured by autotroph does not revert back to the solar input and it passes to the herbivores. It moves progressively through various trophic level.

Questions:

1. List two man – made ecosystems.
Ans. Garden and pond are man – made ecosystems.
2. Name two decomposers operating in our ecosystem
Ans. Bacteria and Fungi.
3. Why do producers always occupy the first trophic level on every food chain?
Ans. Because producers (plants) have the ability to trap solar energy with the help of chlorophyll.
4. What will happen if we kill all the organisms in one trophic level?
Ans. If we kill all the organisms in one trophic level, the population of organisms in previous and next trophic level will increase.
5. What will be the amount of energy available to the organisms of the trophic level of a food chain, if the energy available at the first trophic level is 10,000 joules?
Ans. Only 10 percent energy is available from the first trophic level to second trophic level, i.e., 1,000 joules.
6. Why are some substances non – biodegradable?
Ans. Some substances are non – biodegradable because , they cannot be broken down into simpler harmless substance in nature.
7. The depletion of ozone layer is a cause of concern. Why?
Ans. Ultraviolet rays from the sun penetrate down the earth and cause health hazards/skin cancer in human being.

8. Why is excessive use of CFCs a cause of concern?

Ans. When CFC'S reach upper layers of the atmosphere, they cause depletion of ozone layer, and allow harmful ISV radiations to reach the surface of the earth to create health hazards.

9. The following organisms form a food chain. Which of these will have the highest concentration of non- biodegradable chemicals? Insects, Hawk, Grass, Snake, Frog. Name the phenomenon associated with it:

Ans. Hawk. Biomagnifications.

10. Which disease is caused in human beings due to depletion of ozone layer in the atmosphere?

Ans. Skin cancer is caused in human being due to depletion of ozone layer in the atmosphere.

11. Discuss the feeding patterns in a food web.

Ans. In a food web, each organism is generally eaten by two or more other kinds of organisms which in turn are eaten by several other organisms. So, a food web is a complex network of many interconnected food chains and feeding relationships.

12. Differentiate between the food habits of organisms belonging to first and second trophic levels.

Ans. Difference between first trophic level and second trophic level:

S.No.	First Trophic Level	Second Trophic Level
(i)	These are the producers.	These are the herbivores
(ii)	They prepare food by their own. (Photosynthesis)	They feed on plants only.

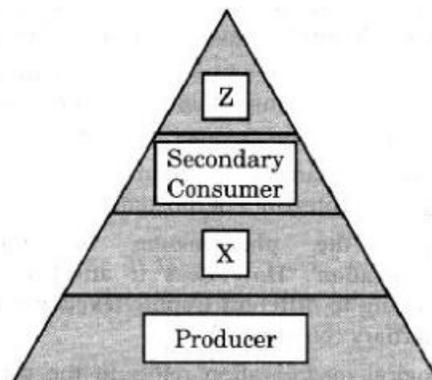
13. State with reason any two possible consequences of elimination of decomposers from the earth.

Ans. (i) The earth would be covered with dead organisms and their excrement as decomposers are recyclers of life materials, returning materials to the system for use by living organisms.

(ii) Elimination of decomposers would create an imbalance of nutrients as they break down complex organic material into simpler substances.

14. Write the appropriate names of the trophic levels

Z and X in the figure given below:



Ans. Z — Tertiary consumers

X — Primary consumers

15. In the food chain:

Grass → deer → lion

Operating in a forest, what will happen if all the:

(i) lions are removed? -

(ii) deers are removed?

Ans. (i) Number Of deer increases which will result in less amount of grass leading to soil erosion.

(ii) Food available for lions would be less. Amount of grassland will increase

16. What is Ozone ? How does it protect the organisms on the earth?

OR

What is ozone and how does it affect any ecosystem?

Ans. Ozone is a triatomic molecule of oxygen, (O₃). It forms a protective blanket over the earth's , atmosphere and its depletion causes harmful effects on human. It absorbs the UV-radiation coming from the sun.

17. It is said, there is a need to put a blanket ban on the products containing aerosols. What are aerosols ? Why is there a demand to put a ban on them?

Ans. An aerosol can be defined as a dispersion of solid and liquid particles suspended in gas. Atmospheric aerosols, unsurprisingly, refer to solid and liquid particles suspended in air. Aerosols are produced by dozens of different processes that occur on land and water surfaces, and in the atmosphere itself. There is a demand to put a ban on them because of their deteriorating effect on Earth's ozone layer.

