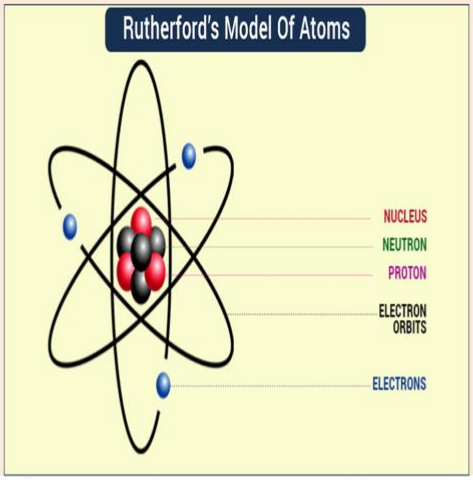
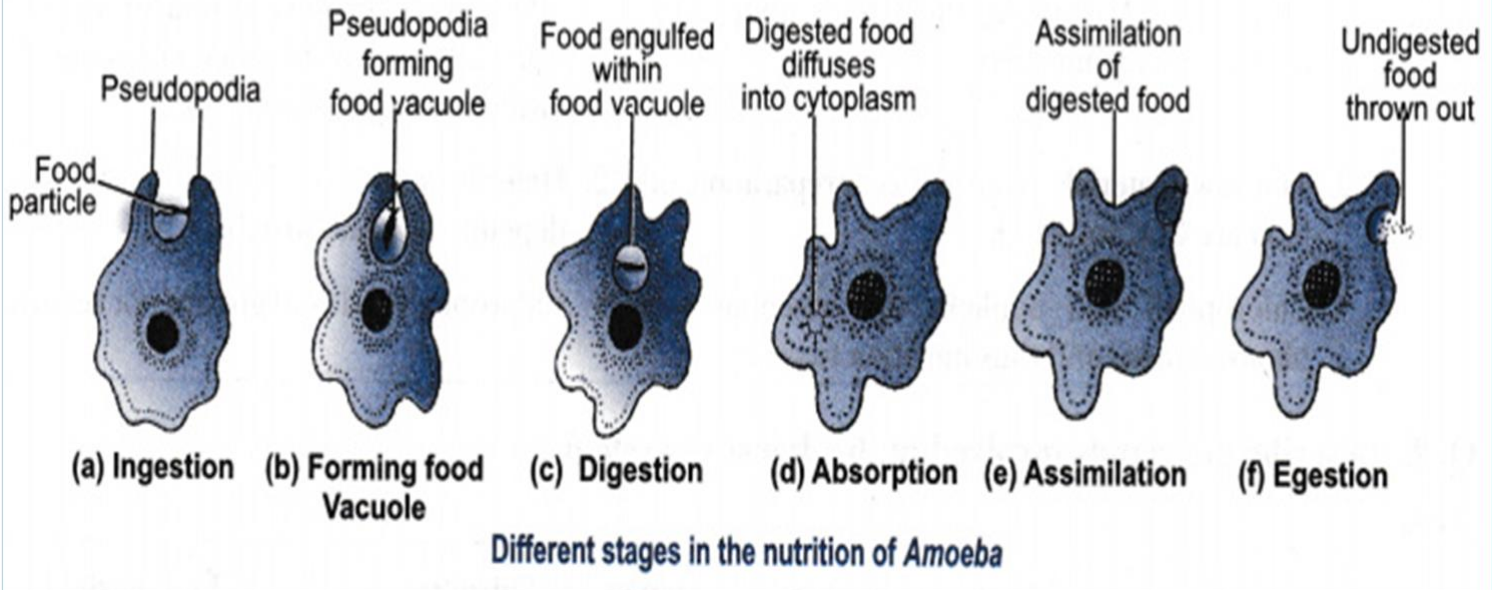
CLASS:IX

SCIENCE NOTES





Different stages in the nutrition of *Amoeba*

Chapter 1 – Matter in Our Surroundings

Exercise-1.1-1.2 Page: 3

Which of the following are matter?

Chair, air, love, smell, hate, almonds, thought, cold, lemon water, smell of perfume.

Solution:

The following substances are matter:

Chair

Air

Almonds

Lemon water.

Give reasons for the following observation:

The smell of hot sizzling food reaches you several meters away, but to get the smell from cold

food you have to go close.

Solution:

Particles in the air, if fueled with higher temperatures, acquire high kinetic energy which aids them

to move fast over a stretch. Hence the smell of hot sizzling food reaches a person even at a distance

of several meters.

A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?

Solution:

The diver is able to easily cut through the water in the swimming pool because of the weak forces of

attraction between water molecules. It is this property of water that attributes to easy diving.

What are the characteristics of the particles of matter?

Solution:

The characteristics of particles of matter are:

(a) Presence of intermolecular spaces between particles

(b) Particles are in constant motion

(c) They attract each other

Exercise-1.3 Page: 6

The mass per unit volume of a substance is called density. (density=mass/volume). Arrange the following in the order of increasing density – air, exhaust from the chimneys, honey, water, chalk, cotton and iron.

Solution:

The following substances are arranged in the increasing density:

Air

Exhaust from chimney

Cotton

Water

Honey

Chalk

Iron

Answer the following.

a) Tabulate the differences in the characteristics of matter.

b) Comment upon the following: rigidity, compressibility, fluidity, filling a gas container,

shape, kinetic energy and density.

Solution:

(a) The difference in the characteristics of the three states of matter.

Characteristics	Solid	Liquid	Gas
Shape	Fixed shape	No Fixed	No Fixed

		shape	shape
Volume	Fixed volume	Fixed volume	No Fixed volume
Intermolecular force	Maximum	Less than solids	Very less
Intermolecular space	Very less	More than solids	maximum
Rigidity/Fluidity	Rigid/cannot flow	Can flow/not rigid	Can flow/not rigid
Compressibility	negligible	compressible	Highly compressible

(b) (i) **Rigidity:** It is the propensity of a substance to continue to remain in its shape when treated
with an external force.
(ii) **Compressibility:** It is the attribute of the particles to contract its intermolecular space when
exposed to an external force thereby escalating its density.
(iii) **Fluidity:** It is the ability of a substance to flow or move about freely.
(iv) **Filling the gas container:** The particles in a container take its shape as they randomly vibrate in
all possible directions.
(v) **Shape:** It is the definite structure of an object within an external boundary
(vi) **Kinetic energy:** Motion allows particles to possess energy which is referred to as kinetic
energy. The increasing order of kinetic energy possessed by various states of matter are:
Solids < Liquids < Gases

Mathematically, it can be expressed as K.E =12mv2, where ‘m’ is the mass and ‘v’ is the velocity
of the particle.

(vii) **Density:** It is the mass of a unit volume of a substance. It is expressed as: d = M/V, where ‘d’ is the density, ‘M’ is the mass and ‘V’ is the volume of the substance

Give reasons

a) A gas fills completely the vessel in which it is kept.

b) A gas exerts pressure on the walls of the container.

c) A wooden table should be called a solid.

d) We can easily move our hand in the air but to do the same through a solid block of wood we need a karate expert.

Solution:

a) Kinetic energy possessed by gas particles is very high which allows them to randomly move
across all directions when contained, hence the particles fills the gas vessel entirely.

b) Gas molecules possess high kinetic energy, due to which they are under constant motion inside
the container in random directions which causes them to hit the walls of the container and hence create vibrations. These collisions with the walls of the container generate pressure.

c) A wooden table should be called a solid as it possesses all the properties of a solid such as
Definite size and shape
Intermolecular attraction between closely packed particles.
It is rigid and cannot be compressed

d) Molecules in gases are loosely packed as compared to solid molecules which are densely packed.

Hence we are easily able to break the force of attraction when we move our hand through air but find it difficult to break through a solid (because of greater forces of attraction between molecules) which a karate expert is able to smash with the application of a lot of force.

4.Liquids generally have a lower density than solids. But you must have observed that ice floats on water. Find out why.

Solution:

Density of ice is less than the density of water. The low density of ice can be attributed to the small

pores it has which allows it to trap air hence ice floats on water.

Exercise-1.4 Page: 9

Convert the following temperature to Celsius scale:

a. 300K b. 573K

Solution:

a. 0°C=273K

300K= (300-273)°C = 27°C

b. 573K= (573-273)°C = 300°C

What is the physical state of water at:

a. 250°C **b. 100**°C ?

Solution:

(a) At 250°C – Gaseous state since it is beyond its boiling point.

(b) At 100°C – It is at the transition state as the water is at its boiling point. Hence it would be

present in both liquid and gaseous state.

For any substance, why does the temperature remain constant during the change of state?

Solution:

It is due to the latent heat as the heat supplied to increase the temperature of the substance is used up to transform the state of matter of the substance hence the temperature stays constant.

Suggest a method to liquefy atmospheric gases.

Solution:

It can be achieved by either increasing the pressure or decreasing the temperature which ultimately leads to the reduction of spaces between molecules.

Exercise-1.5 Page:

1.**Why does a desert cooler cool better on a hot dry day?**

Solution:

It is because the temperature is high and it is less humid on a hot dry day which enables better evaporation. High levels of this evaporation provide better cooling effects.

2. How does the water kept in an earthen pot (matka) become cool during summer?

Solution:

An earthen pot is porous in nature. These tiny pores facilitate penetration of water and hence their evaporation from the pot surface. The process of evaporation requires energy which is contributed by water in the pot as a result of which water turns cooler.

3.Why does our palm feel cold when we put on some acetone or petrol or perfume on it?

Solution:

Acetone, petrol, and perfume are volatile substances that get evaporated when they come in contact
with air. Evaporation is facilitated as it uses energy from palm hence leaving a cooling effect on our
palms.

4. Why are we able to sip hot tea or milk faster from a saucer rather than a cup?

Solution:

A saucer has a larger surface area than a cup which promotes quicker evaporation hence the tea or milk in a saucer cools down faster.

5. What type of clothes should we wear in summer?

Solution:

In summer, it is preferred to wear light-coloured cotton clothes because light colour reflects heat and cotton materials have pores that absorb sweat, facilitating their evaporation hence causing a cooling effect in the skin.

Exercise Page: 12

Convert the following temperature to Celsius scale.

(a) 293K (b) 470K

Solution:

0°C=273K

(a) 293K= (293 – 273)°C = 20°C

(b) 470K= (470 – 273)°C = 197°C

2.Convert the following temperatures to the Kelvin scale.

(a) 25°C **(b) 373**°C

Solution:

0°C = 273K

(a) 25°C = (25+273)K = 298K

(b) 373°C = (373+273)K = 646K

3. Give reason for the following observations:

(a) Naphthalene balls disappear with time without leaving any solid.

(b) We can get the smell of perfume while sitting several metres away.

Solution:

(a) At room temperature, naphthalene balls undergo sublimation wherein they directly get converted
from a solid to a gaseous state without having to undergo the intermediate state, i.e., the liquid state.

(b) Molecules of air move at a higher speed and have large intermolecular spaces. Perfumes comprise
of flavoured substances that are volatile which scatters quickly in air, becoming less concentrated over a distance. Hence we are able to smell perfume sitting several metres away.

5. Arrange the following in increasing order of forces of attraction between the particles – water, sugar, oxygen.

Solution:

Oxygen (gas) < water (liquid) < sugar (solid)

6. What is the physical state of water at –

(a) 25°C (b) 0°C (c) 100°C?

Solution:

(a) At 25°C, the water will be in liquid form (normal room temperature)

(b) At 0°C, the water is at its freezing point, hence both solid and liquid phases are observed.

(c) At 100°C, the water is at its boiling point, hence both liquid and gaseous state of water (water
vapour) are observed.

7.Give two reasons to justify –

(a) Water at room temperature is a liquid.

(b) An iron almirah is a solid at room temperature.

Solution:

(a) Transition in the states of matter of water occurs at 0°C and 100°C. At room temperature, water

is in the liquid state, thereby exhibiting all the properties of a liquid such as

Water flows at this temperature
It has a fixed volume and it takes the shape of its container
(b) The melting and boiling points of iron are as high as 1538°C and 2862°C respectively. The room
temperature is about 20-25 °C. Hence iron almirah is a solid at room temperature.

8. Why is ice at 273K more effective in cooling than water at the same temperature?

Solution:

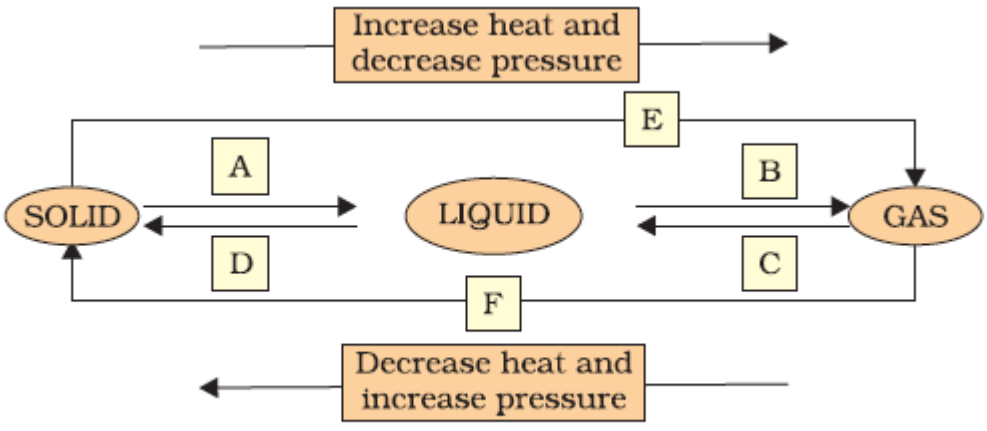
Water at this temperature(273K) is less effective than ice as ice can readily form water through absorption of ambient heat energy as opposed to water which does not exhibit this property as it already possesses additional latent heat of fusion so does not require extra heat. Hence ice cools rapidly compared to water at the same temperature.

9. What produces more severe burns, boiling water or steam?

Solution:

Steam produces severe burns. It is because it is an exothermic reaction that releases a high amount of heat which it had consumed during vaporization.

10. Name A, B, C, D, E and F in the following diagram showing a change in its state.



Solution:

A: Melting (or) fusion (or) liquefaction

B: Evaporation (or) vaporization

C: Condensation

D: Solidification

E: Sublimation

F: Sublimation

Chapter 2: Is Matter Around Us Pure

Exercise-2.1 Page: 15

1. What is meant by a substance?

Solution:

It is a pure single form of matter. A substance has definite properties and compositions. Example – Iron

2. List the points of differences between homogeneous and heterogeneous mixtures.

Solution:

Homogeneous mixture	**Heterogeneous mixture**
Particles are uniformly distributed throughout the mixture	All the particles are completely mixed and can be distinguished with the bare eyes or under a microscope.
Has a uniform composition	Irregular composition
No apparent boundaries of division	Noticeable boundaries of division.

Exercise-2.2 Page: 18

1. Differentiate between homogenous and heterogeneous mixtures with examples.

Solution:

The following are the differences between heterogeneous and homogenous mixtures.

Heterogeneous mixture	**Homogeneous mixture**
All the particles are completely mixed and can be distinguished with the bare eyes or under a microscope.	Particles are uniformly distributed throughout the mixture
Irregular composition	Has a uniform composition
Noticeable boundaries of division.	No apparent boundaries of division
Example: seawater, blood, etc.	Example: rainwater, vinegar, etc.

2. How are sol, solution and suspension different from each other?

Solution:

Attributes	**Sol**	**Solution**	**Suspension**
Type of Mixture	Heterogeneous	Homogeneous	Heterogeneous
Size of particles	10-7 – 10-5cm	Less than 1nm	More than 100nm
Tyndall effect	Exhibited	Not exhibited	May or may not be exhibited
Appearance	Usually glassy	Unclouded	Cloudy and

	and clear	and clear	opaque
Visibility	Visible with an ultramicroscope	Not visible	Visible with naked eye
Diffusion	Diffuses very slowly	Diffuses rapidly	Do not diffuse
Stability	Pretty stable	Highly stable	Unstable
Settling	Get settled in centrifugation	Do not settle	Settle on their own
Example	Milk, blood, smoke	Salt solution, Sugar solution	Sand in water, dusty air

3. To make a saturated solution, 36g of sodium chloride is dissolved in 100 g of water at 293 K. Find its concentration at this temperature.

Solution:

Mass of solute (NaCl) = 36 g

Mass of solvent (H_2O) = 100 g

Mass of solution (NaCl + H_2O) = 136 g

Concentration = Mass of solute/Mass of solution x 100

Concentration = 36/136 x 100 = 26.47%

Hence, the concentration of the solution is 26.47%

Exercise-2.3 Page: 24

1. How will you separate a mixture containing kerosene and petrol (difference in their boiling points is more than 25°C), which are miscible with each other?

Solution:

A technique known as simple distillation can be used to separate the mixture of miscible liquids, where the difference in boiling point is more than 25°C, to name a few – kerosene and petrol. The whole concept is established on the

volatility property of substances. The following are the various steps in the process of simple distillation:

(a) In a distillation flask, take the mixture.

(b) Treat the mixture with heat while a thermometer is affix.

(c) We observe evaporation of petrol as it has a low boiling point.

(d) As the vapours advance towards the condenser, a dip in the temperature causes condensation of the vapours into liquid which can be accumulated in a flask.

(e) We notice that kerosene tends to remain in the flask in a liquid state due to comparatively higher boiling point.

(f) Consequently, the liquids are separated.

2. Name the techniques used to separate the following:

(a) Butter from curd.

(b) Salt from seawater

(c) Camphor from salt

Solution:

a) A process known as centrifugation is used to separate butter from curd. The process is governed on the principle of density.

b) We can use the simple evaporation technique to separate salt from seawater. Distillation causes water to evaporate leaving solid salt behind, hence the production of salt.

c) Sublimation can be used to separate camphor from salt as during the phase change, camphor does not undergo a liquid phase.

3. What type of mixtures are separated by the technique of crystallization?

Solution:

The technique of crystallization is used to separate solids from a liquid solution. It is linked to precipitation, but in this technique, the precipitate is achieved in a crystal form which exhibits extremely high levels of purity. The principle of crystallization can be applied to purify impure substances.

Exercise-2.4 Page: 24

1. Classify the following as physical or chemical changes:

Cutting of trees

Melting of butter in a pan

Rusting of almirah

Boiling of water to form steam

Passing of electric current through water and water breaking into hydrogen and oxygen gases.

Dissolving common salt in water

Making a fruit salad with raw fruits, and

Burning of paper and wood

Solution:

The following is the classification into physical and chemical change

Physical change	Chemical change
Cutting the trees Boiling of water to form steam Melting of butter in a pan Making a fruit salad with raw fruits Dissolving common salt in water	Rusting of almirah Passing of electric current through water, and water breaking into hydrogen and oxygen gases Burning of paper and wood

2. Try segregating the things around you as pure substances and mixtures.

Solution:

Listed below are the classifications based on pure substances and mixtures:

Pure substance	Mixture
Water	Soil

Salt	Salad
Iron	Air
Diamond	Steel

Exercise Page: 28

1. Which separation techniques will you apply for the separation of the following?

(a) Sodium chloride from its solution in water.

(b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride.

(c) Small pieces of metal in the engine oil of a car.

(d) Different pigments from an extract of flower petals.

(e) Butter from curd.

(f) Oil from water.

(g) Tea leaves from tea.

(h) Iron pins from sand.

(i) Wheat grains from husk.

(j) Fine mud particles suspended in water.

Solution:

(a) In water, sodium chloride in its solution can be separated through the process of Evaporation.

(b) The technique of sublimation is apt as Ammonium chloride supports Sublimation.

(c) Tiny chunks of metal pieces in engine oil of car can be manually filtered.

(d) Chromatography can be used for the fine segregation of various pigments from an extract of flower petals.

(e) The technique of centrifugation can be applied to separate butter from curd. It is based on the concept of difference in density.

(f) To separate oil from water which are two immiscible liquids which vary in their densities, separating funnel can be an effective method.

(g) Tea leaves can be manually separated from tea using simple filtration methods.
(h) Iron pins can be separated from sand either manually or with the use of magnets as the pins exhibit strong magnetic quality which can be a key characteristic hence taken into consideration.
(i) The differentiating property between husk and wheat is that there is a difference in their mass. If treated with a small amount of wind energy, a remarkable variation in the moving distance is noticed. Hence to separate them, the sedimentation/winnowing procedure can be applied.
(j) Due to the property of water, sand or fine mud particles tends to sink in the bottom as it is denser provided they are undisturbed. Through the process of sedimentation/decantation water can be separated from fine mud particles as the technique is established on obtaining clear water by tilting it out.