18. 'Traditional use of forest areas is not useful in maintaining biodiversity. Do you agree with this statement? Explain with the help of an example.

Ans. The Great Himalayan National Park contains within its reserved area, alpine meadows which were grazed by sheep in summer. But now without regular grazing by sheep, the grass first grows very tall and then falls over, preventing fresh growth.

19. Why is Government of India imposing a ban on the use of polythene bags? Suggest two alternatives to use these bags and explain how this ban is likely to improve the environment.

OR

In some states of our country there is a ban on the use of polythene bags for shopping. Why? List there advantages of using jute or cloth bags over polythene bags.

Ans. Government of India is imposing a ban on the use of polythene bags because they cannot be degraded naturally by the action of microorganisms. Because of their non-biodegradability, they stay in the soil for a long time and continue to poison it with toxic by-products that keep leaching from them. Also, they do not allow water to seep in, as they are waterproof. These polythene bags, when accidentally eaten by stray animals, can harm them and can even lead to their death.

20. Give any two ways in which biodegradable substances would affect the environment.

Ans. (i) They produce foul smell during decomposition process.

(ii) They may produce harmful gases such as ammonia, methane and carbon dioxide.

21. What is meant by food chain? "The number of tropic levels in a food chain is limited." Give reason to justify this statement.

Ans. Food chain is a simple representation of energy flow in nature.

For example: A rat eats grains, a snake eats a rat, which in turn, is eaten by an eagle.

In a food chain, the number of trophic levels is limited to 4-5. This is because according to 10% law of energy transfer, only 10% of energy passes from one trophic level to next. Thus the amount of energy decreases with successive trophic levels. After five trophic levels⁶ existence of organisms would become impossible with such negligible amount of energy.

22. Explain the phenomenon of ‘Biological Magnification’. How does it affect organisms belonging to different trophic levels particularly the tertiary consumers?

Ans. Biological magnification refers to the process of increase in the concentration of a toxic chemical with increasing trophic level in a food chain. Harmful or poisonous substance such as DDT sprinkled to kill pests on plants enter the food chain. The plants absorb these harmful chemicals from soil along with water and minerals. They enter the food chain at producer level and then transfer to the next trophic level. The tertiary consumers get more higher levels of these chemicals.

23. Mention any three significance of a food chain.

Ans. Significance of a food chain:

- (i) It helps in understanding the food relationship and interactions among various organisms in an ecosystem.
- (ii) It helps in following the basic mechanism of transfer of food energy and nutrients through various components of nature.
- (iii) It helps to understand the movement of toxic substances in an ecosystem and the problem of their biological magnification.

24. “Our food grains such as wheat and rice, the vegetables and fruits and even meat are found to contain varying amounts of pesticide residues.” State the reason to explain how and why it happens?

Ans. A large number of pesticides and chemicals are used to protect our crops from pests and diseases. Some of these chemicals are washed down into the soil, while some enter the water bodies. From the soil, they are absorbed by plants along with water and minerals; and from water bodies, they are taken up by aquatic plants and animals. This is how these chemicals enter the food chain. Because these chemicals cannot decompose, they accumulate progressively at each trophic level. As the food chain proceeds, the concentration of pesticides also increases. This increase in the concentration of harmful chemicals with each step of the food chain is called biomagnifications. That is why food grains, such as wheat and rice, vegetables, fruits and even meat are found to contain pesticide residue.

25. (i) What is the full form of: UNEP.

- (ii) On what basis are organisms grouped as producers, consumers and decomposers?
- (iii) Write two problems that would arise if there were no decomposers in an ecosystem.

Ans. (i) The full form of: UNEP is United Nations Environment Programmes.

(ii) Organisms can be grouped as producers, consumers and decomposers according to the manner in which they obtain their sustenance from the environment.

(iii) Two problems that would arise in absence of decomposers in an ecosystem are:

- (a) Decomposition of garbage as well as dead plants and animals will not take place. 1
- (b) Natural replenishment of soil will not take place.

26. Damage to the ozone layer is a cause for concern.
Justify this statement. Suggest any two steps to limit this damage.

OR

Ans. Due to ozone layer depletion, the ultraviolet rays reaches earth and causes certain ill-effects which are bad for us and for crops. Exposure to U-V rays can lead to greater incidence of skin cancer, cataracts and damages to the eye and immune deficiency. Two steps to limit this damage are:

- (i) Minimizing the use of CFCs. CFC's released into air accumulates in the upper atmosphere and reacts with ozone resulting in reduction in the thickness of the ozone layer.
- (ii) In 1987, UNEP (United Nation Environment Programme) Succeeded in reaching an agreement to freeze CFC Production at 1986 levels.

27. When did the amount of Ozone in the atmosphere begin to drop sharply ? Why did this happen? How was this problem taken care of by UNEP?

Ans. The amount of Ozone in the atmosphere began to drop sharply in the 1980s. This decrease is due to the synthetic chemicals like chlorofluorocarbons which are used as refrigerants and in fire extinguishers. In 1987, United Nations Environment Programme, (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels.

28. Explain why the use of plastic bags are banned in many places? What could be more environment- friendly alternative?

Ans. Plastic is a non-biodegradable substance.

Hence a plastic bag will persist in the environment and lead to several environmental problems. It would be better to use paper bags or cloth bags instead of polythene bags.

29. What are chlorofluorocarbon? How are they responsible for causing ozone hole in atmosphere? What will be the consequences of ozone hole?

Ans. Carbon compounds which contain chlorine and fluorine are called CFCs (chlorofluorocarbons). e.g., CCl₂F₂ (Dichlorodifluoromethane). They lead to depletion of ozone layer causing ozone hole. Nitric oxide also reacts with ozone to form NO₂ and O₂. CFCs (Chlorofluorocarbons) react with ozone in stratosphere and depletes ozone.

- (i) It may lead to skin burns.
- (ii) It may cause skin cancer.

30. Give reasons:

- (i) Kulhads have been banned for serving tea on platform.
- (ii) Decomposers are not included in any food chain.
- (iii) Producers are transducers of energy

Ans. (i) As the top layer of soil is used up in making kulhads, it leads to infertility of the soil:

- (ii) As decomposers, e.g., bacteria and fungi act on all trophic levels when the organisms occupying that level dies.
- (ii) Producers are green plants, so they can convert solar energy into chemical energy in the form of food molecules.

Textbook Exercises:

1. Which of the following groups contain only biodegradable items?

- | | |
|--------------------------------------|-----------------------------|
| (a) Grass, flowers and leather | (b) Grass, wood and plastic |
| (c) Fruit-peels, cake and lime-juice | (d) Cake, wood and grass |

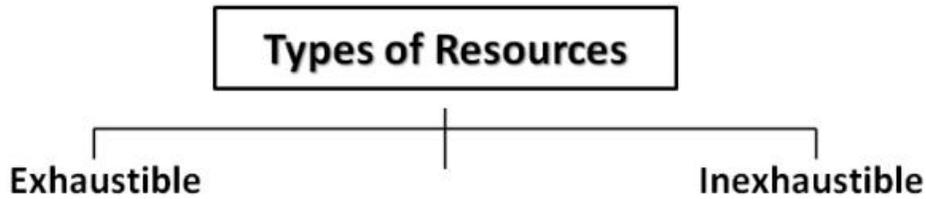
Ans. (a), (c), (d)