2. Write the steps you would use for making tea. Use the words solution, solvent, solute, dissolve, soluble, insoluble, filtrate, and residue.

Solution:
(a) Into a vessel, add a cup of milk which is the solvent, supply it with heat.
(b) Add tea powder or tea leaves to the boiling milk, which acts as a solute. Continue to heat
(c) The solute i.e., the tea powder remains insoluble in the milk which can be observed while it is still boiling.
(d) At this stage, add some sugar to the boiling solution while stirring
(e) Sugar is a solute but is soluble in the solvent
(f) Continuous stirring causes the sugar to completely dissolve in the tea solution hence reaching saturation.
(g) Once the raw smell of tea leaves is vanished and tea solution is boiled enough, take the solution off the heat, filter or strain it to separate tea powder and the tea solution. The insoluble tea powder remains as a residue while the solute (sugar) and the solvent (essenced milk solution) strain through the filter medium which is collected as the filtrate.

3. Pragya tested the solubility of three different substances at different temperatures and collected the data as given below (results are given in the following table, as grams of a substance dissolved in 100 grams of water to form a saturated solution).

Substance dissolved	Temperature in K				
	283	293	313	333	353
	Solubility				
Potassium nitrate	21	32	62	106	167
Sodium chloride	36	36	36	37	37
Potassium chloride	35	35	40	46	54
Ammonium chloride	24	37	41	55	66

(a) What mass of potassium nitrate would be needed to produce a saturated solution of
potassium nitrate in 50 grams of water at 313K?
(b) Pragya makes a saturated solution of potassium chloride in water at 353 K and leaves the
solution to cool at room temperature. What would she observe as the solution cools? Explain.
(c) Find the solubility of each salt at 293 K. Which salt has the highest solubility at this
temperature?
(d) What is the effect of change of temperature on the solubility of a salt?

Solution:

(a) Given:

Mass of potassium nitrate required to produce a saturated solution in 100 g of water at 313 K = 62g

To find:

Mass of potassium nitrate required to produce a saturated solution in 50 g of water =?

Required amount = 62 x 50/100 = 31

Hence 31 g of potassium nitrate is required.

(b) The solubility of potassium chloride in water is decreased when a saturated solution of potassium chloride loses heat at 353 K. Consequently, Pragya would observe crystals of potassium chloride which would have surpassed it solubility at low temperatures.

(c) Listed below is the solubility of each salt at 293 K:

Solubility of Potassium nitrate —> 32/100

Solubility of Sodium chloride —> 36/100

Solubility of Potassium chloride —> 35/100

Solubility of Ammonium chloride —> 37/100

It is observed that the ammonium chloride salt has the highest amount of solubility when compared to any other salt at 293 K.

(d) Effect of change of temperature on the solubility of salts:

The table clearly depicts that the solubility of the salt is dependent upon the temperature and increases with an increase in temperature. With this, we can infer that when a salt arrives at its saturation point at a specific temperature, there is a propensity to dissolve more salt through an increase in the temperature of the solution.

4. Explain the following giving examples.

(a) Saturated solution

(b) Pure substance

(c) Colloid

(d) suspension

Solution:

(a) Saturated solution: It is that state in a solution at a specific temperature when a solvent is no more soluble without an increase in the temperature.

Example: Excess carbon leaves off as bubbles from a carbonated water solution saturated with carbon.

(b) Pure substance: A substance is said to be pure when it comprises of only one kind of molecules, atoms or compounds without adulteration with any other substance or any divergence in the structural arrangement. Example: Sulphur, diamonds

(c) Colloid: A Colloid is an intermediate between solution and suspension. It has particles of various sizes, that ranges between 2 to 1000 nanometers. Colloids can be distinguished from solutions using the Tyndall effect. Tyndall effect is defined as the scattering of light (light beam) through a colloidal solution. Example: Milk, gelatin.

(d) Suspension: It is a heterogeneous mixture that comprises of solute particles that are insoluble but are suspended in the medium. These particles that are suspended are not microscopic but visible to bare eyes and are large enough (usually larger than a micrometre) to undergo sedimentation.

5. Classify each of the following as a homogeneous or heterogeneous mixture.

soda water, wood, air, soil, vinegar, filtered tea.

Solution:

The following is the classification of the given substances into homogenous and heterogenous mixture.

Homogenous mixture	**Heterogeneous mixture**
Soda water	Wood
vinegar	Soil
Filtered tea	
Air	

6. How would you confirm that a colourless liquid given to you is pure water?

Solution:

We can confirm if a colourless liquid is pure by setting it to boil. If it boils at 100°C it is said to be pure. But if there is a decrease or increase in the boiling point, we infer that water has added impurities hence not pure.

7. Which of the following materials fall into the category of "pure substance"?

(a)Ice

(b)Milk

(c)Iron

(d)Hydrochloric acid

(e)Calcium oxide

(f)Mercury

(g)Brick

(e)Wood

(f)Air.

Solution:

Following substances from the above-mentioned list are pure substances:

Iron

Ice

Hydrochloric acid

Calcium oxide

Mercury

8. Identify the solutions among the following mixtures.

(a) Soil

(b) Sea water

(c) Air

(d) Coal

(e) Soda water

Solution:

The following are the solutions from the above-mentioned list of mixture:

Sea water
Air
Soda water

9. Which of the following will show the “Tyndall effect”?
(a) Salt solution
(b) Milk
(c) Copper sulphate solution
(d) Starch solution.
Solution:
Tyndall effect is exhibited by only milk and starch solution from the above-mentioned list of solutions.
10. Classify the following into elements, compounds and mixtures.
(a) Sodium
(b) Soil
(c) Sugar solution
(d) Silver
(e) Calcium carbonate
(f) Tin
(g) Silicon
(h) Coal
(i) Air
(j) Soap
(k) Methane
(l) Carbon dioxide
(m) Blood.
Solution:

Elements	Compounds	Mixture
Sodium	Calcium carbonate	Soil

Silver	Carbon dioxide	Sugar solution
Tin	Methane	Coal
Silicon		Air
		Blood
		Soap

Chapter 3 – Atoms and Molecules

Exercise-3.1 Page: 32

1. In a reaction, 5.3g of sodium carbonate reacted with 6 g of acetic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium acetate. Show that these observations are in agreement with the law of conservation of mass.

Sodium carbonate + acetic acid → Sodium acetate + carbon dioxide + water

Solution:

Sodium carbonate + acetic acid → Sodium acetate + carbon dioxide + water

5.3g 6g 8.2g 2.2g 0.9g

As per the law of conservation of mass, the total mass of reactants must be equal to the total mass of

products

As per the above reaction, LHS = RHS i.e., 5.3g + 6g = 2.2g + 0.9 g + 8.2 g = 11.3 g

Hence the observations are in agreement with the law of conservation of mass.

2. Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?

Solution:

We know hydrogen and water mix in the ratio 1: 8.

For every 1g of hydrogen, it is 8g of oxygen.

Therefore, for 3g of hydrogen, the quantity of oxygen = 3 x 8 = 24g

Hence, 24g of oxygen would be required for the complete reaction with 3g of hydrogen gas.

3. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?

Solution:

The postulate of Dalton's Atomic theory which is a result of the law of conservation of mass is,

"Atoms can neither be created nor destroyed".

4. Which postulate of Dalton's atomic theory can explain the law of definite proportions?

Solution:

The postulate of Dalton's atomic theory that can explain the law of definite proportions is – the

relative number and kinds of atoms are equal in given compounds.

Exercise-3.2 Page: 35

1. Define the atomic mass unit?

Solution:

An atomic mass unit is a unit of mass used to express weights of atoms and molecules where one

atomic mass is equal to 1/12th the mass of one carbon-12 atom.

2. Why is it not possible to see an atom with naked eyes?

Solution:

Firstly, atoms are miniscule in nature, measured in nanometers. Secondly, except for atoms of noble

gasses, they do not exist independently. Hence, an atom cannot be visible to the naked eyes.

Exercise-3.3-3.4 Page: 39

1. Write down the formulae of

(i) sodium oxide

(ii) aluminium chloride

(iii) sodium sulphide

(iv) magnesium hydroxide

Solution:

The following are the formulae:

(i) sodium oxide – Na_2O

(ii) aluminium chloride – $AlCl_3$

(iii) sodium sulphide – Na_2S

(iv) magnesium hydroxide – $Mg(OH)_2$

2. Write down the names of compounds represented by the following formulae:

(i) $Al_2(SO_4)_3$

(ii) $CaCl_2$

(iii) K_2SO_4

(iv) KNO_3

(v) $CaCO_3$.

Solution:

Listed below are the names of the compounds for each of the following formulae

(i) $Al_2(SO_4)_3$ – Aluminium sulphate

(ii) $CaCl_2$ – Calcium chloride

(iii) K_2SO_4 – Potassium sulphate

(iv) KNO_3 – Potassium nitrate

(v) $CaCO_3$ – Calcium carbonate

3. What is meant by the term chemical formula?

Solution:

Chemical formula is the symbolic representation of a chemical compound. For example: The chemical formula of hydrochloric acid is HCl.

4. How many atoms are present in a

(i) H_2S molecule and

(ii) PO_4^{3-} ion?

Solution:

The number of atoms present are as follows:

(i) H_2S molecule has 2 atoms of hydrogen and 1 atom of sulphur hence 3 atoms in totality.

(ii) PO_4^{3-} ion has 1 atom of phosphorus and 4 atoms of oxygen hence 5 atoms in totality.

Exercise-3.5.1-3.5.2 Page: 40

1. Calculate the molecular masses of H_2 , O_2 , Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.

Solution:

The following are the molecular masses:

The molecular mass of H_2 – 2 x atoms atomic mass of H = 2 x 1u = 2u

The molecular mass of O_2 – 2 x atoms atomic mass of O = 2 x 16u = 32u

The molecular mass of Cl_2 – 2 x atoms atomic mass of Cl = 2 x 35.5u = 71u

The molecular mass of CO_2 – atomic mass of C + 2 x atomic mass of O = 12 + (2×16)u = 44u

The molecular mass of CH_4 – atomic mass of C + 4 x atomic mass of H = 12 + (4 x 1)u = 16u

The molecular mass of C_2H_6– 2 x atomic mass of C + 6 x atomic mass of H = (2 x 12) +

(6 x 1)u=24+6=30u

The molecular mass of C_2H_4– 2 x atomic mass of C + 4 x atomic mass of H = (2x 12) +

(4 x 1)u=24+4=28u

The molecular mass of NH_3– atomic mass of N + 3 x atomic mass of H = (14 +3 x 1)u= 17u

The molecular mass of CH_3OH – atomic mass of C + 3x atomic mass of H + atomic mass of O + atomic mass of H = (12 + 3×1+16+1)u=(12+3+17)u = 32u

2. Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65u,

Na = 23 u, K=39u, C = 12u, and O=16u.

Solution:

Given:

Atomic mass of Zn = 65u

Atomic mass of Na = 23u

Atomic mass of K = 39u

Atomic mass of C = 12u

Atomic mass of O = 16u

The formula unit mass of ZnO= Atomic mass of Zn + Atomic mass of O = 65u+16u = 81u

The formula unit mass of Na_2O = 2 x Atomic mass of Na + Atomic mass of O = (2 x 23)u +16u=46u+16u=62u

Exercise-3.5.3 Page: 42

1. If one mole of carbon atoms weighs 12grams, what is the mass (in grams) of 1 atom of carbon?

Solution:

Given: 1 mole of carbon weighs 12g

1 mole of carbon atoms = 6.022×10^{23}

Molecular mass of carbon atoms = 12g = an atom of carbon mass

Hence, mass of 1 carbon atom = $12 / 6.022 \times 10^{23} = 1.99 \times 10^{-23}$g

2. Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23u, Fe = 56 u)?

Solution:

Given: Atomic mass of Na=23u, Atomic mass of Fe= 56u

To calculate the number of atoms in 100g of sodium:

23g of Na contains = 6.022×10^{23} atoms

1g of Na contains = 6.022×10^{23} atoms / 23

100g of Na contains = 6.022×10^{23} atoms X 100 / 23

= 2.6182×10^{24} atoms

To calculate the number of atoms in 100g of sodium:

56g of Fe contains = 6.022×10^{23} atoms

1g of Fe contains = 6.022×10^{23} atoms / 56

100g of Fe contains = 6.022×10^{23} atoms X 100 / 56

= 1.075×10^{24} atoms

Hence, through comparison, it is evident that 100g of Na has more atoms.

Exercise Page: 43

1. A 0.24g sample of compound of oxygen and boron was found by analysis to contain 0.096g of boron and 0.144g of oxygen. Calculate the percentage composition of the compound by weight.

Solution:

Given: Mass of the sample compound = 0.24g, mass of boron = 0.096g, mass of oxygen = 0.144g

To calculate percentage composition of the compound:

Percentage of boron = mass of boron / mass of the compound x 100

= 0.096g / 0.24g x 100 = 40%

Percentage of oxygen = 100 – percentage of boron

= 100 – 40 = 60%

2. When 3.0g of carbon is burnt in 8.00 g of oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

Solution:

11.00g of carbon dioxide is formed when 3.00g carbon is burnt in 8.00g of oxygen.

Carbon and oxygen are combined in the ratio 3:8 to give carbon dioxide using up all the carbon and

oxygen

Hence, for 3g of carbon and 50g of oxygen, 8g of oxygen is used and 11g of carbon is formed, the

left oxygen is unused i.e., 50-8=42g of oxygen is unused.

This depicts the law of definite proportions – The combining elements in compounds are present in

definite proportions by mass.

3. What are polyatomic ions? Give examples.

Solution:

Polyatomic ions are ions that contain more than one atom but they behave as a single unit

Example: CO_3^{2-} , $H_2PO_4^-$

4. Write the chemical formula of the following.

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate

Solution:

The following are the chemical formula of the above-mentioned list:

(a) Magnesium chloride – $MgCl_2$

(b) Calcium oxide – CaO

(c) Copper nitrate – $Cu(NO_3)_2$

(d) Aluminium chloride – $AlCl_3$

(e) Calcium carbonate – $CaCO_3$

5. Give the names of the elements present in the following compounds.

(a) Quick lime

(b) Hydrogen bromide

(c) Baking powder

(d) Potassium sulphate.

Solution:

The following are the names of the elements present in the following compounds:

(a) Quick lime – Calcium and oxygen (CaO)

(b) Hydrogen bromide – Hydrogen and bromine (HBr)

(c) Baking powder – Sodium, Carbon, Hydrogen, Oxygen ($NaHCO_3$)

(d) Potassium sulphate – Sulphur, Oxygen, Potassium (K_2SO_4)

6. Calculate the molar mass of the following substances.

(a) Ethyne, C_2H_2

(b) Sulphur molecule, S_8

(c) Phosphorus molecule, P_4 (Atomic mass of phosphorus =31)

(d) Hydrochloric acid, HCl

(e) Nitric acid, HNO_3

Solution:

Listed below is the molar mass of the following substances:

(a) Molar mass of Ethyne C_2H_2= 2 x Mass of C+2 x Mass of H = (2×12)+(2×1)=24+2=26g

(b) Molar mass of Sulphur molecule S_8 = 8 x Mass of S = 8 x 32 = 256g

(c) Molar mass of Phosphorus molecule, P_4 = 4 x Mass of P = 4 x 31 = 124g

(d) Molar mass of Hydrochloric acid, HCl = Mass of H+ Mass of Cl = 1+35.5 = 36.5g

(e) Molar mass of Nitric acid, HNO_3 =Mass of H+ Mass of Nitrogen + 3 x Mass of O = 1 + 14+

3×16 = 63g

7. What is the mass of –

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms((Atomic mass of aluminium =27)?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

Solution:

The mass of the above mentioned list is as follows:

(a) Atomic mass of nitrogen atoms = 14u

Mass of 1 mole of nitrogen atoms= Atomic mass of nitrogen atoms

Therefore, mass of 1 mole of nitrogen atom is 14g

(b) Atomic mass of aluminium =27u

Mass of 1 mole of aluminium atoms = 27g

1 mole of aluminium atoms = 27g, 4 moles of aluminium atoms = 4 x 27 = 108g

(c) Mass of 1 mole of sodium sulphite Na_2SO_3 = Molecular mass of sodium sulphite = 2 x Mass of Na + Mass of S + 3 x Mass of O = (2 x 23) + 32 +(3x 16) = 46+32+48 = 126g

Therefore, mass of 10 moles of Na_2SO_3 = 10 x 126 = 1260g

8. Convert into mole.

(a) 12g of oxygen gas
(b) 20g of water
(c) 22g of carbon dioxide

Solution:

Conversion of the above-mentioned molecules into moles is as follows:

(a) Given: Mass of oxygen gas=12g

Molar mass of oxygen gas = 2 Mass of Oxygen = 2 x 16 = 32g

Number of moles = Mass given / molar mass of oxygen gas = 12/32 = 0.375 moles

(b) Given: Mass of water = 20g

Molar mass of water = 2 x Mass of Hydrogen + Mass of Oxygen = 2 x 1 + 16 = 18g

Number of moles = Mass given / molar mass of water

= 20/18 = 1.11 moles

(c) Given: Mass of carbon dioxide = 22g

Molar mass of carbon dioxide = Mass of C + 2 x Mass of Oxygen = 12 + 2x 16 = 12+32=44g

Number of moles = Mass given/ molar mass of carbon dioxide = 22/44 = 0.5 moles

9. What is the mass of:
(a) 0.2 mole of oxygen atoms?
(b) 0.5 mole of water molecules?

Solution:

The mass is as follows:

(a) Mass of 1 mole of oxygen atoms = 16u, hence it weighs 16g

Mass of 0.2 moles of oxygen atoms = 0.2 x 16 = 3.2u

(b) Mass of 1 mole of water molecules = 18u, hence it weighs 18g

Mass of 0.5 moles of water molecules = 0.5 x 18 = 9u

10. Calculate the number of molecules of sulphur (S_8) present in 16g of solid sulphur.

Solution:

To calculate molecular mass of sulphur:

Molecular mass of Sulphur (S_8) = 8xMass of Sulphur = 8×32 = 256g

Mass given = 16g

Number of moles = mass given/ molar mass of sulphur

= 16/256 = 0.0625 moles

To calculate the number of molecules of sulphur in 16g of solid sulphur:

Number of molecules = Number of moles x Avogadro number

= 0.0625 x 6.022 x 10^{23} molecules

= 3.763 x 10^{22} molecules

11. Calculate the number of aluminium ions present in 0.051g of aluminium oxide.

(*Hint:* The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27u)

Solution:

To calculate the number of aluminium ions in 0.051g of aluminium oxide:

1 mole of aluminium oxide = 6.022 x 10^{23} molecules of aluminium oxide

1 mole of aluminium oxide (Al_2O_3) = 2 x Mass of aluminium + 3 x Mass of Oxygen

= (2x 27) + (3 x16) = 54 +48 = 102g

1 mole of aluminium oxide = 102g = 6.022 x 10^{23} molecules of aluminium oxide

Therefore, 0.051g of aluminium oxide has = 0.051 x 6.022 x 10^{23} / 102

= 3.011 x 10^{20} molecules of aluminium oxide

One molecule of aluminium oxide has 2 aluminium ions, hence number of aluminium ions present in 0.051g of aluminium oxide = 2 x 3.011x 10^{20} molecules of aluminium oxide

= 6.022 x 10^{20}

Chapter 4 – Structure Of The Atom

Exercise-4.1 Page: 47

1. What are the canal rays?

Solution:

The radiations that are positively charged are canal rays. This discovery was crucial in the discovery

of another subatomic particle that was positively charged – proton.

2. If an atom contains one electron and one proton, will it carry any charge or not?

Solution:

Since a proton is a positively charged particle and an electron is a negatively charged particle, the net

charge becomes neutral as both the particles neutralizes each other.

Exercise-4.2 Page: 49

1. On the basis of Thompson's model of an atom, explain how the atom is neutral as a whole.

Solution:

As per Thompson's model of an atom,

(i) An atom contains a positively charged sphere in which the negatively charged electrons are implanted.

(ii) Electrons and protons are equal in magnitude, hence an atom on the whole is electrically neutral.