2. Which of the following constitute a food-chain?
 (a) Grass, wheat and mango (b) Grass, goat and human
 (c) Goat cow and elephant (d) Grass, fish and goat
Ans. (b) Grass, goat and human
3. Which of the following are environment-friendly practices?
 (a) Carrying cloth-bags
 (b) To put purchases while shopping. Switching off unnecessary lights and fans
 (c) Walking to school instead of getting your mother to drop you on her scooter.
 (d) All of the above
Ans. (d) All of the above
4. What will happen if we kill all the organism in one trophic level?
Ans. If we kill all the organisms in one trophic level, then the next trophic levels will not get food to eat and the entire food chain gets disturbed,. At the same time the population of organisms at the lower trophic level will increase in abundance causing imbalance in nature.
5. Will the impact of removing all the organism in a trophic level be different for different trophic levels? Can the organisms of any trophic level be removed without causing any damage to the ecosystem?
Ans. Yes
 Removal of any organism will have different effect but it will cause an ill effect on the survival of that ecosystem.
6. What is biological magnification? Will the levels of this magnification be different at different levels of ecosystem?
Ans. The accumulation of harmful chemicals in the body of living organism at different trophic levels in a food chain is called biological' magnification. Yes, the concentration of these harmful chemicals will be different at different trophic levels. It will be maximum at the last trophic level which is mostly the top carnivores.
7. What are the problems caused by the non- biodegradable wastes that we generate?
Ans. (i) Biological magnification
 (ii) They cause biomagnifications and increase pollution
 (iii) They make environment unclean
 (iv) They kill useful micro – organisms, thereby reducing the fertility of soil.
8. If all the waste we generate is biodegradable, will this have no impact on the environment?
Ans. Even the biodegradable wastes cause the environmental pollution. Accumulation of biodegradable wastes are responsible for:
 (i) The excess of domestic sewage and nitrates from fertilizers cause excessive growth of phytoplankton's called algal bloom, which in turn kills the aquatic animals.
 (ii) The heaps of biodegradable solid wastes destroy the natural beauty of the landscape and make the surroundings unhygienic.
 (iii) The decay and decomposition of such wastes produces foul gases and causes air pollution.
9. Why is damage to the ozone layer a cause for concern? What steps are being taken to limit this damage?
Ans. Refer Q-26 (Page No: 178)

16. MANAGEMENT OF NATURAL RESOURCES

Quick Review

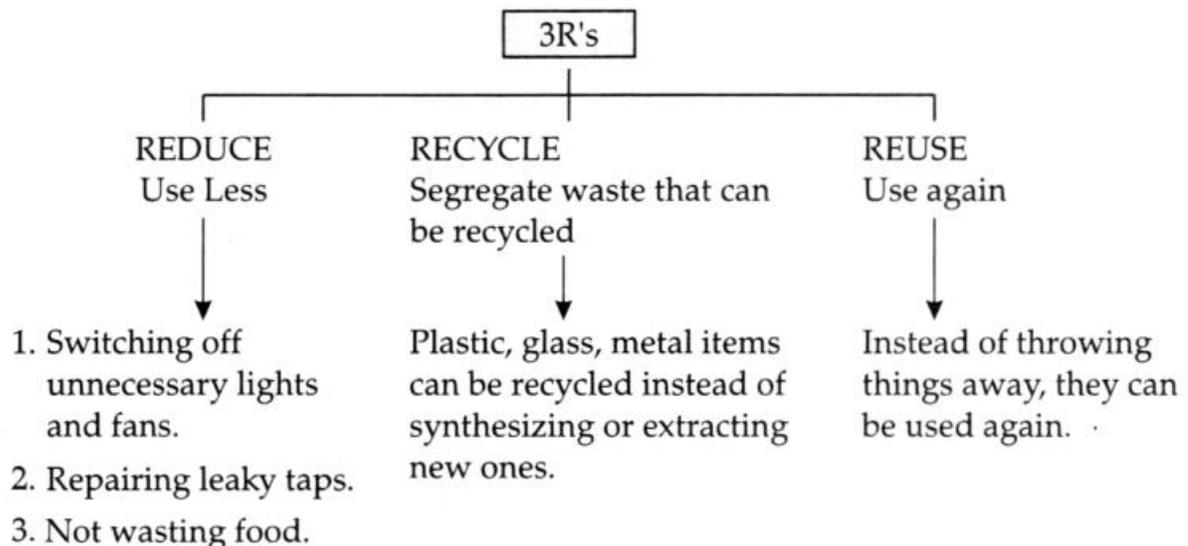
Natural Resources: Anything in the environment 'which can be used' is called natural resource. For example, soil, air, water, forests, wildlife, coal and petroleum.



These are present in limited quantity
E.g., Coal, petroleum.

These are present in unlimited quantity
E.g., Air, water.

- Coliform is a group of gram-negative rod-shaped bacteria that are found in
- human intestine. Their presence in water is an indicator of contamination by disease-causing micro-organisms indicating faecal pollution. It includes Salmonella and Escherichia coli.
- Largely untreated sewage such as garbage and excreta are dumped into Ganga. Pollution is also caused by human activities such as bathing, washing and immersion of ashes or unburnt corpses.
- Industries also contribute in Ganga's pollution by loading chemical effluents and making the water toxic, killing aquatic organisms.
- Ganga Action Plan is a massive multi-core project launched in 1985, which has been undertaken to clean the excess pollution from river Ganga.
- **Management of Natural resources** Three R's to save the environment:



- **Sustainable Management**
Management of resource wisely so they meet current basic human needs while preserving them for the needs of future generations.
- The management of natural resources require:
(a) Long term perspective so that these will last for generations to come.

(b) Ensure equitable distribution of resources so that all economic sections benefit from these resources.

(c) Safe disposal of waste.

- The objective of sustainable development is to provide the economic well being to the present and the future generations and to maintain a healthy environment and life support system.
- pH stands for 'Potential of Hydrogen'. It is negative logarithm (base 10) of the hydrogen ion concentration in moles per litres.
- The acidic and basic character of aqueous solutions can be described in terms of hydrogen ion and hydroxide ion concentration.
- Pollutant is the substance that causes a harmful change in the environment, thereby producing adverse effects on living organisms. Some of the common pollutants include pesticides, industrial wastes and emissions, exhaust fumes from vehicles and sewage.
- Biodiversity is the existence of a wide variety of species of plants, animals and micro-organisms in a natural habitat within a particular environment or of genetic variation within a species.
- Forest is a 'biodiversity hotspot' because it is an area where number of species or range of different life form exists.
- Wildlife means all those naturally occurring animals, plants and their species which are not cultivated, domesticated and tamed.
- Conservation is the sensible use of the earth's natural resources in order to avoid excessive degradation and betterment of the environment.
- Afforestation is the practice of transforming an area into forest, usually when trees have not grown there, and involves three types of forestry programmes.
- Social and environmental forestry involves raising of trees for firewood, fodder, agricultural implements for the benefits of rural and tribal community.
- Agro-Forestry is an absolute commercial forestry developed to fulfil the need of various forest-based industries.
- It is done on the fallow land or free-grazing lands.
- Urban forestry involves growing of ornamental trees along roads, vacant lands and common parts of urban areas.
- Large reservoirs of petroleum have been preserved by nature for millions of years between porous rocks beneath the earth.
- Non-renewable energy sources are energy sources which cannot be replaced easily when they get exhausted and are also called conventional sources of energy. They are used traditionally for many years and take millions of years to form fossil fuels.
- The fossil fuels, coal and petroleum get exhausted and their combustion pollutes our environment, so a judicious use of these resources is necessary.
- Necessity of judicious use of coal and petroleum: The fossil fuels, coal and petroleum will get exhausted and their combustion pollutes our environment, so a judicious use of these resources is necessary.
- When combustion takes place, oxides of carbon, hydrogen, nitrogen and sulphur are formed.
- Carbon monoxide is formed instead of carbon dioxide if there is insufficient air.

- The oxides of sulphur, nitrogen and carbon monoxide are poisonous at high concentrations.
- Carbon dioxide is a greenhouse gas which leads to global warming.
- **Water for all**
 - a) Water is the basic necessity for all terrestrial forms of life.
 - b) Rain is an important source of water.
 - c) Irrigation methods like dams, tanks and canals have been used in various parts of India.
- **Dams**

Dams ensure the storage of adequate water for irrigation and are also used for generating electricity.

Various dams have built on rivers to regulate the flow of water.
E.g., a) Tehri Dam — On river Ganga
b) Sardar Sarovar Dam — On river Narmada
c) Bhakra Nangal Dam — On river Satluj
- **Advantages of Dams**
 - a) Ensures adequate water for irrigation.
 - b) To generate electricity.
 - c) Continuous supply of water to cities and towns.
- **Disadvantages of Dams**
 - a) **Social problems:**
 - (i) Many tribals and peasants are displaced and rendered homeless.
 - (ii) They do not get adequate compensation or rehabilitation.
 - b) **Environmental problems:**
 - (i) Deforestation
 - (ii) Loss of biodiversity
 - (iii) Disturb ecological balance
 - c) **Economic problems:**
 - (i) Huge amount of public money is used.
 - (ii) No proportionate benefit to people.
 - (iii) No equitable distribution of water.

➤ **Rain Water Harvesting**

Rain water harvesting is to make rain water percolate under the ground so as to recharge 'groundwater'.