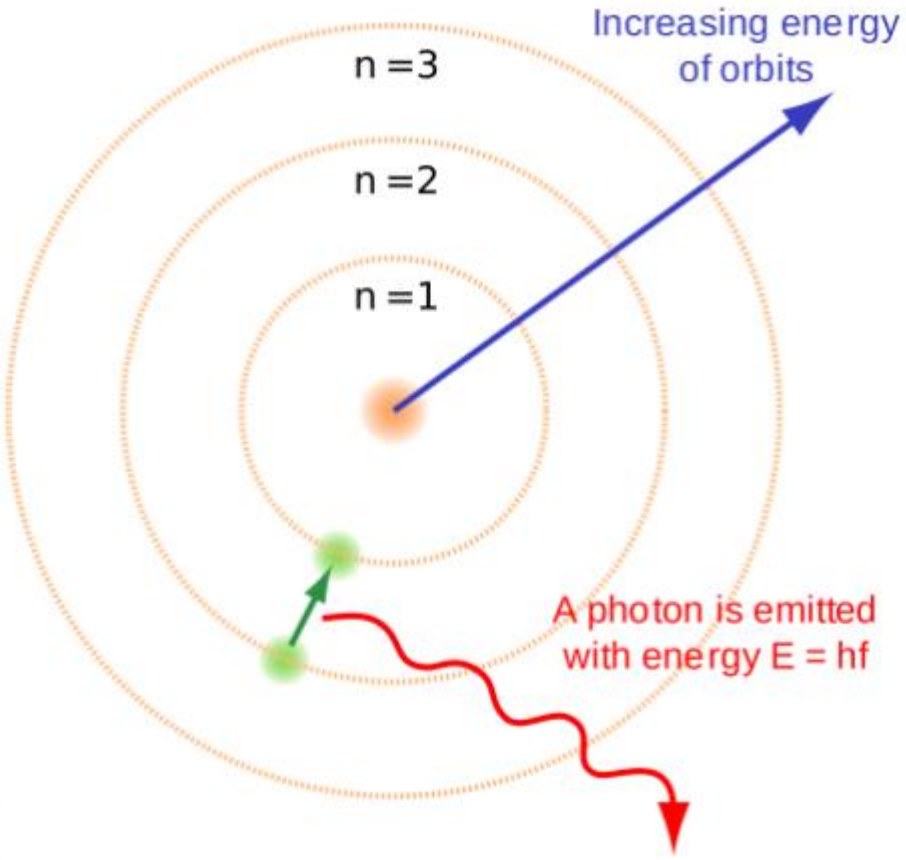
2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

Solution:

As per Rutherford's model of an atom, the positively charged protons are the ones that are present in the atom.

3. Draw a sketch of Bohr's model of an atom with three shells.

Solution:



4. What do you think would be the observation if the ∝– particle scattering experiment is carried out using a foil of a metal other than gold?

Solution:

In the ∝ – particle scattering experiment, when any other metal foil is used instead of gold, the observation would remain the same. This is because the structure of an atom when considered individually remains the same.

Exercise-4.2.4 Page: 49

1. Name the three subatomic particles of an atom.

Solution:

An atom consists of three subatomic particles:

Protons – positively charged

Electrons – negatively charged

Neutrons – neutral in nature (no charge)

2. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

Solution:

Given: Atomic mass of helium atom = 4u, 2 protons in helium nucleus

Atomic mass = number of protons + number of neutrons

4 = 2 + number of neutrons

Number of neutrons = 4 – 2 = 2

Hence, Helium has 2 neutrons.

Exercise-4.3 Page: 50

1. Write the distribution of electrons in Carbon and Sodium atoms.

Solution:

Distribution of electrons in Carbon atoms:

The atomic number of Carbon is 6

Number of electrons is equal to the number of protons in carbon atom i.e., 6

The distribution of electrons in carbon atom is K – 2, L – 4

Distribution of electrons in sodium atoms:

The atomic number of Sodium is 11

Number of electrons is equal to the number of protons in sodium atom i.e., 11

The distribution of electrons in sodium atom is K – 2, L – 8, M – 1

2. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

Solution:

K shell can hold 2 electrons

L shell can hold 8 electrons

Hence, when both the shells are full, the total number of electrons present in the atom = 2+8 = 10 electrons.

Exercise-4.4 Page: 52

1. How will you find the valency of chlorine, sulphur and magnesium?

Solution:

The definite combining capacity of the atoms of each element, wherein electrons are lost, gained or shared to make the octet of electrons present in the outermost shell is defined as valency. To measure valency, we can figure out the number of electrons that are required to complete the shell in which

it is contained or losing excess electrons if present, once the filling is complete.

To find the valency of chlorine:

The atomic number of chlorine is 17

Number of electrons is equal to the number of protons in chlorine i.e., 17

The distribution of electrons in chlorine atom is K – 2, L – 8, M – 7

Hence, from the distribution of chlorine it is clearly evident that to fill the M shell only one electron is required. Therefore its valency is -1. i.e, one electron less

To find the valency of sulphur:

The atomic number of sulphur is 16

Number of electrons is equal to the number of protons in sulphur i.e., 16

The distribution of electrons in sulphur atom is K – 2, L – 8, M – 6

Hence, from the distribution of sulphur it is clearly evident that to fill the M shell two more electrons are required. Therefore its valency is -2, i.e., two electrons lesser.

To find the valency of magnesium:

The atomic number of magnesium is 12

Number of electrons is equal to the number of protons in magnesium i.e., 12

The distribution of electrons in magnesium atom is K – 2, L – 8, M – 2

Hence, from the distribution of magnesium it is clearly evident that to fill the M shell six more electrons are required. But M shell has two electrons only. It possesses lesser electrons than needed to fill the shell.

Thus, we say that the magnesium atom is not stable as the M shell has 2 electrons. Its valency is +2, meaning it has 2 electrons in excess.

Exercise-4.5 Page: 52

1. If the number of electrons in an atom is 8 and number of protons is also 8, then

(i) What is the atomic number of the atom? and

(ii) What is the charge on the atom?

Solution:

Given: Number of electrons = 8

Number of protons = 8

(a) The atomic number of an atom is the same as the number of protons in that atom, hence its atomic number is 8.

(b) In an atom, the number of protons is equal to the number of electrons. Hence both the charges – positive and negative neutralize each other. Therefore, the atom does not possess any charge.

2. With the help of given Table, find out the mass number of oxygen and sulphur atom.

Table: Composition of Atoms of the First Eighteen Elements with Electron Distribution in Various Shells.

Name of Element	Symbol	Atomic number	Number of Protons	Number of Neutrons	Number of electrons	Distribution of electrons K L M N				Valency
Hydrogen	H	1	1	–	1	1	–	–	–	1
Helium	He	2	2	2	2	2	–	–	–	0
Lithium	Li	3	3	4	3	2	1	–	–	1
Beryllium	Be	4	4	5	4	2	2	–	–	2
Boron	B	5	5	6	5	2	3	–	–	3
Carbon	C	6	6	6	6	2	4	–	–	4
Nitrogen	N	7	7	7	7	2	5	–	–	3
Oxygen	O	8	8	8	8	2	6	–	–	2
Fluorine	F	9	9	10	9	2	7	–	–	1
Neon	Ne	10	10	10	10	2	8	–	—	0
Sodium	Na	11	11	12	11	2	8	1	–	1
Magnesium	Mg	12	12	12	12	2	8	2	–	2

Aluminium	Al	13	13	14	13	2	8	3	–	3
Silicon	Si	14	14	14	14	2	8	4	–	4
Phosphorus	P	15	15	16	15	2	8	5	–	3,5
Sulphur	S	16	16	16	16	2	8	6	–	2
Chlorine	Cl	17	17	18	17	2	8	7	–	1
Argon	Ar	18	18	22	18	2	8	8		0

Solution:

(a) To find the mass number of Oxygen:

Number of protons = 8

Number of neutrons = 8

Atomic number = 8

Atomic mass number = Number of protons + number of neutrons = 8 + 8 = 16

Therefore, mass number of oxygen = 16

(b) To find the mass number of Sulphur:

Number of protons = 16

Number of neutrons = 16

Atomic number = 16

Atomic mass number = Number of protons + number of neutrons = 16 + 16 = 32

Exercise-4.6 Page: 53

1. For the symbol H, D and T, tabulate three subatomic particles found in each of them.

Solution:

The following table depicts the subatomic particles in Hydrogen (H), Deuterium (D), and Tritium(T).

Isotope	Symbol	Mass no.	Atomic no.	No. of electrons	No. of protons	No. of neutrons

Hydrogen	H	1	1	1	1	0
Deuterium	D	2	1	1	1	1
Tritium	T	3	1	1	1	2

2. Write the electronic configuration of any one pair of isotopes and isobar.

Solution:

(a) Isotopes: Isotopes are atoms which have the same number of protons but the number of neutrons differs. This leads to the variation in mass number too.

Example: Carbon molecule exists as $_{6}C^{12}$ and $_{6}C^{14}$ but when their electronic configuration is noticed, both have K-2; L-4

(b) Isobars: Isobars are atoms which have the same mass number but differ in the atomic number. Electronic configuration of an isobar pair is as follows,

Example: Electronic configuration of $_{20}Ca^{40}$ – K-2; L-8; M-8; N- 2

Electronic configuration of $_{18}Ar^{40}$ – K-2; L-8; M-8

Exercise Page: 54

1. Compare the properties of electrons, protons and neutrons.

Solution:

Property	**Electrons**	**Protons**	**Neutrons**
Charge	Negatively charged	Positively charged	No charge.
Location	Located outside the nucleus	Located within the nucleus	Located inside the nucleus of an atom
Weight	Mass is negligible	1 a.m.u	1 a.m.u
Affinity	Attracted	Attracted	Do not get

	towards positively charged	towards negatively charged	attracted to any charged particle

2. What are the limitations of J.J.Thomson's model of the atom?

Solution:

The following are the limitations of the J.J. Thomson's model of an atom.

The model failed to explain the outcome of alpha particle scattering which was conducted by Rutherford. The model failed to depict why majority of these alpha particles pass through gold foil while some are diverted through small and big angles, while some others rebound completely, returning back on their path.

It did not provide any experimental evidence and was established on imagination.

3. What are the limitations of Rutherford's model of the atom?

Solution:

Following are the limitations of Rutherford's model of the atom:

There is no expected stability in the revolution of the electron in a circular orbit

Charged particles radiate energy when accelerated thus causing the revolving electrons to lose energy and would fall into the nucleus

Hence atoms must be highly unstable. Matter would not exist in their known form which clearly is an assumption as atoms are highly stable.

4. Describe Bohr's model of the atom.

Solution:

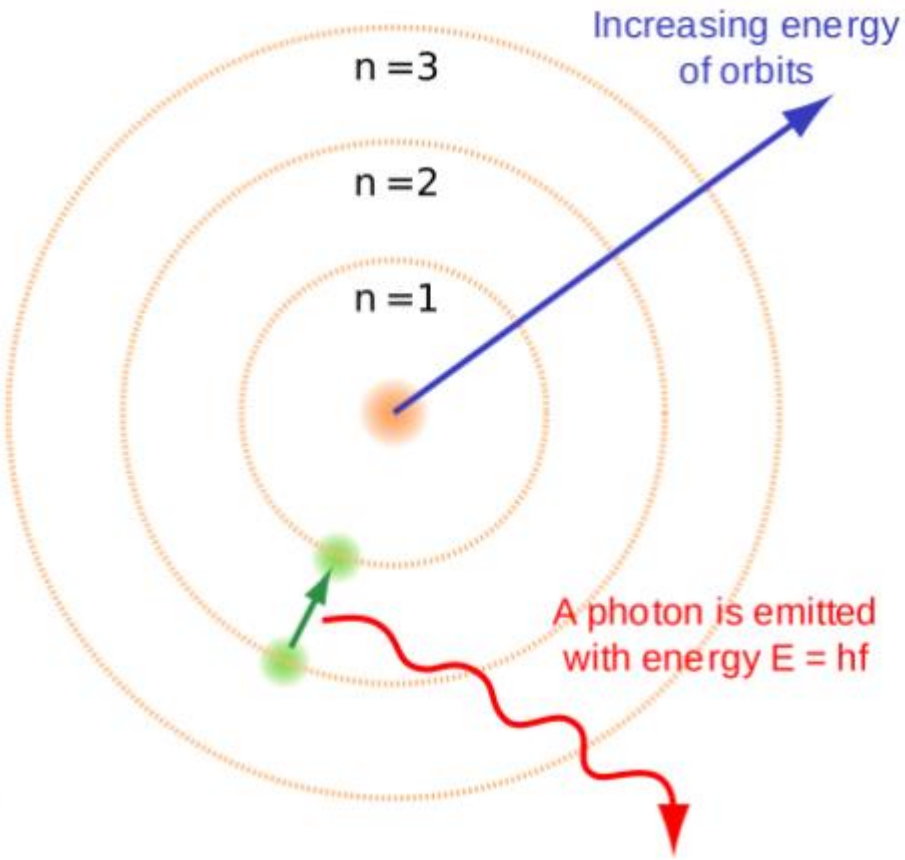
An atom holds the nucleus at the centre.

Negatively charged electrons revolve around the nucleus.

The atoms in it contains distinct orbits of electrons.

Electrons do not radiate energy when they are in their orbits.

The distinct orbits are named as K, L, M, N orbits. Numbers used to denote them are n=1, 2, 3, 4

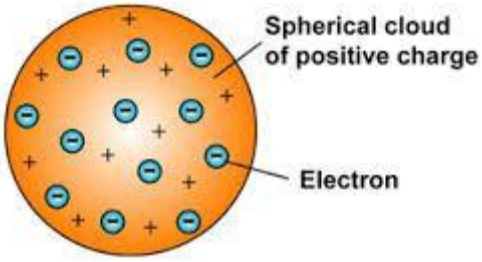


5. Compare all the proposed models of an atom given in this chapter.

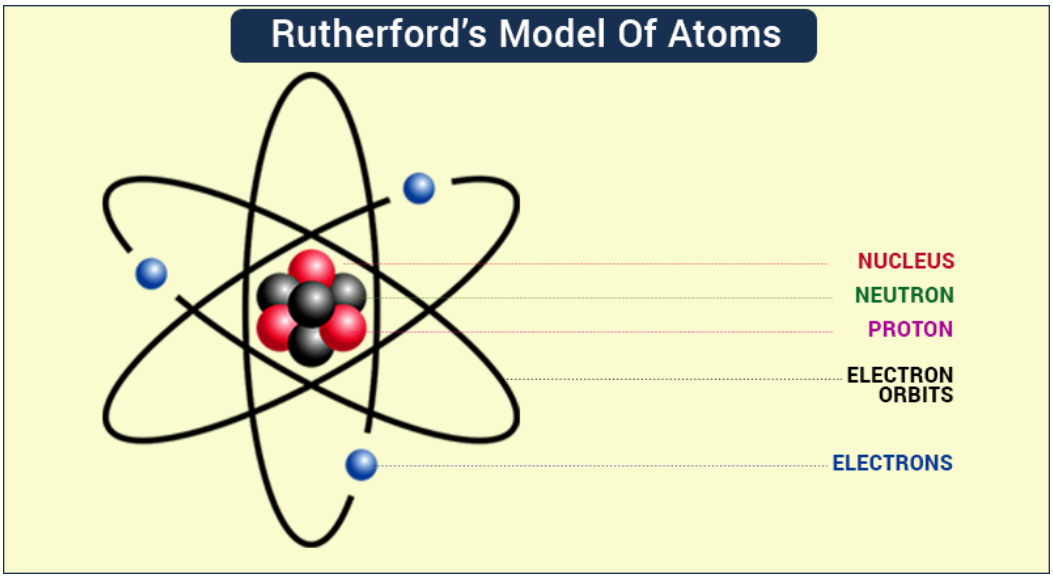
Solution:

Thomson	**Rutherford**	**Bohr**
● Sphere is positively charged ●Electrons are negatively charged and scattered all through the inside of the sphere. ● Positively charged = negatively charged ● The net charge in the atom is zero.	● The nucleus is at the centre and is positively charged holding the entire mass. ● Electrons are negatively charged revolving in a well-defined path ●In comparison with the nucleus, the size of the atom is very large.	●Nucleus is present at the centre and is positively charged ● Electrons are negatively charged, revolving around but do not radiate energy. ● The distinct orbits are labelled as K, L, M, N

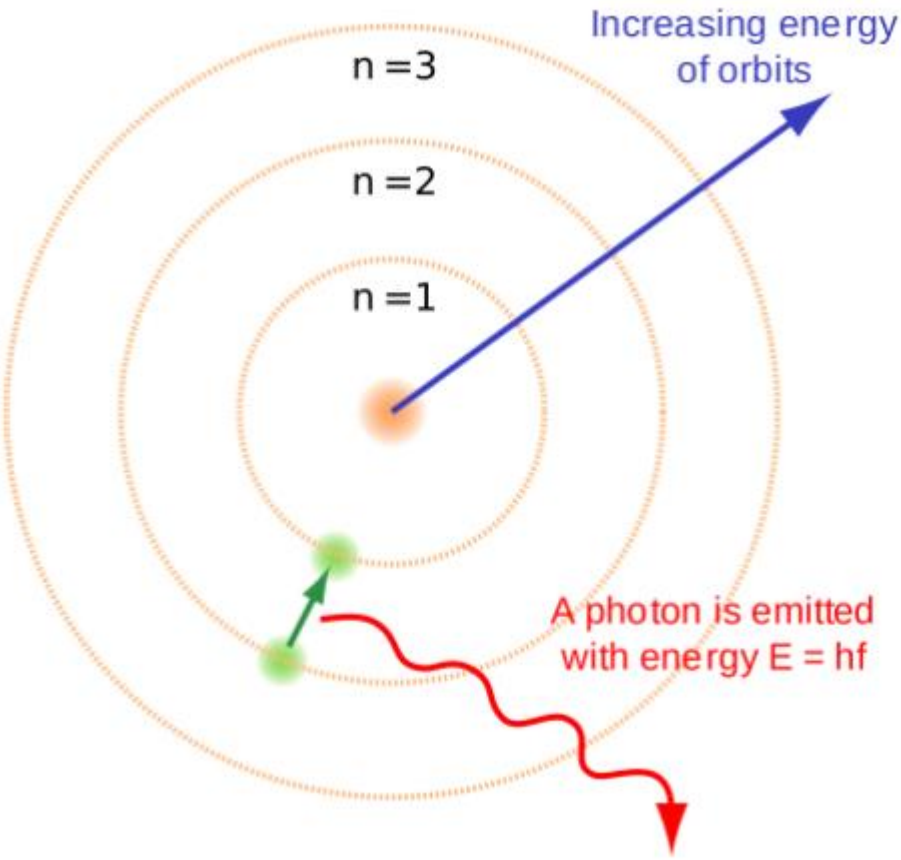
6. Thomson's Model of Atom



7. Rutherford's Model of Atoms



8. Bohr's model of the atom



Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.

Solution:

Maximum number of electrons that can be accommodated in a shell is given by the formula: $2n^2$, where n= 1, 2, 3…

Maximum number of electrons in different shells are:

K shell – n=1 ; $2n^2 = 2(1)^2 = 2$

L shell – n=2 ; $2n^2 = 2(2)^2 = 8$

M shell – n=3 ; $2n^2 = 2(3)^2 = 18$

N shell- n=4 ; $2n^2 = 2(4)^2 = 32$

The outermost orbit can be accommodated with 8 electrons at the maximum. The electrons are not taken in unless the inner shells are filled which are filled step-wise, hence the highest element has K-2; L-8 ; M-8 distribution of electrons.

9. Define valency by taking examples of silicon and oxygen.

Solution:

The definite combining capacity of the atoms of each element, wherein electrons are lost, gained or shared to make the octet of electrons present in the outermost shell is defined as valency. To measure valency, we can figure out the number of electrons that are required to complete the shell in which it is contained or losing excess electrons if present, once the filling is complete.

Example : To find the valency of silicon:

The atomic number of silicon is 14

Number of electrons is equal to the number of protons in silicon i.e., 14

The distribution of electrons in silicon atom is K – 2, L – 8, M – 4

Hence, from the distribution of silicon it is clearly evident that to fill the M shell 4 electrons are required. Therefore its valency is 8-4=4.