Know the Terms

- **Natural resources:** They are the stock of the nature such as air, water, soil, minerals, coal, petroleum, forest and wildlife that are useful to mankind in many ways.
- **Pollution:** It is defined as the undesirable change in physical, chemical or biological characteristics of our soil, air or water, which harmfully affect human lives or the lives of other species.
- **Pollutant:** It is the substance that causes a harmful change in the environment, thereby producing adverse effects on living organisms. Some of the common pollutants include pesticides, industrial wastes and emissions, exhaust fumes from vehicles and sewage.
- **Sustainable Development:** It is the development which can be maintained for a long time without undue damage to the environment.

- **Biodiversity:** It is the existence of a wide variety of species of plants, animals and micro-organisms in a natural habitat with in a particular environment or of genetic variation with in a species.
- **Wildlife:** It means all those naturally occurring animals, plants and their species that are not cultivated, domesticated and tamed.
- **Conservation:** It is the sensible use of the earth's natural resources in order to avoid excessive degradation and betterment of the environment.

Questions:

1. How does increasing demand for energy adversely affect our environment?
Ans. To meet the increased demand for energy, more and more natural resources are exploited. Pollutants are emitted during exploitation and use of natural resources which affect our environment.
2. "We need to manage our resources". List two reasons to justify this statement.
Ans. We need to manage natural resources because of the reasons listed below:
 - (i) A majority of natural resources is limited.
 - (ii) Human population is increasing at a tremendous rate. -
 - (iii) Utilization of natural resources is increasing at an exponential rate.
 - (iv) Need to conserve resources for future generations.
3. How is solar energy useful to the living world?
Ans. Plants carry out photosynthesis, which converts the energy of the sun into a form which can be used by the rest of the living world.
4. Give one example each from your daily life where the domestic waste can be effectively reused and recycled. .
Ans. Reuse: We can reuse the empty bottles of jam, etc. for the storage purposes.
 Recycle: We can recycle old newspapers, aluminium cans etc.
5. State an instance where human intervention saved the forests from destruction.
Ans. Human intervention saved the Arabari forest range of West Bengal from destruction with active and willing participation of local community, The Sal forest of Arabari underwent a remarkable recovery.
6. Water is a valuable resource. List two ways, that you would suggest every family member to save this resource.
Ans. (i) Turning-off the taps when not in use.
 (ii) Checking the leaking water pipelines and getting them repaired.
7. What is Coli form?
Ans. It is a group of bacteria found in human intestine whose presence in water indicates contamination by disease causing micro-organisms.
8. List any two measures that you suggest for better management of water resources.
Ans. (i) Roof top rain water harvesting.
 (ii) Watershed management.
9. Mention one reason of discontentment among the people who have been displaced by building dams.
Ans. It displaces large number of local people without adequate compensation and rehabilitation.

10. What is meant by “Sustainable management”

Why is reuse considered better than recycling?

Ans. “Sustainable development is the development which can be maintained for a longtime without undue damage to the environment. Ways to achieve sustainable development are to plant more trees. Recycling needs additional energy to make a usable item. Reuse does not require additional energy and hence, is better than recycle.

11. What is meant by three types of ‘R’ (3-R’s) to save the environment? Explain with example how would you follow the 3-R’s in your school to save the environment.

Ans. Reduce, Reuse, Recycle (for all the three) I (only $\frac{1}{2}$ mark if two are mentioned)

Examples:

- (i) Switch off the fans and bulbs when not in use,
- (ii) Reuse of paper, polythene bags, etc.,
- (iii) Reduce the wastage of water / paper or any other item

12. Why do we need alternative sources of energy? Give two reasons.

- Ans.** (i) Fossil fuels are conventional sources of energy that will not last longer.
(ii) To reduce air pollution.

13. Why do we need alternative sources of energy? Give two reasons.

- Ans.** (i) Fossil fuels are conventional sources of energy that will not last longer.
(ii) To reduce air pollution.

14. Which natural resource are the ‘biodiversity hot spots’ ? Suggest what happens when there is a loss of biodiversity?

Ans. Forest are the natural resources known as biodiversity hot spots. ‘When there is a loss of biodiversity there is a loss of ecological stability.

15. Why are forests considered “biodiversity hot spots”? List two ways in which an individual can contribute effectively to the management of forests and wildlife?

Ans. Biodiversity is measured by the number of different life forms found in an area. In a forest, various species are available which include bacteria, fungi, ferns, plants, nematodes, insects, birds, reptiles and mammals. Forests are therefore, called biodiversity hot spots. An individual can contribute in management of forest and wildlife by

- (i) Avoiding cutting of forest and killing of wildlife.
- (ii) Educating people about the importance of forest and wild life in our life.

16. State the main purpose of water harvesting system and also mention the source which fills the pond behind harvesting structures.

Ans: The main purpose of water harvesting system is to help in recharge of ground water. Rain is the source which fills the pond behind harvesting structures.

17. List and explain any two advantages associated with water harvesting at community level.

Ans. Water harvesting at the community level is capturing, collection and storage of rain water and surface run off for filing either small water bodies or recharging ground water. This is carried out through water shed management, check dams, earthen dams, roof top harvesting and filter wells in flood drains.

Benefits:

- (i) It ensures water availability in non-rainy season.
- (ii) Water becomes available for drinking as well as irrigation.

18. What is water harvesting? How can this technique help in the conservation of water?

Ans: (i) Water harvesting is a technique of capturing rain water when it falls and taking measures to keep the water clean.

(ii) Water is stored underground that remains unpolluted, it recharges wells and provides moisture for vegetation over a wide area.

19. Why do we seek construction of dams? Mention any two problems faced with the construction of large dams?

OR

The construction of large dams leads to social and environment problems. List two problems of each category.

Ans. *Social problems:*

(i) Many people are rendered homeless.

(ii) Displacement of large number of tribals without due compensation.

(iii) Migration into the cities for settlements.

Environmental problems:

(i) Deforestation / loss of biodiversity

(ii) Soil erosion / ecological imbalance

20. “Burning of fossil fuels results in global warming”.

Give reasons to justify this statement.

Ans. Burning of fossil fuels produces green house gases (CO, CO₂, water vapour, oxides of nitrogen, sulphur). High concentration of CO₂ causes global warming.

21. Why must we conserve our forests? List any three causes for deforestation to take place.

Ans. We must conserve our forest because:

(i) They are source of raw materials for our industries.

(ii) They provide us with wood to make furniture and buildings.

(iii) They are source of medicine.

(iv) They provide firewood and food.

Causes of deforestation are:

(i) Overgrazing

(ii) Building roads and dams

(iii) Natural calamities like forest fire.

22. Suggest three ways to maintain a balance between environment and development to survive.

Ans. The three ways to maintain a balance between environment and development to survive are:

(i) Forest resources should be used in an environmentally and developmentally sound manner.

(ii) Instead of using non-renewable natural resources, use of renewable natural resources should be preferred.

(iii) Waste water generated by industries should be recycled.

23. (i) Why is reusing even better than recycling? List any two reasons.

(ii) Give any three examples of human activities leading to destruction of forests.

Ans. (i) Reusing is even better than recycling because the process of recycling uses some energy. In the ‘reuse’ strategy, you simply use things again and again, without using any energy for generating something new.

24. (i) Name any two fossil fuels. Why are they so-called?
 (ii) Mention the role of forests in conserving the environment. How do the forest get depleted?

Ans: (i) Coal and Petroleum. Formed from the degradation of biomass millions of years ago.

- (ii) (a) Preservation of biodiversity (b) Provide forest products

Reasons for depletion:

- (a) Indiscriminate falling of trees.
 (b) Destroying biodiversity to produce one particular kind of trees.

25. What are the advantages of watershed management?

Ans. The advantages are:

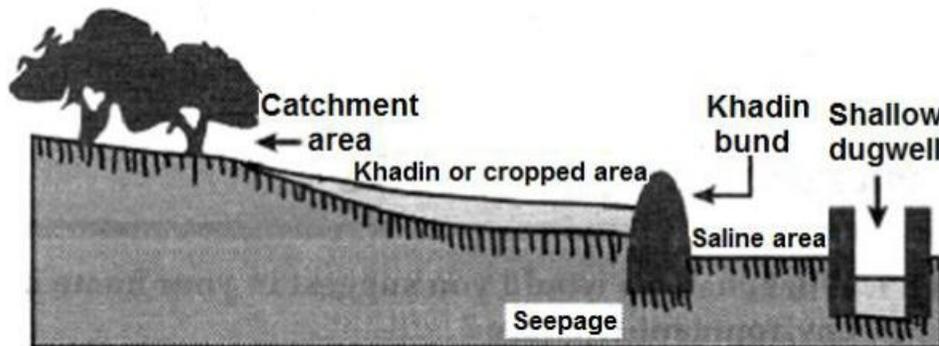
- (i) Watershed management only increases the production and income of the watershed community.
 (ii) It also mitigates droughts and floods.
 (iii) It increases the life of the downstream dam and reservoirs.