To find the valency of oxygen:

The atomic number of oxygen is 8

Number of electrons is equal to the number of protons in oxygen i.e., 8
The distribution of electrons in oxygen atom is K – 2, L – 6
Hence, from the distribution of oxygen it is clearly evident that to fill the M shell 6 more electrons are required. Therefore its valency is 8-6=2.

10. Explain with examples

(i) Atomic number,

(ii) Mass number,

(iii) Isotopes and

(iv) Isobars.

Give any two uses of isotopes.

Solution:

(i) The number of positively charged protons present in the nucleus of an atom is defined as the atomic number and is denoted by Z. Example: Hydrogen has one proton in its nucleus, hence its atomic number is one.

(ii) The total number of protons and neutrons present in the nucleus of an atom is known as the mass number. It is denoted by A. $_{20}Ca^{40}$. Mass number is 40. Atomic number is 20.

(iii) The atoms which have the same number of protons but different number of neutrons are referred to as isotopes. Hence the mass number varies. Example: The most simple example is the Carbon molecule which exists as $_{6}C^{12}$ and $_{6}C^{14}$

(iv) Isobars: Isobars are atoms which have the same mass number but differ in the atomic number.

Examples are, $_{20}Ca^{40}$and $_{18}Ar^{40}$

Uses of isotopes:

The isotope of Iodine atom is used to treat goitre and iodine deficient disease.

In the treatment of cancer, an isotope of cobalt is used.

Fuel for nuclear reactors is derived from the isotopes of the Uranium atom.

11. Na+ has completely filled K and L shells. Explain.

Solution:

The atomic number of sodium is 11. It has 11 electrons in its orbitals wherein the number of protons is equal to the number of electrons. Hence, its electronic configuration is K-2 ; L-8 ; M-1 ; The one electron in the M shell is lost and it obtains a positive charge since it has one more proton than electrons, and obtains a positive charge, Na+ . The new electronic configuration is K-1 ; L-8 which is the filled state. Hence it is very difficult to eliminate the electron from a filled state as it is very stable.

12. If bromine atom is available in the form of, say, two isotopes $_{35}Br^{79}$ (49.7%) and $_{35}Br^{81}$ (50.3%), calculate the average atomic mass of Bromine atom.

Solution:

The atomic masses of two isotopic atoms are 79 (49.7%) and 81 (50.3%).

Thus, total mass = (79 * 49.7 / 100) + (81 * 50.3 / 100) = 39.263 + 40.743 = 80.006 u

13. The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes $_8X^{16}$ and $_8X^{18}$ in the sample?

Solution:

Let the percentage of $_8X^{16}$ be ‘a’ and that of $_8X^{18}$ be ‘100-a’.

As per given data,

16.2u = 16 a / 100 + 18 (100-a) /100

1620 = 16a + 1800 – 18a

1620 = 1800 – 2a

a = 90%

Hence, the percentage of isotope in the sample $_8X^{16}$ is 90% and that of $_8X^{18}$ = 100-a = 100- 90=10%

14. If Z=3, what would be the valency of the element? Also, name the element.

Solution:

Given: Atomic number, Z = 3

The electronic configuration of the element = K-2; L-1, hence its valency = 1

The element with atomic number 3 is Lithium.

15. Composition of the nuclei of two atomic species X and Y are given as under

	X	Y
Protons =	**6**	**6**
Neutrons =	**6**	**8**

Give the mass numbers of X and Y. What is the relation between the two species?

Solution:

Mass number of X: Protons + neutrons = 6+6 = 12

Mass number of Y: Protons + neutrons = 6+8 = 14

They are the same element as their atomic numbers are the same.

They are isotopes as they differ in the number of neutrons and hence their mass numbers.

16. For the following statements, write T for true and F for false.

(a) J.J. Thomson proposed that the nucleus of an atom contains only nucleons.

(b) A neutron is formed by an electron and a proton combining together. Therefore it is neutral.

(c) The mass of an electron is about 1/2000 times that of proton.

(d) An isotope of iodine is used for making tincture iodine, which is used as a medicine.

Solution:

(a) Statement is False

(b) Statement is False

(c) Statement is True

(d) Statement is False

17. Put a tick(✓) against correct choice and cross(x) against wrong choice in questions 15, 16 and 17.

Rutherford's alpha – particle scattering experiment was responsible for the discovery of

(a) Atomic nucleus
(b) Electron
(c) Proton
(d) Neutron
Solution:
(a) Atomic nucleus

Isotopes of an element have

(a) The same physical properties
(b) Different chemical properties
(c) Different number of neutrons
(d) Different atomic numbers.
Solution:
(c) Different number of neutrons

18. Number of valence electrons in Cl– ion are:

(a) 16
(b) 8
(c) 17
(d) 18
Solution:
(b) 8
Electronic distribution of Cl is K-2, L-8, M-7. Valence electrons are 7, hence chlorine gains one electron for the formation of Cl^-. Therefore, its valency is 8.

19. Which one of the following is a correct electronic configuration of Sodium?

(a) 2, 8
(b) 8, 2, 1
(c) 2, 1, 8
(d) 2, 8, 1
Solution:
(d) 2, 8, 1

Complete the following table.

Atomic number	Mass number	Number of neutrons	Number of Protons	Number of electrons	Name of the atomic species
9	–	10	–	–	–
16	32	–	–	–	Sulphur
–	24	–	12	–	–
–	2	–	1	–	–
–	1	0	1	0	–

Solution:

The following table depicts the missing data:

Atomic number(Z) =Number of protons

Mass number = Number of neutrons + atomic number

(or)

Mass number(A) = Number of neutrons + number of neutrons

Atomic number	Mass number	Number of neutrons	Number of Protons	Number of electrons	Name of the atomic species
9	19	10	9	9	Fluorine
16	32	16	16	16	Sulphur
12	24	12	12	12	Magnesium
1	2	1	1	1	Deuterium
1	1	0	1	0	Hydrogen

Chapter 5 – The Fundamental Unit Of Life

Exercise-5.1 Page: 59

1. Who discovered cells, and how?

Solution:

in 1665, Robert Hooke discovered cells while examining a thin slice of cork through a self-designed microscope. He observed that the cork resembled the structure of a honeycomb consisting of numerous tiny compartments. The minuscule boxes are referred to as cells.

2. Why is the cell called the structural and functional unit of life?

Solution:

Cells form the structure of an entity. A group of cells form a tissue, further an organ and ultimately an organ system. They perform fundamental functions and life processes such as respiration, digestion, excretion etc in both unicellular and multicellular entities. They perform all the activities independently. Hence, cells are referred to as structural and fundamental units of life.

Exercise-5.2.1 Page: 61

3. How do substances like CO_2 and water move in and out of the cell? Discuss.

Solution:

CO_2 moves by diffusion – These cellular waste accumulates in high concentrations in the cell, whereas the concentration of CO_2 in the external surroundings is comparatively lower. This difference in the concentration level inside and out of the cell causes the CO_2 to diffuse from a region of higher(within the cell) to a lower concentration.

H_2O diffuses by osmosis through the cell membrane. It moves from a region of higher concentration to a lower concentrated region through a selectively permeable membrane until equilibrium is reached.

4. Why is the plasma membrane called a selectively permeable membrane?

Solution:

The plasma membrane is called as a selectively permeable membrane as it permits the movement of only a certain molecules in and out of the cells. Not all molecules are free to diffuse.

Exercise-5.2.2-5.2.4 Page: 63

5. Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.

Prokaryotic Cell	**Eukaryotic Cell**
1. Size: Generally small (1-10 μm) 1 μm = 10^{-6}m 2. Nuclear region: _____ _____ and known as _____ 3. Chromosome: single 4. Membrane-bound cell organelles absent.	1. Size: Generally large (5-100 μm) 2. Nuclear region: well defined and surrounded by a nuclear membrane. 3. More than one chromosome. 4. _____ _____ _____

Solution:

Prokaryotic Cell	**Eukaryotic Cell**
1. Size: Generally small (1-10 μm) 1 μm = 10^{-6}m 2. The nuclear region is poorly defined due to the absence of a nuclear membrane and known as the nucleoid. 3. There is a single chromosome. 4. Membrane-bound cell organelles absent.	1. Size: Generally large (5-100 μm) 2. Nuclear region: well defined and surrounded by a nuclear membrane. 3. There are more than one chromosomes. 4. Membrane-bound cell organelles present.

Exercise-5.2.5 Page: 65

6. Can you name the two organelles we have studied that contain their own genetic material?

Solution:

The two organelles which have their own genetic material are:

1. Mitochondria
2. Plastids

7. If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?

Solution:

In the event of any damage to cells and when revival of cells is not possible, Lysosomes burst and enzymes digest such cells. This is why lysosomes are often referred to as ‘suicide bags’.

8. Why are lysosomes known as suicide bags?

Solution:

When there is damage to the cell and when revival is not possible, lysosomes may burst, and the enzymes digest their own cell. Consequently, lysosomes are known as suicide bags.

9. Where are proteins synthesised inside the cell?

Solution:

Protein synthesis in cells takes place in ribosomes. Hence, ribosomes are also referred to as protein factories. Ribosomes are particles that are found attached to the rough endoplasmic reticulum.

Exercise Page: 67

1. Make a comparison and write down ways in which plant cells are different from animal cells.

Solution:

The following table depicts the differences between plant cells and animal cells.

Characteristic	Plant Cell	Animal Cell

Cell wall	Present	Absent
Shape of cell	Distinct edges, shape is either rectangular or square shaped.	Round and irregular shape
Nucleus	Present. Lies on one side of the cell	Present. Lies in the center of the cell
Lysosomes	Rarely present	Always present
Plastids	Present	Absent
Structure of Vacuoles	Single or a few large vacuole that is centrally located	Presence of numerous and small vacuoles

2. How is prokaryotic cell different from a eukaryotic cell?

Solution:

The following are the differences between prokaryotic and eukaryotic cells.

Prokaryotic Cell	**Eukaryotic Cell**
1. Size: Generally small (1-10 μm) 1 μm = 10^{-6}m 2. The nuclear region is not well defined as the nuclear membrane is absent and is referred to as the nucleoid. 3. There is a single chromosome. 4. Membrane-bound cell organelles absent.	1. Size: Generally large (5-100 μm) 2. Nuclear region: well defined and girdled by a nuclear membrane. 3. There are more than one chromosomes. 4. Membrane-bound cell organelles present.

3. What would happen if the plasma membrane ruptures or breaks down?

Solution:

If plasma membrane ruptures or breaks down then molecules of some substances will freely move in and out of the cells. As plasma membrane acts as a mechanical barrier, exchange of material from its surroundings through osmosis or diffusion in a cell won't take place. Consequently, the cell would die due to the disappearance of the protoplasmic material.

4. What would happen to the life of a cell if there was no Golgi apparatus?

Solution:

The Golgi apparatus consists of stacks of membrane-bound vesicles whose functions are as follows:

storage of substances

packaging of substances

manufacture of substances

Without the golgi apparatus, the cells will be disabled from packing and dispatching materials that were produced by the cells. The golgi apparatus is also involved in the formation of cells. Hence, in the absence of golgi apparatus, cells will not be produced.

5. Which organelle is known as the powerhouse of the cell? Why?

Solution:

Mitochondria are known as the powerhouse of the cell. It is because it releases the energy required for different activities of life. Mitochondria releases energy in the form of ATP(Adenosine triphosphate) molecules, essential for numerous chemical activities of life. Hence ATP is often referred to as 'energy currency of the cell'.

6. Where do the lipids and proteins constituting the cell membrane get synthesised?

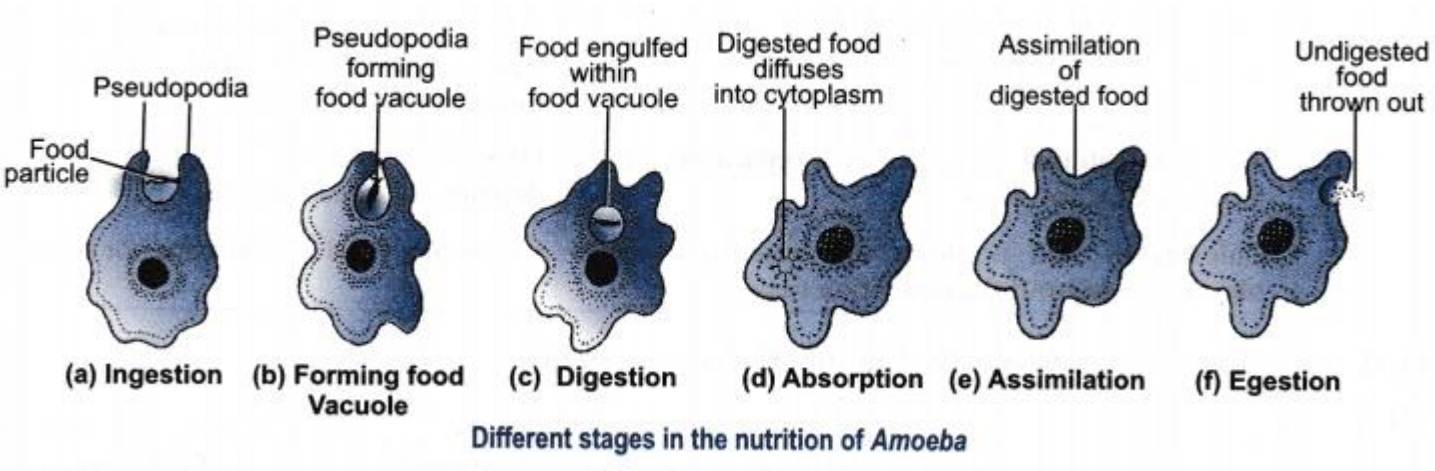
Solution:

Lipids and proteins are synthesised in the ER [Endoplasmic Reticulum].

How does an Amoeba obtain its food?

Solution:

Through the process of endocytosis, an Amoeba obtains its food. As its cell membrane is flexible enough, food particles are engulfed forming a food vacuole girdling it which is assisted by the pseudopodia. Amoeba secretes digestive enzymes to bring about digestion of the engulfed particle once food is trapped.



Different stages in the nutrition of *Amoeba*

What is osmosis?

Solution:

The process of movement of a water molecule from a region of higher concentration to a region of lower concentration through a semipermeable membrane is known as osmosis.

9. Carry out the following osmosis experiment:

Take four peeled potato halves and scoop each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now,

(a) Keep cup A empty

(b) Put one teaspoon sugar in cup B

(c) Put one teaspoon salt in cup C

(d) Put one teaspoon sugar in the boiled potato cup D.

Keep these for two hours. Then observe the four potato cups and answer the following:

(i) Explain why water gathers in the hollowed portion of B and C.

(ii) Why is potato A necessary for this experiment?

(iii) Explain why water does not gather in the hollowed out portions of A and D.

Solution:

(i) Water accumulates in the hollowed portions of B and C as a difference in the water concentration
is observed. Thereby, endosmosis occurs as the cells act as a semipermeable membrane.

(ii) Potato A is essential in this experiment as it is significant to compare different scenarios seen in
potato cups B, C and D. The potato A in this experiment clearly shows that the potato cavity on its
own cannot bring about water movement.

(iii) Cup in A does not show any change in the water flow concentration for osmosis to occur, which
requires the concentration to be higher than the other. Cells in cup D are dead, thus there is no
existence of a semipermeable membrane for water flow. Consequently, osmosis does not occur.

10. Which type of cell division is required for growth and repair of body and which type is involved in formation of gametes?

Solution:

There are two ways in which a cell divides:

Mitosis

Meiosis

Mitosis is the type of cell division that is involved in the growth and repair of body whereas meiosis is a type of cell division which results in the formation of gametes.

Chapter 6: Tissues (All in text and Exercise
Questions solved)

Exercise-6.1 Page: 69

1. What is a tissue?

Solution:

A tissue is defined as a cluster of cells which are similar in structure and work together to perform a particular function.

2. What is the utility of tissues in multicellular organisms?

Solution:

The use of tissues in multicellular organisms is to provide structural and mechanical strength as well as to allow division of labour.

Exercise-6.2 Page: 73

3. Name types of simple tissues.

Solution:

The types of simple tissues are as follows:

➢ Parenchyma

➢ Collenchyma

➢ Sclerenchyma

4. Where is apical meristem found?

Solution:

In plants, apical meristem are typically found at:

The tip of the shoot

Root of the plant

5. Which tissue makes up the husk of coconut?

Solution:

The Sclerenchymatous tissue, which is a type of permanent tissue makes up the husk of the coconut. These tissues causes the plant to become stiff and hard. The cells of this tissue are dead and their cell walls are thickened because of the presence of lignin.

6. What are the constituents of phloem?

Solution:

The phloem constitutes of the following four elements, they are:

➢ Sieve tube

➢ Companion cells

➢ Phloem parenchyma

➢ Phloem fibres

Exercise-6.3 Page: 77

7. Name the tissue responsible for movement of our body.

Solution:

Two tissues jointly are responsible for the movement of our body, namely:

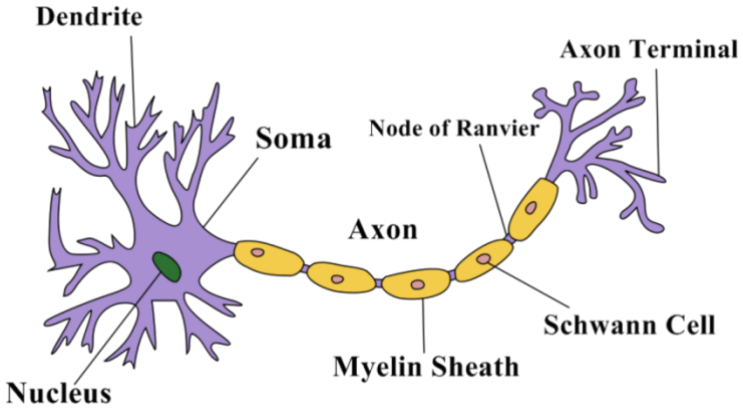
➢ Muscular tissue

➢ Nervous tissue

8. What does a neuron look like?

Solution:

A neuron is a nerve cell consisting of the cell body with a nucleus and cytoplasm from which a long and thin hair like structure emerges. Every neuron has one elongated part known as the axon, and several short and small branched structures known as dendrites. A single neuron can even be a meter long.



9. Give three features of cardiac muscles.

Solution:

The cardiac muscles are specialized tissues that are evolved to pump blood throughout the body.

The following are the features of the cardiac muscles:

➢ They are cylindrical in shape.

➢ Striated muscle fibers.

➢ They are uninucleated and branched.

➢ These muscles are involuntary in nature.

10. What are the functions of areolar tissue?

Solution:

Areolar tissues are typically observed in animals. They are connective tissues and are found in between skin and muscles. They are also located around blood vessels and nerves and are present in the bone marrow. The space inside the organs is filled with these tissues. They support the delicate internal organs and assist in tissue repair in case of damage.

Exercise Page: 78

1. Define the term 'tissue'?

Solution:

A tissue is defined as a cluster of cells which are similar in structure and work together to perform a particular function.

2. How many types of elements together make up the xylem tissue? Name them.

Solution:

The xylem tissue is made up of four main elements, namely:

➢ Vessels

➢ Tracheids

➢ Xylem fibres

➢ Xylem parenchyma

3. How are simple tissues different from complex tissues in plants?

Solution:

The following are the differences:

Simple tissues	Complex tissues

They are made up of a single type of cell that performs only one common function	They are made up of more than one kind of a cell that coordinate to perform one particular function

4. Differentiate between parenchyma, collenchyma and sclerenchyma on the basis of their cell wall.

Solution:

The following are the differences based on cell wall between different tissues:

Parenchyma	**Collenchyma**	**Sclerenchyma**
Cell walls are thin and made up of cellulose	Cell walls are thick at the edges due to the deposition of pectin	Cell walls are thick due to the deposition of lignin

5. What are the functions of the stomata?

Solution:

Stomata are the tiny pores present on the outer layer of the cells, the epidermis. Stomata bring about the exchange of gases and transpiration.

6. Diagrammatically show the difference between the three types of muscle fibres.

Solution:

There are three types of muscle fibres, they are:

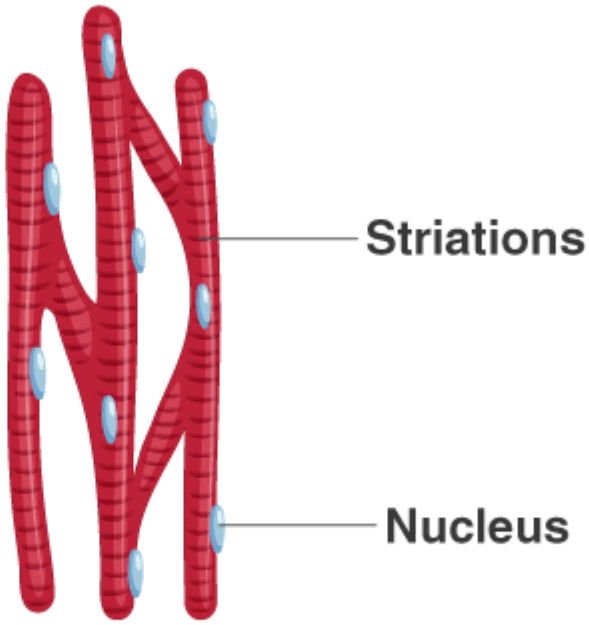
1. Cardiac muscles

Present in the heart.

Involuntary in nature.

They have 1 nucleus.

The muscle fibers are branched.



Cardiac Muscles

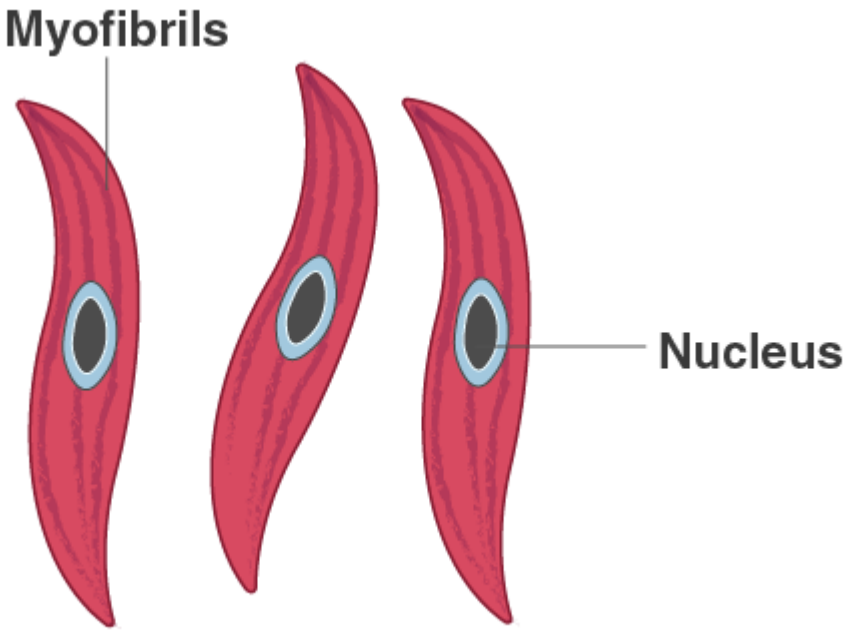
2. Smooth muscles

Found in lungs and alimentary canal.

Involuntary in nature.

They have 1 nucleus.

They are spindle shaped.



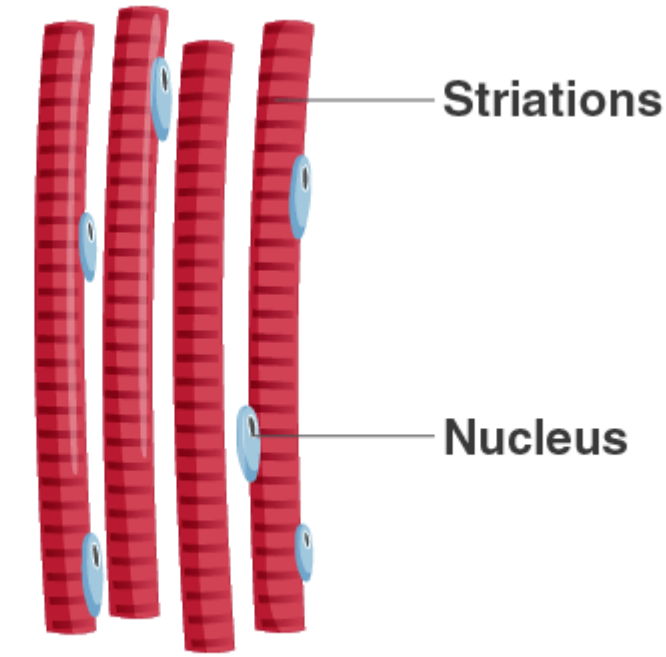
Smooth Muscles

3. Striated muscles

They are connected with bones

Voluntary in nature.

They are long and cylindrical muscle fibers.
They possess many nuclei.
Striated muscles are unbranched.



Striated Muscles

7. What is the specific function of the cardiac muscle?

Solution:

The cardiac muscles are branched and cylindrical. They are uninucleated and are involuntary in nature. Throughout one's lifetime, the cardiac muscles bring about the rhythmic contraction and relaxation.

8. Differentiate between striated, un-striated and cardiac muscles on the basis of their structure and site/location in the body.

Solution:

The following are the differences between different types of muscles based on their structure and location in the body.

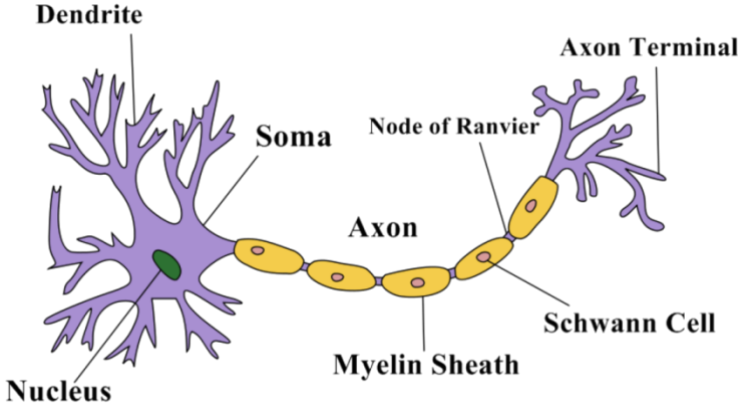
Character	**Striated muscles**	**Un-striated muscles**	**Cardiac muscles**
Shape/Structure	Long, cylindrical,	Long and tapering.	Cylindrical and non –

	non – tapering. They are un-branched.	They are un – branched.	tapering. They are branched.
Location in body	Hands, legs and skeletal muscles	Wall of stomach, intestine, ureter and bronchi	Heart
Dark and light bands	Present	Absent	Present but less prominent

9. Draw a labelled diagram of a neuron.

Solution:

Diagram of a neuron along with the labelling is as follows:



10. Name the following.

(a) Tissue that forms the inner lining of our mouth.

(b) Tissue that connects muscle to bone in humans.

(c) Tissue that transports food in plants.

(d) Tissue that stores fat in our body.

(e) Connective tissue with a fluid matrix.

(f) Tissue present in the brain.

Solution:

(a) Tissue that forms the inner lining of our mouth – The epithelial tissue, Squamous epithelium.

(b) Tissue that connects muscle to bone in humans – Tendon

(c) Tissue that transports food in plants – Phloem

(d) Tissue that stores fat in our body – Adipose tissue

(e) Connective tissue with a fluid matrix – Blood, it is a fluid connective tissue

(f) Tissue present in the brain – Nervous tissue

11. Identify the type of tissue in the following:

Skin, bark of tree, bone, lining of kidney tubule, vascular bundle.

Solution:

➢ Skin: Striated squamous epithelial tissue

➢ Bark of tree: Protective tissue and cork

➢ Bone: Connective tissue

➢ Lining of kidney tubule: Cuboidal epithelial tissue

➢ Vascular bundle: Conducting tissue(xylem and phloem). Complex permanent tissue

12. Name the regions in which parenchyma tissue is present.

Solution:

The parenchyma is found in:

The pith of stems and roots

When parenchyma contains chlorophyll it is called as chlorenchyma, it is found in green leaves

Parenchyma found in aquatic plants has large air cavities which enables them to float and are hence called aerenchyma.

13. What is the role of epidermis in plants?

Solution:

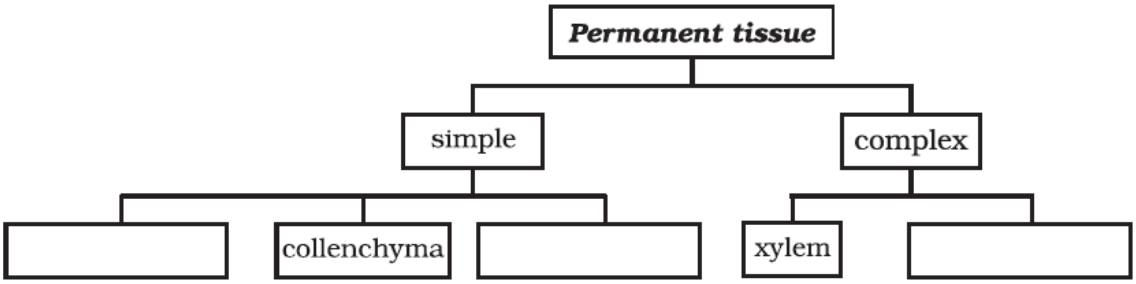
The epidermis in plants forms an uninterrupted and continuous layer that has no intercellular spaces. It provides protection.

14. How does the cork act as a protective tissue?

Solution:

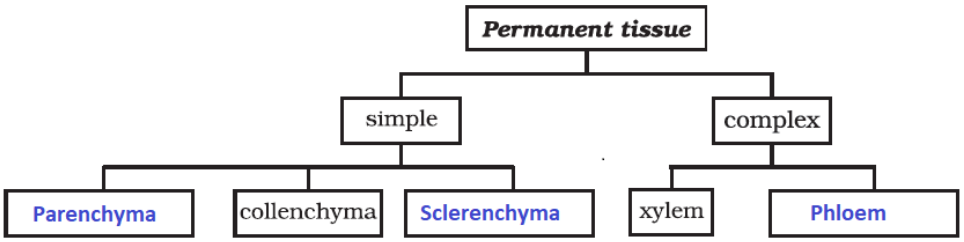
Cork cells are dead. The arrangement of cells is so dense, that there is no intercellular space. Deposition of suberin is observed on the walls of the cells that make them impervious to water and gases.

15. Complete the following chart.



Solution:

The completed chart is as follows:



Chapter 7- Diversity in Living Organisms

Q1. Why do we classify organisms?

Ans:

By classifying organisms, it is easier and more convenient to study their characteristics. Similarities exhibited by various entities allow us to categorize different entities into a class and hence, study the group as a whole.

Q2. Give three examples of the range of variations that you see in life-forms around you.

Ans:

Listed below are a few ranges of variations observed in life-forms:

(a) Small frog to big whale

(b) Creeper to the eucalyptus tree

(c) Black cuckoo to colourful peacock

Class 9 Science Chapter 7 Exercise-7.1 Questions with Answer

Q3. Which do you think is a more basic characteristic for classifying organisms?

(a) the place where they live.

(b) the kind of cells they are made of. Why?

Ans:

The most basic classification of organisms should be established on the kind of cells they are made up of. This is because the habitat can have species with different characteristics living harmoniously whereas the entities with similar cell arrangement will exhibit equivalent characteristics.

Q4. What is the primary characteristic on which the broad division of organisms is made?

Ans:

The basic characteristic on which organisms are primarily divided is the nature of cells. It is broadly classified as prokaryotic cells and eukaryotic cells, which furthermore is classified into subclasses.

Q5. On what basis are plants and animals put into different categories?

Ans:

The following is the basis for categorization of plants and animals:

(a) The most fundamental consideration of classification is the presence and absence of a cell wall.

(b) The next important criterion is the mode of nutrition. The mechanism through which entities acquire their nutrients is used as the base for classification.

Class 9 Science Chapter 7 Exercise-7.2 Questions with Answers

Q6. Which organisms are called primitive and how are they different from the so-called advanced organisms?

Ans:

Primitive organisms are the organisms that exhibit a very simple and basic cell arrangement, mechanism and structure and no division of labour is observed. Advanced organisms, on the other hand, are the organisms possessing millions of cells that are grouped into various organs performing different functionality such as mammals.

Q7. Will advanced organisms be the same as complex organisms? Why?

Ans:

Yes. Complex organisms are the same as advanced organisms. The consequence of advancement leads to multiple cell arrangements that operate uniquely.

Class 9 Science Chapter 7 Exercise-7.3 Questions with Answers

Q8. What is the criterion for classification of organisms as belonging to kingdom Monera or Protista?

Ans:

One of the most significant differences in classification is the development of the nucleus. The ones with no nuclear membranes are defined to be Monera while the ones that have well-defined nuclei walls are Protista.

Q9. In which kingdom will you place an organism which is single-celled, eukaryotic and photosynthetic?

Ans:

Since the cell is photosynthetic, it must have a well-defined nucleus wall. Therefore, it needs to be placed in Protista kingdom.

Q10. In the hierarchy of classification, which grouping will have the smallest number of organisms with maximum common characteristics and which will have the largest number of organisms?

Ans:

(a) The organisms belonging to the Kingdom Monera will have the smallest number of organisms and with maximum characteristics in common.

(b) The organisms belonging to the Kingdom Animalia will have the largest number of organisms.

Class 9 Science Chapter 7 Exercise-7.4 Questions with Answer

Q11. Which division among plants has the simplest organisms?

Ans:

Algae or Thallophyta has the simplest organisms among the plants.

Q12. How are pteridophytes different from the phanerogams?

Ans:

The following are the differences:

Pteridophytes	**Phanerogams**
They possess a naked embryo	They possess a covered embryo
Exhibit unclear reproductive organ	Exhibit well-defined reproductive organ

Q13. How do gymnosperms and angiosperms differ from each other?

Ans:

In gymnosperms, the seeds are naked while in angiosperms the seeds are covered.

Class 9 Science Chapter 7 Exercise-7.5 Questions with Answers

Q14. How do poriferan animals differ from coelenterate animals?

Ans:

Listed below are the differences:

Porifera	**Coelenterata**
Division of labour is not noticed	Division of labour is observed
Cellular level of organization exhibited	Tissue level of organization exhibited
Coelom absent	Coelom present

Q15. How do annelid animals differ from arthropods?

Ans:

Listed below are the differences:

Annelida	**Arthropoda**
The entire body is segmented into rings	Segmentation of body into head, abdomen and the thorax region
Skeleton is absent	Presence of exoskeleton
Hermaphrodites	Presence of different sexes, bisexual present

Q16. What are the differences between amphibians and reptiles?

Ans:

Listed below are the differences:

Amphibia	**Reptilia**
Skin is moist and soft	Skin is hardened
In water, they breathe through their skin	Can exist in water. They come to land to intake oxygen

Respire through lungs or gills	Respire through lungs
Capable of jumping	They crawl
Indirect development is noticed	Direct development observed

Q17. What are the differences between animals belonging to the Aves group and those in the mammalian group?

Ans:

Listed below are the differences:

Aves	**Mammalia**
Body is covered with feathers	Body is covered with hairs
Teeth absent	Teeth present
They possess a beak	Beak absent
Forelimbs are present and modified to take a flight	Forelimbs are present and used for multiple activities
Bones are hollow	Bones are solid
Body is streamlined	Streamlining of body is not observed (except whales)

Exercise

Q1. What are the advantages of classifying organisms?

Ans:

Listed below are the advantages of classification of organisms:

When organisms are classified, their common features can easily be studied.

The study of scientific experiments is simplified.
The interrelation of humans with other entities can be interpreted. Their dependence and interactions can be studied.
When entities are crossbred and modified genetically, it paves the way for commercial applications.

Q2. How would you choose between two characteristics to be used for developing a hierarchy in classification?

Ans:

The basis of the start of the hierarchy will be formed by the Gross character while the basis of steps further will be taken care of by the fine character.
For instance:
Human beings are categorized under vertebrates as they possess the vertebral column
For categorization of tetrapods
For Tetrapods, the existence of four limbs is taken into consideration
In the case of mammals, the mammary gland is the required part

Q3. Explain the basis for grouping organisms into five kingdoms.

Ans:

The following factors govern the basis of grouping organisms into five kingdoms
The number of cells present forms the first criteria.
Next is the arrangement and the number of layers present.
Another important factor for classification is the existence of cell wall.
Classification of complex organisms is also based on the mode of intake of nutrition.
To classify, we consider the organization level too.

Q4. What are the major divisions in the Plantae? What is the basis of these divisions?

Ans:

The following table depicts plant division and the basis of classification for each division.

Division	Basis of Classification
Thallophyta or Algae	Like body
Bryophyta	The body is divided into leaf and stem
Pteridophyta	The body is separated into root, stem and leaf
Gymnosperm	Seed-bearing, naked seeds
Angiosperm	Seed bearings covered seeds

Q5. How are the criteria for deciding divisions in plants different from the criteria for deciding the subgroups among animals?

Ans:

One of the major specifications to categorize plants into Thallophytes and Bryophytes is the basic cell structure.

Gymnosperms and Angiosperms are classified on the basis of visibility of seeds.

Hence, morphological characteristics play a key role in plant classification. In animal classification, cytology is considered primarily as more minute structural variations are taken into account.

The cell layers, cytology, morphology are significant features to be considered in the classification of animals.

The presence and absence of various features decide the classification of higher hierarchies.

Q6. Explain how animals in Vertebrata are classified into further subgroups.

Ans:

Vertebrata has two subclasses namely

Pisces

Tetrapod

Wherein, organisms belonging to Pisces subclass have a streamlined body with tails and fins which help them in their movement (swim) whereas, the Tetrapoda species have four limbs for their movement.

Furthermore, The tetrapod animals are classified as:

1. Amphibia: The animals belonging to this group are adaptive in nature. They dwell both in the land as well as in water. They show the presence of specialized organs, which allows them to breathe underwater.
2. Reptilia: The animals belonging to this class crawl. Their skin is very thick and withstands extreme temperatures.
3. Aves: The forelimbs of these organisms are modified which help them in their flight. They lack teeth and instead have a beak and feathers that cover up their body.
4. Mammalia: The animals belonging to this group show nurturing skills as they contain mammary glands to support them. Their skin is covered with hair and most of them are viviparous in nature.

Chapter 8: Motion

Intext Questions – 1 Page: 100

1. An object has moved through a distance. Can it have zero displacement? If yes, support your answer with an example.

Solution

Yes, an object moving a certain distance can have zero total displacement. Displacement refers to the shortest distance between the initial and the final positions of the object. Even if an object moves through a considerable distance, if it eventually comes back to its initial position, the corresponding displacement of the object would be zero.

2. A farmer moves along the boundary of a square field of side 10m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds from his initial position?

Solution

Given that the farmer covers the entire boundary of the square field in 40 seconds, the total distance traveled by the farmer in 40 seconds is 4*(10) = 40 meters.

Therefore, the average distance covered by the farmer in one second is: 40m/40 = 1m

Two minutes and 20 seconds can be written as 140 seconds. The total distance traveled by the farmer in this timeframe is: 1 m * 140 = 140m

Since the farmer is moving along the boundary of the square field, the total number of laps completed by the farmer will be: 140m/40 = 3.5 laps

Now, the total displacement of the farmer depends on the initial position. If the initial position of the farmer is at one corner of the field, the terminal position would be at the opposite corner (since the field is square).

In this case, the total displacement of the farmer will be equal to the length of the diagonal line across the opposite corners of the square.

Applying the Pythagoras theorem, the length of the diagonal can be obtained as follows: **$\sqrt{(10^2+10^2)}$= $\sqrt{200}$= 14.14m**.

This is the **maximum** possible displacement of the farmer.

If the initial position of the farmer is at the mid-point between two adjacent corners of the square, the net displacement of the farmer would be equal to the side of the square, which is 10m. This is the **minimum** displacement.

If the farmer starts at a random point around the perimeter of the square, his net displacement after traveling 140m will lie between 10m and 14.14m.

3. Which of the following is true for displacement? (a) It cannot be zero. (b) Its magnitude is greater than the distance travelled by the object.

Solution

Neither of the statements are true. Statement (a) is false because the displacement of an object which travels a certain distance and comes back to its initial position is zero. Statement (b) is false because the displacement of an object can be equal to, but never greater than the distance traveled.

Intext Questions – 2 Page: 102

1. Distinguish between speed and velocity.

Solution

Difference Between Speed and Velocity	
Velocity	**Speed**
It refers to the displacement of a given object over a time interval.	It refers to the distance moved by an object over a time interval.
It has a specific direction	It does not have any direction.
Velocity = displacement/time	Speed = distance / time

Velocity can hold a negative value	Speed cannot hold a negative value.

2. Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?

Solution

Since average speed is the total distance traveled in a time frame and velocity is the total displacement in the time frame, the magnitude of average velocity and average speed will be the same when the total distance traveled is equal to the displacement.

3. What does the odometer of an automobile measure?

Solution

The odometer measures the total distance traveled by the automobile.

4. What does the path of an object look like when it is in uniform motion?

Solution

The path of an object in uniform motion is a straight line.

5. During an experiment, a signal from a spaceship reached the ground station in five minutes. What was the distance of the spaceship from the ground station? The signal travels at the speed of light, that is, 3×10^8 m/s.

Solution

Given that the signal travels in a straight line, the distance between the spaceship and the ground station is equal to the total distance traveled by the signal.

5 minutes = 5*60 seconds = 300 seconds.

Speed of the signal = 3×10^8 m/s.

Therefore, total distance = (3×10^8 m/s) * 300s

= $9*10^{10}$ meters.

Intext Questions – 3 Page: 103

1. When will you say a body is in (i) uniform acceleration? (ii) non-uniform acceleration?

Solution

Uniform Acceleration: In this type of acceleration, the body moves along a straight line and its velocity increases/decreases at a uniform rate (it changes at a constant rate in any constant time interval).

Non-Uniform Acceleration: In this type of acceleration, the body moves along a straight line and its velocity increases/decreases at a rate that is not uniform (it changes at a different rate for a given constant time interval).

2. A bus decreases its speed from 80 km h–1 to 60 km h–1 in 5 s. Find the acceleration of the bus.

Solution

Given, the initial velocity (u) = 80km/hour = 80000m/3600s= 22.22 $m.s^{-1}$

The final velocity (v) = 60km/hour = 60000m/3600s= 16.66 $m.s^{-1}$

Time frame, t = 5 seconds.

Therefore, acceleration (a) =(v-u)/t = (16.66 $m.s^{-1}$ – 22.22 $m.s^{-1}$)/5s

= -1.112 $m.s^{-2}$

Therefore, the total acceleration of the bus is -1.112$m.s^{-2}$. It can be noted that the negative sign indicates that the velocity of the bus is decreasing.

3. A train starting from a railway station and moving with uniform acceleration attains a speed 40 km h–1 in 10 minutes. Find its acceleration.

Solution

Given, the initial velocity (u) of the train = 0$m.s^{-1}$ (at rest)

Terminal velocity (v) of the train = 40km/hour = 11.11 $m.s^{-1}$

Time interval, t = 10 minutes = 600 s.

The acceleration of the train is given by =(v-u)/t = (11.11 $m.s^{-1}$ – 0 $m.s^{-1}$)/600s

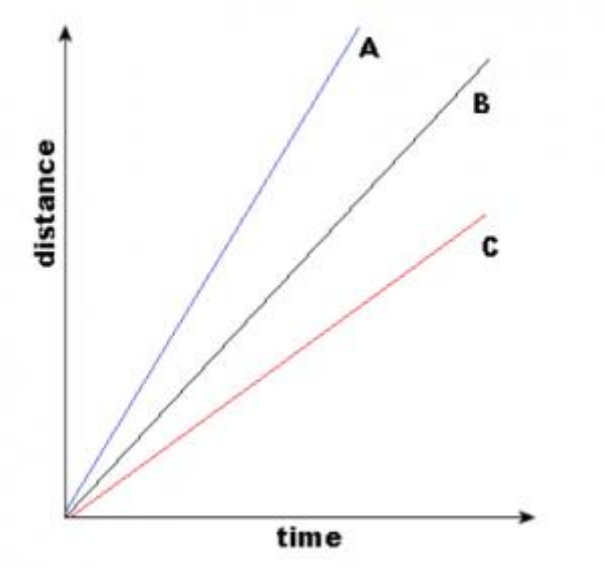
= **0.0185 $m.s^{-2}$**

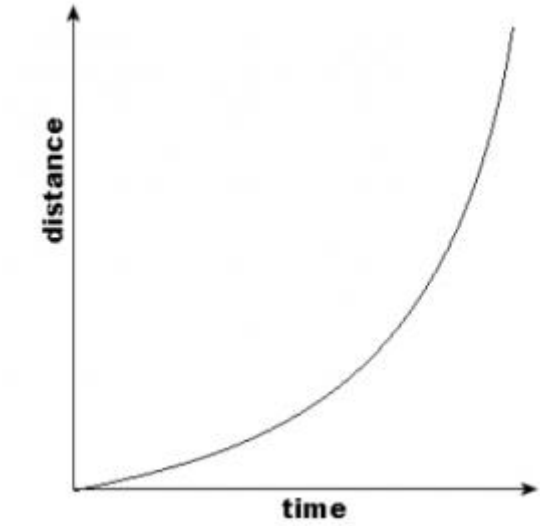
Intext Questions – 4 Page: 107

1. What is the nature of the distance-time graphs for uniform and non-uniform motion of an object?

Solution

For uniform motion, the distance-time graph is a straight line. On the other hand, the distance-time graph of an object in non-uniform motion is a curve.



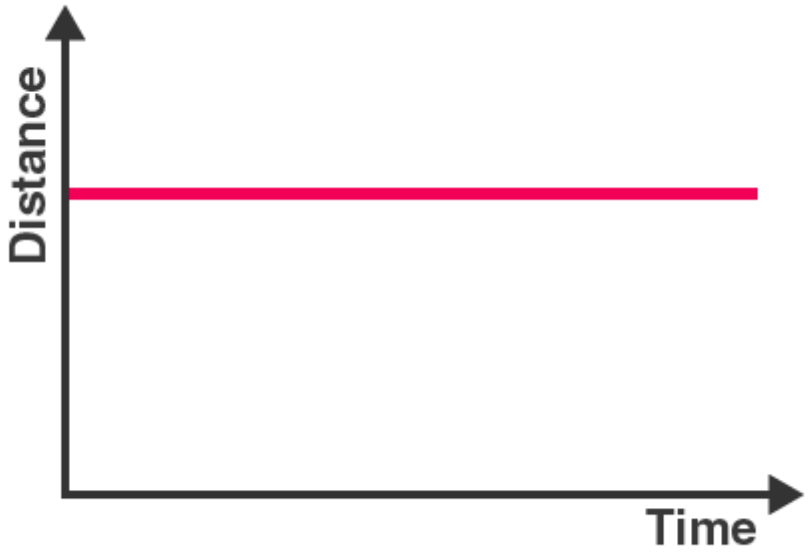


The first graph describes uniform motion and the second one describes non-uniform motion.

2. What can you say about the motion of an object whose distance-time graph is a straight line parallel to the time axis?

Solution

This distance-time graph can be plotted as follows.

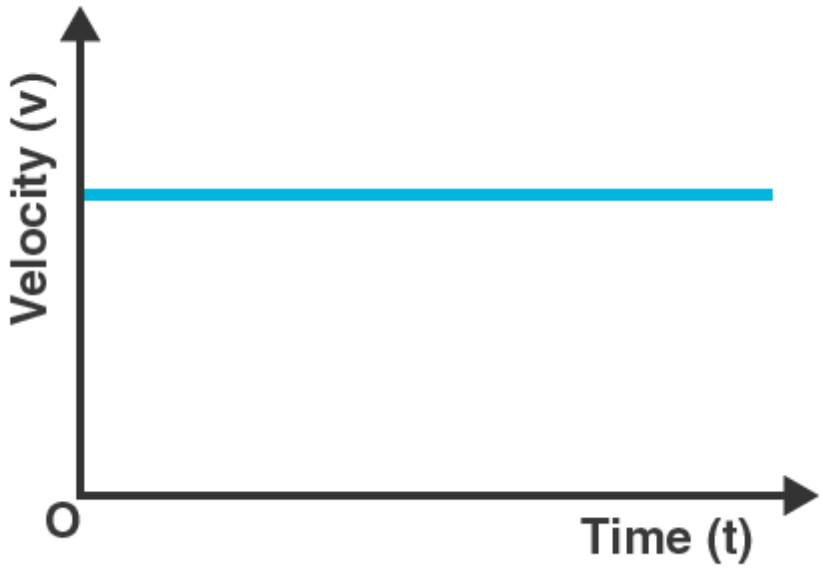


Since there is no change in the distance traveled by the object (or the Y-Axis value) at any point in the X-Axis (time), the object is at rest.

3. What can you say about the motion of an object if its speed-time graph is a straight line parallel to the time axis?

Solution

This speed-time graph can be plotted as follows.

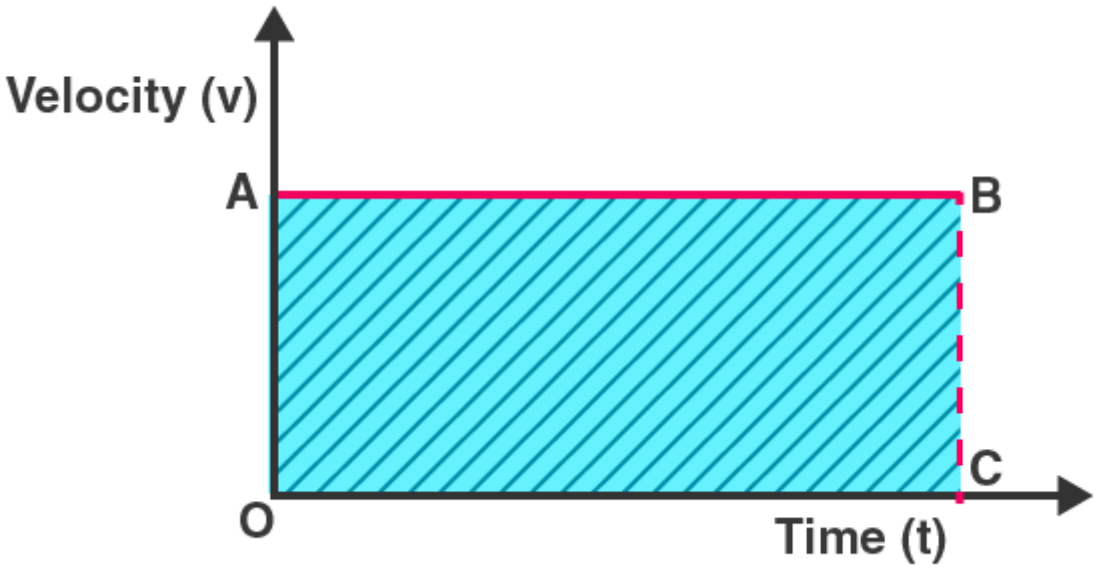


Since there is no change in the velocity of the object (Y-Axis value) at any point of time (X-axis value), the object is said to be in uniform motion.

4. What is the quantity which is measured by the area occupied below the velocity-time graph?

Solution

Considering an object in uniform motion, its velocity-time graph can be represented as follows.



Now, the area below the velocity-time graph is the area of the rectangle OABC, which is given by OA*OC. But OA is the velocity of the object and OC represents time. Therefore, the shaded area can be represented as:

Area under the velocity-time graph = velocity*time.

Substituting the value of velocity as displacement/time in the previous equation, it is found that the area under the velocity-time graph represents the total displacement of the object.

Intext Questions – 5 Page: 109,110

1. A bus starting from rest moves with a uniform acceleration of 0.1 m s^{-2} for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.

Solution

(a) Given, the bust starts from rest. Therefore, initial velocity (u) = 0 m/s

Acceleration (a) = 0.1 $m.s^{-2}$

Time = 2 minutes = 120 s

Acceleration is given by the equation a=(v-u)/t

Therefore, terminal velocity (v) = (at)+u

= (0.1 $m.s^{-2}$ * 120s) + 0 $m.s^{-1}$

= 12$m.s^{-1}$ + 0 $m.s^{-1}$

Therefore, terminal velocity (v) = 12m/s

(b) As per the third motion equation,

Since a = 0.1 $m.s^{-2}$, v = 12 $m.s^{-1}$, u = 0 $m.s^{-1}$, and t = 120s, the following value for s (distance) can be obtained.

Distance, s =$(v^2 – u^2)/2a$

=$(12^2 – 0^2)/2(0.1)$

Therefore, s = 720m.

The speed acquired is 12$m.s^{-1}$ and the total distance traveled is 720m.

2. A train is travelling at a speed of 90 km h^{-1}. Brakes are applied so as to produce a uniform acceleration of –0.5 m s^{-2}. Find how far the train will go before it is brought to rest.

Solution

Given, initial velocity (u) = 90 km/hour = 25 $m.s^{-1}$

Terminal velocity (v) = 0 $m.s^{-1}$

Acceleration (a) = -0.5 $m.s^{-2}$

As per the third motion equation, $v^2-u^2=2as$

Therefore, distance traveled by the train (s) =$(v^2-u^2)/2a$

s = $(0^2-25^2)/2(-0.5)$ meters = 625 meters

The train must travel 625 meters at an acceleration of -0.5 ms^{-2} before it reaches the rest position.

3. A trolley, while going down an inclined plane, has an acceleration of 2 cm s^{-2}. What will be its velocity 3 s after the start?

Solution

Given, initial velocity (u) = 0 (the trolley begins from the rest position)

Acceleration (a) = 0.02 ms^{-2}

Time (t) = 3s

As per the first motion equation, v=u+at

Therefore, terminal velocity of the trolley (v) = 0 + (0.02 ms^{-2})(3s)= 0.06 ms^{-2}

Therefore, the velocity of the trolley after 3 seconds will be 6 $cm.s^{-2}$

4. A racing car has a uniform acceleration of 4 m s^{-2}. What distance will it cover in 10 s after start?

Solution

Given, the car is initially at rest; initial velocity (u) = 0 ms^{-1}

Acceleration (a) = 4 ms^{-2}

Time period (t) = 10 s

As per the second motion equation, $s = ut+1/2\ at^2$

Therefore, the total distance covered by the car (s) = 0 * 10m + 1/2 (4ms^{-2})$(10s)^2$

= 200 meters

Therefore, the car will cover a distance of 200 meters after 10 seconds.

5. A stone is thrown in a vertically upward direction with a velocity of 5 m s^{-1}. If the acceleration of the stone during its motion is 10 m s^{-2} in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?

Solution

Given, initial velocity (u) = 5 m/s

Terminal velocity (v) = 0 m/s (since the stone will reach a position of rest at the point of maximum height)

Acceleration = 10 ms^{-2} in the direction opposite to the trajectory of the stone = -10 ms^{-2}

As per the third motion equation, $v^2 – u^2 = 2as$

Therefore, the distance traveled by the stone (s) = $(0^2 – 5^2)/ 2(10)$

Distance (s) = 1.25 meters

As per the first motion equation, v = u + at

Therefore, time taken by the stone to reach a position of rest (maximum height) = (v – u) /a

=(0-5)/-10 s

Time taken = 0.5 seconds

Therefore, the stone reaches a maximum height of 1.25 meters in a timeframe of 0.5 seconds.

Exercises Page: 112,113

1. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?

Solution

Given, diameter of the track (d) = 200m

Therefore, circumference of the track (π*d) = 200π meters.

Distance covered in 40 seconds = 200π meters

Distance covered in 1 second = 200π/40

Distance covered in 2minutes and 20 seconds (140 seconds) = 140 * 200π/40 meters

= (140*200*22)/(40* 7) meters = 2200 meters

Number of laps completed by the athlete in 140 seconds = 140/40 = 3.5

Therefore, the final position of the athlete (with respect to the initial position) is at the opposite end of the circular track. Therefore, the net displacement will be equal to the diameter of the track, which is 200m.

Therefore, the net distance covered by the athlete is 2200 meters and the total displacement of the athlete is 200m.

2. Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 30 seconds and then turns around and jogs 100 m back to point C in another 1 minute. What are Joseph's average speeds and velocities in jogging (a) from A to B and (b) from A to C?

Solution

Given, distance covered from point A to point B = 300 meters

Distance covered from point A to point C = 300m + 100m = 400 meters

Time taken to travel from point A to point B = 2 minutes and 30 seconds = 150 seconds

Time taken to travel from point A to point C = 2 min 30 secs + 1 min = 210 seconds

Displacement from A to B = 300 meters

Displacement from A to C = 300m – 100m = 200 meters

Average speed = total distance travelled/ total time taken

Average velocity = total displacement/ total time taken

Therefore, the average speed while traveling from A to B = 300/150 ms^{-1} = 2 m/s

Average speed while traveling from A to C = 400/210 ms^{-1}= 1.9 m/s

Average velocity while traveling from A to B =300/150 ms^{-1}= 2 m/s

Average velocity while traveling from A to C =200/210 ms^{-1}= 0.95 m/s

3. Abdul, while driving to school, computes the average speed for his trip to be 20 $km.h^{-1}$. On his return trip along the same route, there is less traffic and the average speed is 30 $km.h^{-1}$. What is the average speed for Abdul's trip?

Solution

Distance traveled to reach the school = distance traveled to reach home = d (say)

Time taken to reach school = t_1

Time taken to reach home = t_2

therefore, average speed while going to school = total distance travelled/ total time taken = d/t_1 = 20 kmph

Average speed while going home = total distance travelled/ total time taken = d/t_2= 30 kmph

Therefore, $t_1 = d/20$ and $t_2 = d/30$

Now, the average speed for the entire trip is given by total distance travelled/ total time taken

$= (d+d)/(t_1+t_2)$kmph = (d+d)/(d/20+d/30)kmph

= 120/5 kmh^{-1} = 24 kmh^{-1}

Therefore, Abduls average speed for the entire trip is 24 kilometers per hour.

4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of 3.0 m s^{-2} for 8.0 s. How far does the boat travel during this time?

Solution

Given, initial velocity of the boat = 0 m/s

Acceleration of the boat = 3 ms^{-2}

Time period = 8s

As per the second motion equation, $s = ut + 1/2\ at^2$

Therefore, the total distance traveled by boat in 8 seconds = $0 + 1/2\ (3)(8)^2$

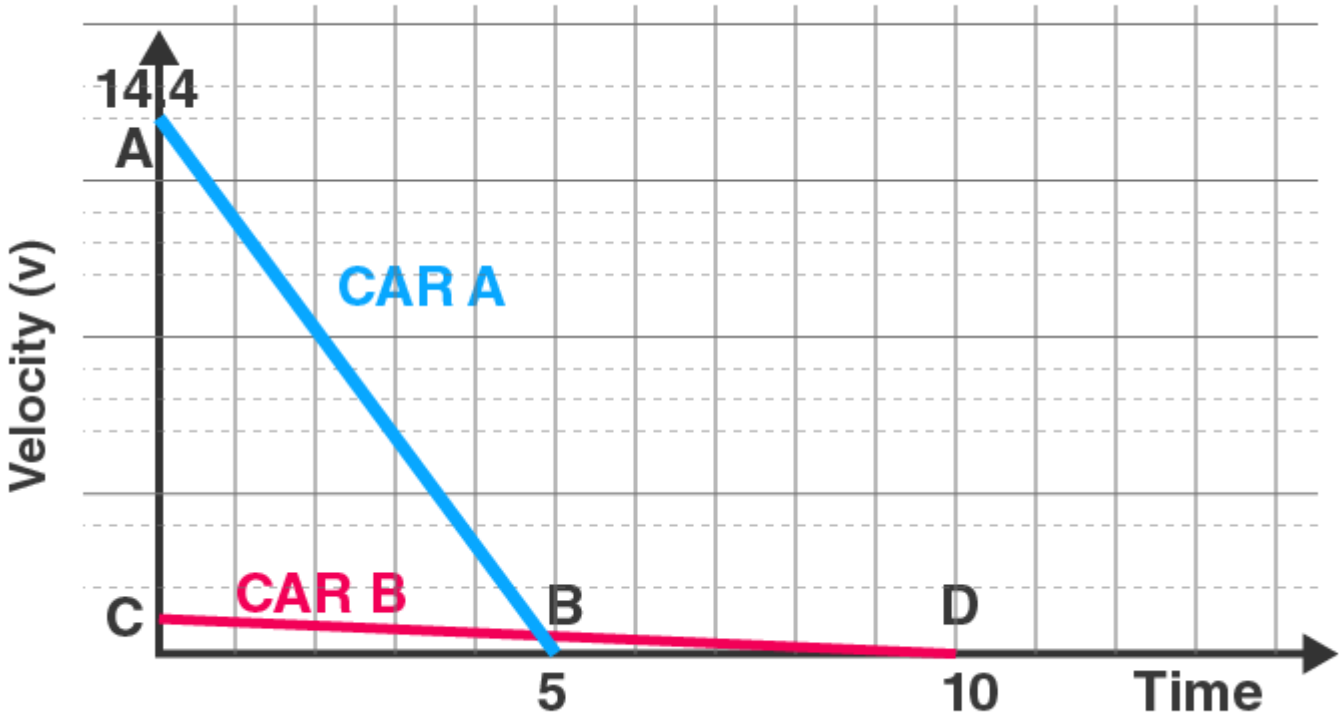
= 96 meters

Therefore, the motorboat travels a distance of 96 meters in a time frame of 8 seconds.