26. (i) What are fossil fuels? Give two examples.

(ii) Diagrammatically represent the Khadin System of Water harvesting.

Ans. (i) Fuels formed from the decomposition of ancient animal and plant remains millions of years ago and which provide energy by combustion are called fossil fuels. For example: Coal and petroleum.

(ii)



27. Eco – club of your school is organizing a debate on the topic ‘Nature’s Fury Unleashed by Human’s Greed (Uttarakhand Disaster). List any four arguments that you will use to convince the audience that humans are responsible for this disaster.

Ans: Mining, unnecessary use of resources, cutting of trees, building concrete jungle. 1

28. Building of big dams gives rise to some problems.

List three main problems that may arise. Suggest a solution to any one of these problems.

Ans: (i) Social problems

(ii) Economic problems (iii) Environmental problems.

Solution: (i) Adequate rehabilitation.

(ii) Compensation to the displaced persons.

(iii) Afforestation.

29. Find out the traditional system of water harvesting /management in your region.

Ans. Khadins, ponds, tals, wells etc are water reservoirs where rain water is stored.

30. Find out the source of water in your region/locality. Is water from this source available to all people living in that area?

Ans. In our locality, water is supplied by municipal board through taps. This water is mainly obtained from river or from tube wells. Some village people get their water supply from wells.

Textbook Exercises:

1. What changes would you suggest in your home in environment-friendly?

- Ans:** (i) Use three R's in your lifestyle
(ii) Save electricity by turning off lights when not in use.
(iii) Plant more and more trees.
(iv) Use cloth bags in place of polythene and plastic bags.

2. Can you suggest some changes in your school that would make it environment-friendly?

- Ans:** (i) Maintaining eco clubs.
(ii) Conducting inter house debates and painting competition emphasizing the role of students in preserving and conserving environment.
(iii) Planting trees in the campus.

3. We saw in this chapter there are four main stakeholders when it comes to forests and wildlife. Which among these should have the authority to decide the management of forest produce? Why do you think so?

- Ans:** The local people should be given the authority to decide management of forest produce because they had been living in forest for centuries. Secondly, they had developed practices to ensure that the resources were used in a sustainable manner.

4. How can you, as an individual, contribute or make a difference to the management of (a) forest and wildlife, (b) water resources and (c) coal and petroleum?

- Ans:** (a) *Forests and wildlife:* Spread awareness about the need to conserve forests and wildlife and take part in community activities with focus on conserving forests and wildlife.

(b) *Water resources:* Save water and install a system of rain water harvesting in your house.

(c) *Coal and petroleum:* Save electricity and use less of it, install electrical gadgets that use less power.

5. What can you as an individual do to reduce your consumption of the various natural resources?

- Ans:** As an individual, I will try my best to use or consume only minimum and the required amount of food, clothes and water.

6. List five things you have done over the last one week to (a) conserve our natural resources. (b) increase the pressure on our natural resources.

- Ans:** (a) (i) I have not wasted food. (ii) I have not wasted water.
(iii) I have not wasted electricity (iv) I have not used petroleum product.
(v) I have not purchased any toys.

(b) (i) I purchased a new shirt.

(ii) I used more paper than required for printing.

(iii) I visited my friend's house on bike

(iv) I did not close that tap while brushing my teeth.

(v) I did not switch off my room lights last night.

7. On the basis of the issues raised in this chapter what changes would you incorporate in your lifestyle in a move towards a sustainable use of our resources?

- Ans:** (i) I will be utilizing these resources to minimum of my requirement.
(ii) I will try to stop their overuse or misuse where and whenever possible.
(iii) I will try to recycle and reuse the things where and whenever possible.
(iv) I will try to walk or use cycle only to go school or any nearby place.