5. A driver of a car travelling at 52 km h^{-1} applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 km h^{-1} in another car applies his brakes slowly and stops in 10 s. On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?

Solution

The speed v/s time graphs for the two cars can be plotted as follows.



The total displacement of each car can be obtained by calculating the area beneath the speed-time graph.

Therefore, displacement of the first car = area of triangle AOB

= (1/2)*(OB)*(OA)

But OB = 5 seconds and OA = 52 $km.h^{-1}$ = 14.44 m/s

Therefore, the area of the triangle AOB is given by: (1/2)*(5s)*(14.44ms^{-1}) = 36 meters

Now, the displacement of the second car is given by the area of the triangle COD

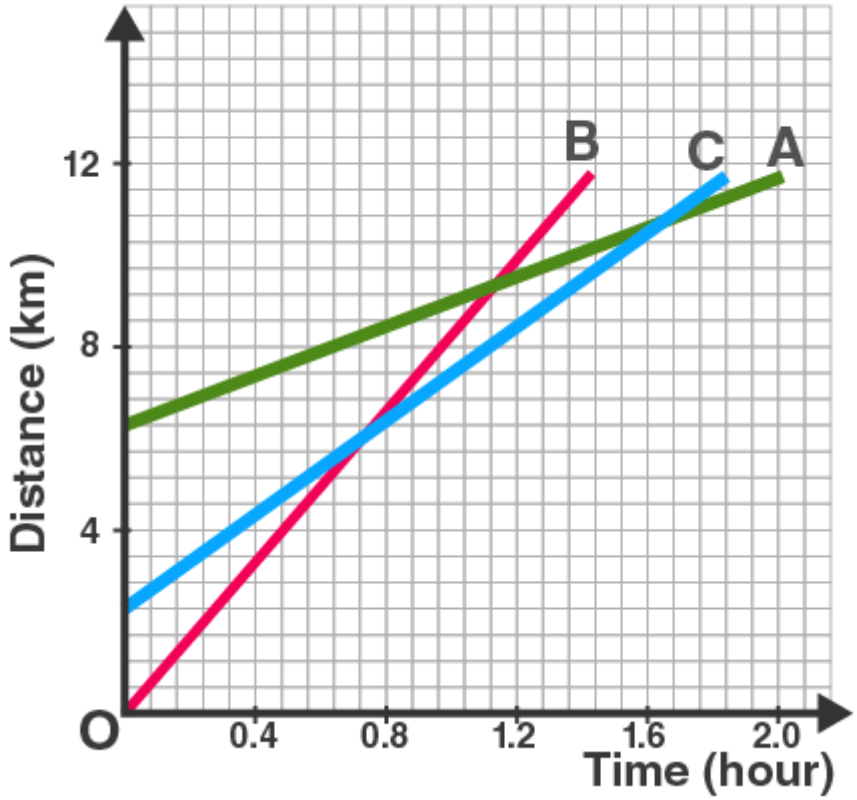
= (1/2)*(OD)*(OC)

But OC = 10 seconds and OC = 3$km.h^{-1}$ = 0.83 m/s

Therefore, area of triangle COD = (1/2)*(10s)*(0.83ms^{-1}) = 4.15 meters

Therefore, the first car is displaced by 36 meters whereas the second car is displaced by 4.15 meters. Therefore, the first car (which was traveling at 52 kmph) traveled farther post the application of brakes.

6. Fig 8.11 shows the distance-time graph of three objects A,B and C. Study the graph and answer the following questions:



(a) Which of the three is travelling the fastest? (b) Are all three ever at the same point on the road? (c) How far has C travelled when B passes A? (d) How far has B travelled by the time it passes C?

Solution

(a) since the slope of line B is the greatest, B is traveling at the fastest speed.

(b) since the three lines do not intersect at a single point, the three objects never meet at the same point on the road.

(c) since there are 7 unit areas of the graph between 0 and 4 on the Y axis, 1 graph unit equals 4/7 km.

Since the initial point of object C is 4 graph units away from the origin, Its initial distance from the origin is 4*(4/7)km = 16/7 km

When A passes B, the distance between the origin and C is 8km

Therefore, total distance traveled by C in this time = 8 – (16/7) km = 5.71 km

(d) the distance that object B has covered at the point where it passes C is equal to 9 graph units.

Therefore, total distance traveled by B when it crosses C = 9*(4/7) = 5.14 km

7. A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of 10 m s^{-2}, with what velocity will it strike the ground? After what time will it strike the ground?

Solution

Given, initial velocity of the ball (u) = 0 (since it began at the rest position)

Distance traveled by the ball (s) = 20m

Acceleration (a) = 10 ms^{-2}

As per the third motion equation,

Therefore,

= 2*(10ms^{-2})*(20m) + 0

$v^2 = 400m^2s^{-2}$

Therefore, v= 20ms^{-1}

The ball hits the ground with a velocity of 20 meters per second.

As per the first motion equation,

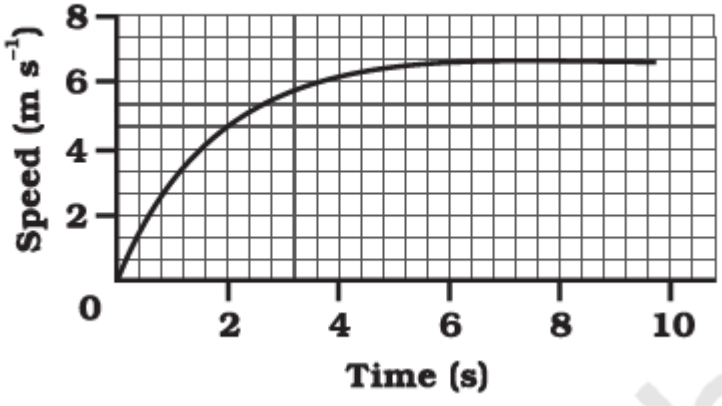
Therefore, t = (v-u)/a

= (20-0)ms^{-1} / 10ms^{-2}

= 2 seconds

Therefore, the ball reaches the ground after 2 seconds.

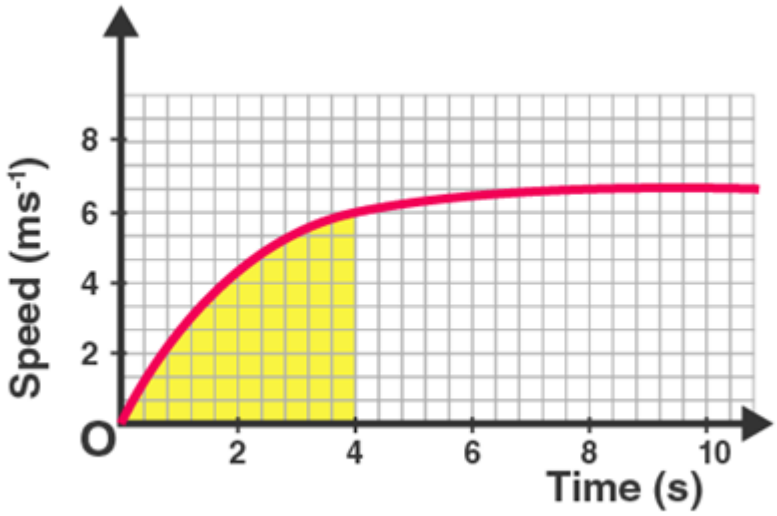
8. The speed-time graph for a car is shown is Fig. 8.12



(a) Find how far does the car travel in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period. (b) Which part of the graph represents uniform motion of the car?

Solution

(a)



The shaded area represents the displacement of the car over a time period of 4 seconds. It can be calculated as:
(1/2)*4*6 = 12 meters. Therefore the car travels a total of 12 meters in the first four seconds.
(b) Since the speed of the car does not change from the points (x=6) and (x=10), the car is said to be in uniform motion from the 6^{th} to the 10^{th} second.

9. State which of the following situations are possible and give an example for each of these: (a) an object with a constant acceleration but with zero velocity (b) an object moving with an acceleration but with uniform speed. (c) an object moving in a certain direction with an acceleration in the perpendicular direction.

Solution

(a) It is possible; an object thrown up into the air has a constant acceleration due to gravity acting on it. However, when it reaches its maximum height, its velocity is zero.
(b) it is impossible; acceleration implies an increase or decrease in speed, and uniform speed implies that the speed does not change over time
(c) It is possible; for an object accelerating in a circular trajectory, the acceleration is perpendicular to the direction followed by the object.

10. An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to revolve around the earth.

Solution

Given, radius of the orbit = 42250 km

Therefore, circumference of the orbit = 2*π*42250km = 265571.42 km

Time taken for the orbit = 24 hours

Therefore, speed of the satellite = 11065.4 $km.h^{-1}$

The satellite orbits the Earth at a speed of 11065.4 kilometers per hour.

Chapter 9: Force and Laws Of Motion(All intext and exercise questions solved)

Intext Questions – 1 Page: 118

1. Which of the following has more inertia: (a) a rubber ball and a stone of the same size? (b) a bicycle and a train? (c) a five-rupee coin and a one-rupee coin?

Solution

Since inertia is dependent on the mass of the object, the object with the greater mass will hold greater inertia. The following objects hold greater inertia because of their mass.

Stone

Train

Five-Rupee coin

2. In the following example, try to identify the number of times the velocity of the ball changes: "A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team". Also identify the agent supplying the force in each case.

Solution

Let the two football teams be team A and team B respectively. Initially, the football is at rest. Now, the football is kicked by a player on team A to another

player of team A. (The velocity of the ball has changed 1 time so far). This change is brought on by the force applied by the player who kicked the ball.
The football is now kicked by the other team A player towards the goal. (The velocity of the ball has changed 2 times so far). This change is also brought on due to the force applied by the team A player who kicked the ball.
The goalkeeper of team B stops the ball, bringing it to rest. (the velocity of the ball has changed 3 times so far). This change is brought on by the force applied by the goalkeeper of team B to stop the ball.
Finally, the goalkeeper of team B kicks the ball towards another player of team B. the velocity of the ball changes for a final time, bringing the total count to 4. This change is also brought on by the goalkeeper of team B, who applies the force to kick the ball forward.
Therefore, the velocity of the ball changes 4 times in this example.

3. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.

Solution

When the branch of the tree is shaken, the branch moves in a to-and-fro motion. However, the inertia of the leaves in attached to the branch resists the motion of the branch. Therefore, the leaves that are weakly attached to the branch fall off due to inertia whereas the leaves that are firmly attached to the branch remain attached.

4. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?

Solution

Initially, when the bus accelerates in a forward direction from a state of rest, the passengers experience a force exerted on them in the backward direction due to their inertia opposing the forward motion.
Once the bus starts moving, the passengers are in a state of motion in the forward direction. When the brakes are applied, the bus moves towards a position of rest. Now, a force in the forward direction is applied on the

passengers because their inertia resists the change in the motion of the bus. This causes the passengers to fall forwards when the brakes are applied.

Intext Questions – 2 Page: 126,127

1. If action is always equal to the reaction, explain how a horse can pull a cart.

Solution

When the horse walks in the forward direction (with the cart attached to it), it exerts a force in the backward direction on the Earth. An equal force in the opposite direction (forward direction) is applied on the horse by the Earth. This force moves the horse and the cart forward.

The velocity at which the horse can move by applying a force on the earth depends on the mass of the horse (and the cart attached to it). The heavier the cart, the slower the motion of the horse (for a given amount of force applied by the horse on the Earth). If the cart is too heavy, the force exerted by the horse on the Earth will be insufficient to even overcome the force of inertia. In this case, the horse will not be able to pull the cart.

2. Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high velocity.

Solution

For the hose to eject water at high velocities, a force must be applied on the water (which is usually done with the help of a pump or a motor). Now, the water applies an equal and opposite force on the hose. For the fireman to hold this hose, he must apply a force on it to overcome the force applied on the hose by the water. The higher the quantity and velocity of the water coming out of the hose, the greater the force that must be applied by the fireman to hold it steady.

3. From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 m s^{-1}. Calculate the initial recoil velocity of the rifle.

Solution

Given, the Bullet's mass (m_1) = 50 g

The rifle's mass (m_2) = 4kg = 4000g

Initial velocity of the fired bullet (v_1) = 35 m/s

Let the recoil velocity be v_2.

Since the rifle was initially at rest, the initial momentum of the rifle = 0

Total momentum of the rifle and bullet after firing = $m_1v_1 + m_2v_2$

As per the law of conservation of momentum, the total momentum of the rifle and the bullet after firing = 0 (same as initial momentum)

Therefore, $m_1v_1 + m_2v_2 = 0$

This implies that $v_2 = -\frac{m_1v_1}{m_2}$

$= -\frac{50g \times 35ms^{-1}}{4000g}$

= -0.4375 m/s

Therefore, the recoil velocity of the rifle is 0.4375 meters per second in the direction opposite to the trajectory of the bullet (backward direction).

4. Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 ms^{-1} and 1 ms^{-1}, respectively. They collide and after the collision, the first object moves at a velocity of 1.67 ms^{-1}. Determine the velocity of the second object.

Solution

Assuming that the first object is object A and the second one is object B, it is given that:

Mass of A (m_1) = 100g

Mass of B (m_2) = 200g

Initial velocity of A (u_1) = 2 m/s

Initial velocity of B (u_2) = 1 m/s

Final velocity of A (v_1) = 1.67 m/s

Final velocity of B (v_2) =?

Total initial momentum = Initial momentum of A + initial momentum of B

= $m_1u_1 + m_2u_2$

= (100g) × (2m/s) + (200g) × (1m/s) = 400 $g.m.sec^{-1}$

As per the law of conservation of momentum, the total momentum before collision must be equal to the total momentum post collision.

Therefore, $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 = 400g.m.s^{-1}$

Solving for v2; $(100g)(1.67ms^{-1}) + (200g)(v_2) = 400\ g.m.s^{-1}$

Therefore, $v_2 = \frac{400-167}{200}\ m.s^{-1}$

v_2 = 1.165 m/s

Therefore, the velocity of object B after the collision is 1.165 meters per second.

Exercises Page: 128,129

1. An object experiences a net zero external unbalanced force. Is it possible for the object to be travelling with a non-zero velocity? If yes, state the conditions that must be placed on the magnitude and direction of the velocity. If no, provide a reason.

Solution

Yes, it is possible. An object moving in some direction with constant velocity will continue in its state of motion as long as there are no external unbalanced forces acting on it. In order to change the motion of the object, some external unbalanced force must act upon it.

2. When a carpet is beaten with a stick, dust comes out of it. Explain.

Solution

When the carpet is beaten with a stick, the stick exerts a force on the carpet which sets it in motion. The inertia of the dust particles residing on the carpet resists the change in the motion of the carpet. Therefore, the forward motion of the carpet exerts a backward force on the dust particles, setting them in motion in the opposite direction. This is why the dust comes out of the carpet when beaten.

3. Why is it advised to tie any luggage kept on the roof of a bus with a rope?

Solution

When some luggage is placed on the roof of a bus which is initially at rest, the acceleration of the bus in the forward direction will exert a force (in the

backward direction) on the luggage. In a similar manner, when a bus which is initially in a state of motion suddenly comes to rest due to the application of brakes, a force (in the forward direction) is exerted on the luggage. Depending on the mass of the luggage and the magnitude of the force, the luggage may fall off the bus due to inertia. Tying up the luggage will secure its position and prevent it from falling off the bus.

4. A batsman hits a cricket ball which then rolls on a level ground. After covering a short distance, the ball comes to rest. The ball slows to a stop because (a) the batsman did not hit the ball hard enough. (b) velocity is proportional to the force exerted on the ball. (c) there is a force on the ball opposing the motion. (d) there is no unbalanced force on the ball, so the ball would want to come to rest.

Solution

When the ball rolls on the flat surface of the ground, its motion is opposed by the force of friction (the friction arises between the ground and the ball). This frictional force eventually stops the ball. Therefore, the correct answer is (c). If the surface of the level ground is lubricated (with oil or some other lubricant), the friction that arises between the ball and the ground will reduce, which will enable the ball to roll for a longer distance.

5. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20 s. Find its acceleration. Find the force acting on it if it's mass is 7 tonnes (Hint: 1 tonne = 1000 kg.)

Solution

Given, distance covered by the truck (s) = 400 meters

Time taken to cover the distance (t) = 20 seconds

Initial velocity of the truck (u) = 0 (since it starts from a state of rest)

From the equations of motion, $s = ut + \frac{1}{2}at^2$

Therefore, $400 = 0(20s) + \frac{1}{2}(a)(400s^2)$ = 2ms^{-2}

The acceleration of the truck is equal to 2 ms^{-2}

As per the second law of motion, Force = Mass × Acceleration

Mass of the truck = 7 tonnes = 7000kg

Force acting on the truck = $7000kg \times 2m.s^{-2}$ = 14000 kg.m.s^{-2} = 14000 N

Therefore, a force of 14000 N is acting on the truck.

6. A stone of 1 kg is thrown with a velocity of 20 ms^{-1} across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?

Solution

Given, Mass of the stone (m) = 1kg

Initial velocity (u) = 20m/s

Terminal velocity (v) = 0 m/s (the stone reaches a position of rest)

Distance traveled by the stone (s) = 50 m

As per the third motion equation, $(v^2 - u^2) = 2as$

The acceleration of the stone is given by: $\frac{(v^2 - u^2)}{2s}$

Therefore, acceleration of the stone (a) = $\frac{0-400}{100}$ ms^{-2} = -4 ms^{-2}

As per the second law of motion, F = ma

Therefore, force acting on the stone, F = 1kg × -4ms^{-2} = -4 N

The frictional force acting on the stone has a magnitude of 4 N and it acts on the direction opposite to that of stone's motion.

7. An 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate: (a) the net accelerating force and (b) the acceleration of the train

Solution

(a) Given, force exerted by the train (F) = 40,000 N

Force of friction = -5000 N (the negative sign indicates that the force is applied in the opposite direction)

Therefore, the net accelerating force = sum of all forces = 40,000 N + (-5000 N) = 35,000 N

(b) Total mass of the train = mass of engine + mass of each wagon = 8000kg + 5 × 2000kg

The total mass of the train is 18000 kg.

As per the second law of motion, F = ma (or: a = F/m)

Therefore, acceleration of the train = (net accelerating force) / (total mass of the train)

= 35,000/18,000 = 1.94 ms^{-2}

The acceleration of the train is 1.94 $m.s^{-2}$.

8. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of 1.7 ms^{-2}?

Solution

Given, mass of the vehicle (m) = 1500 kg

Acceleration (a) = -1.7 ms^{-2}

As per the second law of motion, F = ma

F = 1500kg × (-1.7 ms^{-2}) = -2550 N

Therefore, a force of 2550 N must act on the vehicle in a direction opposite to that of its motion.

9. What is the momentum of an object of mass m, moving with a velocity v?

(a) $(mv)^2$ (b) mv^2 (c) ½ mv^2 (d) mv

Solution

Since momentum is defined as the product of mass and velocity, the correct answer is (d), mv.

10. Using a horizontal force of 200 N, we intend to move a wooden cabinet across a floor at a constant velocity. What is the friction force that will be exerted on the cabinet?

Solution

Since the velocity of the cabinet is constant, its acceleration must be zero. Therefore, the effective force acting on it is also zero. This implies that the magnitude of opposing frictional force is equal to the force exerted on the cabinet, which is 200 N. Therefore, the total friction force is -200 N.

11. Two objects, each of mass 1.5 kg, are moving in the same straight line but in opposite directions. The velocity of each object is 2.5 ms^{-1} before the collision during which they stick together. What will be the velocity of the combined object after collision?

Solution

Given, mass of the objects (m_1 and m_2) = 1.5kg

Initial velocity of the first object (u_1) = 2.5 m/s

Initial velocity of the second object which is moving in the opposite direction (u_2) = -2.5 m/s

When the two masses stick together, the resulting object has a mass of 3 kg ($m_1 + m_2$)

Velocity of the resulting object (v) =?

As per the law of conservation of momentum, the total momentum before the collision is equal to the total momentum after the collision.

Total momentum before the collision = $m_1u_1 + m_2u_2$

= (1.5kg) (2.5 m/s) + (1.5 kg) (-2.5 m/s) = 0

Therefore, total momentum after collision = (m_1+m_2) v = (3kg) v = 0

Therefore v = 0

This implies that the object formed after the collision has a velocity of 0 meters per second.

12. According to the third law of motion when we push on an object, the object pushes back on us with an equal and opposite force. If the object is a massive truck parked along the roadside, it will probably not move. A student justifies this by answering that the two opposite and equal forces cancel each other. Comment on this logic and explain why the truck does not move.

Solution

Since the truck has a very high mass, the static friction between the road and the truck is high. When pushing the truck with a small force, the frictional force cancels out the applied force and the truck does not move. This implies that the two forces are equal in magnitude but opposite in direction (since the person pushing the truck is not displaced when the truck doesn't move). Therefore, the student's logic is correct.

13. A hockey ball of mass 200 g travelling at 10 ms^{-1} is struck by a hockey stick so as to return it along its original path with a velocity at 5 ms^{-1}. Calculate the magnitude of change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick.

Solution

Given, mass of the ball (m) = 200g

Initial velocity of the ball (u) = 10 m/s

Final velocity of the ball (v) = – 5m/s

Initial momentum of the ball = mu = 200g × 10 ms^{-1} = 2000 $g.m.s^{-1}$

Final momentum of the ball = mv = 200g × –5 ms^{-1} = –1000 $g.m.s^{-1}$

Therefore, the change in momentum (mv – mu) = –1000 $g.m.s^{-1}$ – 2000 $g.m.s^{-1}$ = –3000 $g.m.s^{-1}$

This implies that the momentum of the ball reduces by 1000 $g.m.s^{-1}$ after being struck by the hockey stick.

14. A bullet of mass 10 g travelling horizontally with a velocity of 150 m s^{-1} strikes a stationary wooden block and comes to rest in 0.03 s. Calculate the distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet.

Solution

Given, mass of the bullet (m) = 10g (or 0.01 kg)

Initial velocity of the bullet (u) = 150 m/s

Terminal velocity of the bullet (v) = 0 m/s

Time period (t) = 0.03 s

To find the distance of penetration, the acceleration of the bullet must be calculated.

As per the first motion equation, $v = u + at$

Therefore, $a = \frac{v-u}{t} = \frac{0-150}{0.03}\ ms^{-2}$

Acceleration of the bullet after striking the wooden block is -5000 ms^{-2}.

Now, from the motion equation: $(v^2 - u^2) = 2as$, the distance of penetration (s)

can be calculated as follows:

$s = \frac{v^2-u^2}{2a} = \frac{0^2-(150)^2}{2(-5000)}$ meters = 2.25 meters

As per the second law of motion, F = ma

Therefore, force exerted by the wooden block on the bullet (F) = 0.01kg × (-5000 ms^{-2})

= -50 N

This implies that the wooden block exerts a force of magnitude 50 N on the bullet in the direction that is opposite to the trajectory of the bullet.

15. An object of mass 1 kg travelling in a straight line with a velocity of 10 ms^{-1} collides with, and sticks to, a stationary wooden block of mass 5 kg. Then they both move off together in the same straight line. Calculate the total momentum just before the impact and just after the impact. Also, calculate the velocity of the combined object.

Solution

Given, mass of the object (m_1) = 1kg

Mass of the block (m_2) = 5kg

Initial velocity of the object (u_1) = 10 m/s

Initial velocity of the block (u_2) = 0

Mass of the resulting object = $m_1 + m_2$ = 6kg

Velocity of the resulting object (v) =?

Total momentum before the collision = $m_1u_1 + m_2u_2$ = (1kg) × (10m/s) + 0 = 10 $kg.m.s^{-1}$

As per the law of conservation of momentum, the total momentum before the collision is equal to the total momentum post the collision. Therefore, the total momentum post the collision is also 10 kg.m.s^{-1}

Now, $(m_1 + m_2) \times v = 10 kg.m.s^{-1}$

Therefore, $v = \frac{10\ kg.m.s^{-1}}{6kg} = 1.66\ ms^{-1}$

The resulting object moves with a velocity of 1.66 meters per second.

16. An object of mass 100 kg is accelerated uniformly from a velocity of 5 ms^{-1} to 8 ms^{-1} in 6 s. Calculate the initial and final momentum of the object. Also, find the magnitude of the force exerted on the object.

Solution

Given, mass of the object (m) = 100kg

Initial velocity (u) = 5 m/s

Terminal velocity (v) = 8 m/s

Time period (t) = 6s

Now, initial momentum (m × u) = 100kg × 5m/s = 500 kg.m.s^{-1}

Final momentum (m × v) = 100kg × 8m/s = 800 kg.m.s^{-1}

Acceleration of the object (a) $= \frac{v-u}{t} = \frac{8-5}{6}\ ms^{-2}$

Therefore, the object accelerates at 0.5 ms^{-2}. This implies that the force acting on the object (F = ma) is equal to:

F = (100kg) × (0.5 ms^{-2}) = 50 N

Therefore, a force of 50 N is applied on the 100kg object, which accelerates it by 0.5 ms^{-2}.

17. Akhtar, Kiran, and Rahul were riding in a motorcar that was moving with a high velocity on an expressway when an insect hit the windshield and got stuck on the windscreen. Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motorcar (because the change in the velocity of the insect was much more than that of the motorcar). Akhtar said that since the motorcar was moving with a

larger velocity, it exerted a larger force on the insect. And as a result the insect died. Rahul while putting an entirely new explanation said that both the motorcar and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

Solution

Kiran's suggestion is correct. The mass of the insect is very small when compared to the mass of the car. As per the law of conservation of momentum, the total momentum before the collision between the insect and the car is equal to the total momentum after the collision. Therefore, the change in the momentum of the insect is much greater than the change in momentum of the car (since force is proportional to mass).

Akhtar's suggestion is also correct. Since the mass of the car is very high, the force exerted on the insect during the collision is also very high.

Rahul's suggestion is partially correct. As per the third law of motion, the force exerted by the insect on the car is equal and opposite to the force exerted by the car on the insect. However, Rahul's suggestion that the change in the momentum is the same contradicts the law of conservation of momentum.

18. How much momentum will a dumb-bell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take its downward acceleration to be 10 ms^{-2}.

Solution

Given, mass of the dumb-bell (m) = 10kg

Distance covered (s) = 80cm = 0.8m

Initial velocity (u) = 0 (it is dropped from a position of rest)

Acceleration (a) = $10ms^{-2}$

Terminal velocity (v) =?

Momentum of the dumb-bell when it hits the ground = mv

As per the third motion equation, $v^2 - u^2 = 2as$

Therefore, $v^2 - 0 = 2(10ms^{-2})(0.8m)$ = $16m^2s^{-2}$

v = 4 m/s

The momentum transferred by the dumb-bell to the floor = (10kg) × (4 m/s) = 40 $kg.m.s^{-1}$

Additional Exercises Page: 130

1. The following is the distance-time table of an object in motion:

Time (seconds)	Distance (meters)
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343

(a) What conclusion can you draw about the acceleration? Is it constant, increasing, decreasing, or zero? (b) What do you infer about the forces acting on the object?

Solution

(a) The distance covered by the object at any time interval is greater than any of the distances covered in previous time intervals. Therefore, the acceleration of the object is increasing.

(b) As per the second law of motion, force = mass × acceleration. Since the mass of the object remains constant, the increasing acceleration implies that the force acting on the object is increasing as well

2. Two persons manage to push a motorcar of mass 1200 kg at a uniform velocity along a level road. The same motorcar can be pushed by three

persons to produce an acceleration of 0.2 m s^{-2}. With what force does each person push the motorcar? (Assume that all persons push the motorcar with the same muscular effort)

Solution

Given, mass of the car (m) = 1200kg

When the third person starts pushing the car, the acceleration (a) is 0.2ms^{-2}.

Therefore, the force applied by the third person (F = ma) is given by:

F = 1200kg × 0.2 ms^{-2} = 240N

The force applied by the third person on the car is 240 N. Since all 3 people push with the same muscular effort, the force applied by each person on the car is 240 N.

3. A hammer of mass 500 g, moving at 50 m s-1, strikes a nail. The nail stops the hammer in a very short time of 0.01 s. What is the force of the nail on the hammer?

Solution

Given, mass of the hammer (m) = 500g = 0.5kg

Initial velocity of the hammer (u) = 50 m/s

Terminal velocity of the hammer (v) = 0 (the hammer is stopped and reaches a position of rest).

Time period (t) = 0.01s

Therefore, the acceleration of the hammer is given by: $a = \frac{v-u}{t} = \frac{0-50\ ms^{-1}}{0.01s}$

a = -5000ms^{-2}

Therefore, the force exerted by the hammer on the nail (F = ma) can be calculated as:

F = (0.5kg) * (-5000 ms^{-2}) = -2500 N

As per the third law of motion, the nail exerts an equal and opposite force on the hammer. Since the force exerted on the nail by the hammer is -2500 N, the force exerted on the hammer by the nail will be +2500 N.

4. A motorcar of mass 1200 kg is moving along a straight line with a uniform velocity of 90 km/h. Its velocity is slowed down to 18 km/h in 4 s by an

unbalanced external force. Calculate the acceleration and change in momentum. Also calculate the magnitude of the force required.

Solution

Given, mass of the car (m) = 1200kg

Initial velocity (u) = 90 km/hour = 25 meters/sec

Terminal velocity (v) = 18 km/hour = 5 meters/sec

Time period (t) = 4 seconds

The acceleration of the car can be calculated with the help of the formula: $a = \frac{v-u}{t}$

$a = \frac{5-25}{4} m.s^{-2}$ = -5 ms^{-2}

Therefore, the acceleration of the car is -5 ms^{-2}.

Initial momentum of the car = m × u = (1200kg) × (25m/s) = 30,000 $kg.m.s^{-1}$

Final momentum of the car = m × v = (1200kg) × (5m/s) = 6,000 $kg.m.s^{-1}$

Therefore, change in momentum (final momentum – initial momentum) = (6,000 – 30,000) $kg.m.s^{-1}$

= -24,000 $kg.m.s^{-1}$

External force applied = mass of car × acceleration = (1200kg) × (-5 ms^{-2}) = -6000N

Therefore, the magnitude of force required to slow down the vehicle to 18 km/hour is 6000 N

Chapter 10 – Gravitation

Exercise-10.1 Page: 134

1. State the universal law of gravitation.

Solution:

The universal law of gravitation states that every object in the universe attracts every other object with a force called the gravitational force. The force acting between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.

Solution:

Consider F is the force of attraction between an object on the surface of earth and earth.

Also consider ‘m’ is the mass of the object on the surface of earth and ‘Me’ is the mass of earth.

Therefore the formula for magnitude of the gravitational force between the earth and an object on the surface is given as

$$G = \frac{GMm}{r^2}$$

Exercise-10.2 Page: 136

1. What do you mean by free fall?

Solution:

Earth’s gravity attracts each object to its center. When an object is dropped from a certain height, under the influence of gravitational force it begins to fall to the surface of Earth. Such an object movement is called free fall.

2. What do you mean by acceleration Q due to gravity?

Solution:

When an object falls freely from a certain height towards the earth's surface, its velocity changes. This velocity change produces acceleration in the object known as acceleration due to letter g denoted gravity.

The gravity-based acceleration value is,

$$g = \frac{9.8m}{s^2}$$

Exercise-10.3 Page: 138

1. What are the differences between the mass of an object and its weight?

Solution:

The differences between the mass of an object and its weight are tabulated below.

Mass	Weight
Mass is the quantity of matter contained in the body.	Weight is the force of gravity acting on the body.
It is the measure of inertia of the body.	It is the measure of gravity.
It only has magnitude.	It has magnitude as well as direction.
Mass is a constant quantity.	Weight is not a constant quantity. It is different at different places.
Its SI unit is kilogram (kg).	Its SI unit is the same as the SI unit of force, i.e., Newton (N).

2. Why is the weight of an object on the moon 1/6th its weight on the earth?

Solution:

The moon's mass is 1/100 times and 1/4 times the earth's radius. As a result, when compared to earth, the gravitational attraction on the moon is about one sixth. Thus, an object's weight on the moon is $1/6^{th}$ its earth weight.

Exercise-10.4 Page: 141

1. Why is it difficult to hold a school bag having a strap made of a thin and strong string?

Solution:

It is tough to carry a college bag having a skinny strap as a result of the pressure on the shoulders. This can be as the result of the pressure is reciprocally proportional to the expanse on that the force acts. The smaller the surface area, the larger is going to be the pressure on the surface. Within the case of a skinny strap, the contact expanse is extremely tiny. Hence, the pressure exerted on the shoulder is extremely huge.

2. What do you mean by buoyancy?

Solution:

The upward force possessed by a liquid on an object that's immersed in it is referred to as buoyancy.

3. Why does an object float or sink when placed on the surface of water?

Solution:

An object float or sink when placed on the surface of water because of two reasons.

(i) If its density is greater than that of water, an object sinks in water.

(ii) If its density is less than that of water, an object floats in water.

Exercise-10.5 Page: 142

1. You find your mass to be 42 kg on a weighing machine. Is your mass more or less than 42 kg?

Solution:

When weighing our body, it is acting by an upward force. The buoyant force is this upward force. As a result, the body is pushed up slightly, resulting in the weighing machine showing less reading than the actual value.

2. You have a bag of cotton and an iron bar, each indicating a mass of 100 kg when measured on a weighing machine. In reality, one is heavier than other. Can you say which one is heavier and why?

Solution:

The bag of cotton is heavier than the bar of iron. The cotton bag has a larger air thrust than the iron bar. The weighing machine therefore indicates a smaller cotton bag weight than its actual weight.

Exercises-10.6 Page: 143

1. How does the force of gravitation between two objects change when the distance between them is reduced to half?

Solution:

Consider the Universal law of gravitation,

According to that law, the force of attraction between two bodies is

$$F = \frac{(Gm_1m_2)}{r^2}$$

Where,

m_1 and m_2 are the masses of the two bodies.

G is the gravitational constant.

r is the distance between the two bodies.

Given that the distance is reduced to half then,

r = 1/2 r

Therefore,

$$F = \frac{(Gm_1m_2)}{r^2}$$

$$F = \frac{(Gm_1m_2)}{(r/2)^2}$$

$$F = \frac{(4Gm_1m_2)}{(r)^2}$$

F = 4F

Therefore once the space between the objects is reduced to half, then the force of gravitation will increase by fourfold the first force.

2. Gravitational force acts on all objects in proportion to their masses. Why then does a heavy object not fall faster than a light object?

Solution:

All objects fall on the bottom with constant acceleration called acceleration thanks to gravity (g). It's constant and therefore the price of 'g' doesn't depend on the mass of associate object. So serious objects don't fall quicker than light-weight objects provided there's no air resistance.

3. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (Mass of the earth is 6×10^{24} kg and radius of the earth is 6.4×10^{6}m.)

Solution:

From Newton's law of gravitation, we know that the force of attraction between the bodies is given by

$$F = \frac{(Gm_1m_2)}{r^2}$$

Here

m_1 = mass of Earth = 6.0×10^{24}kg

m_2 = mass of the body = 1kg

r = distance between the two bodies

Radius of Earth = 6.4×10^{6}m

G = Universal gravitational constant = 6.67×10^{-11} Nm^2kg^{-2}

By substituting all the values in the equation

$$F = \frac{(Gm_1m_2)}{r^2}$$

$$F = \frac{6.67 \times 10^{11}(6.0 \times 10^{24} \times 1)}{(6.4 \times 10^{6})^2}$$

F = 9.8 N

This shows that Earth exerts a force of 9.8 N on a body of mass 1 kg. The body will exert an equal force of attraction of 9.8 N on the Earth.

4. The earth and the moon are attracted to each other by gravitational force. Does the earth attract the moon with a force that is greater or smaller or the same as the force with which the moon attracts the earth? Why?

Solution:

The earth attracts the moon with associate degree equal force with that the moon attracts the planet however these forces are in opposite directions. By universal law of gravitation, the force between moon and also the sun can be,

$$F = \frac{(Gm_1m_2)}{d^2}$$

Where,

d = distance between the earth and moon.

m_1 m_2 = masses of earth and moon respectively.

5. If the moon attracts the earth, why does the earth not move towards the moon?

Solution:

According to universal law of gravitation and Newton third law, we all know that the force of attraction between 2 objects is the same, however in wrong way. So the planet attracts the moon with the identical force because the moon exerts on earth however in opposite directions. Since earth is far larger in size than moon, that the acceleration cannot be detected on earth surface.

6. What happens to the force between two objects, if

(i) The mass of one object is doubled?

(ii) The distance between the objects is doubled and tripled?

(iii) The masses of both objects are doubled?

Solution:

(i)

According to universal law of gravitation, the force between 2 objects (m_1 and m_2) is proportional to their plenty and reciprocally proportional to the sq. of the distance(R) between them.

$$F = \frac{(G2m_1m_2)}{R^2}$$

If the mass is doubled for one object.

F = 2F, so force is also doubled.

(ii)

If the distance between the objects is doubled and tripled

If it's doubled

Hence,

$$F = \frac{(Gm_1m_2)}{2R^2}$$

F = 4F, Force thus becomes one-fourth of its initial force.

If it's tripled

Hence,

$$F = \frac{(Gm_1m_2)}{3R^2}$$

F = 9F, Force thus becomes one-ninth of its initial force.

(iii)

If masses of both the objects are doubled, then

$$F = \frac{(G2m_1 2m_2)}{R^2}$$

F = 4F, Force will therefore be four times greater than its actual value.

7. What is the importance of universal law of gravitation?

Solution:

The universal law of gravitation explains many phenomena that were believed to be unconnected:

(i) The motion of the moon round the earth

(ii) The force that binds North American nation to the world

(iii) The tides because of the moon and therefore the Sun

(iv) The motion of planets round the Sun

8. What is the acceleration of free fall?

Solution:

When anybody is in free fall, the sole force functioning on the article is that the earth's field of force. By Newton's second law of motion all the forces manufacture acceleration, therefore all the objects accelerate toward the world's surface thanks to attraction of the earth.

This acceleration is thought as acceleration thanks to gravity close to earth's surface. It's denoted by 'g' and its worth is 9.8m/s^2 and it's constant for all objects close to earth's surface (irrespective of their masses).

9. What do we call the gravitational force between the earth and an object?

Solution:

Gravitational force is known as the object's weight between the earth and an object.

10. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets him at the equator. Will the friend agree with the weight of gold bought? If not, why? [Hint: The value of g is greater at the poles than at the equator.]

Solution:

The weight of a body on the earth's surface;

W = mg wherever (m = mass of the body and g= acceleration thanks to gravity)

The value of g is a lot of at poles as compared to equator. So gold can weigh less at the equator as compared to poles.

Therefore, Amit's friend won't believe the load of the gold bought.

11. Why will a sheet of paper fall slower than one that is crumpled into a ball?

Solution:

A sheet of paper has a lot of area as compared to a crumpled paper ball. A sheet of paper must face a lot of air resistance. As result a sheet of paper falls slower than the crumpled ball.

12. Gravitational force on the surface of the moon is only 1/6 as strong as gravitational force on the earth. What is the weight in newton's of a 10 kg object on the moon and on the earth?

Solution:

Given data:

Acceleration due to earth's gravity = g_e or g = 9.8 m/s^2

Object weight m = 10 kg

Acceleration due to moon gravity = g_m

Weight on the earth= W_e

Weight on the moon = W_m

Weight = mass x gravity

$g_m = (1/6)\ g_e$ (given)

So $W_m = m\ g_m = m \times (1/6)\ g_e$

$W_m = 10 \times (1/6) \times 9.8 = 16.34$ N

$W_e = m \times g_e = 10 \times 9.8$

$W_e = 98$N

13. A ball is thrown vertically upwards with a velocity of 49 m/s.

Calculate

(i) The maximum height to which it rises,

(ii) The total time it takes to return to the surface of the earth.

Solution:

Given data:

Initial velocity u = 49m/s

Final speed v at maximum height = 0

Acceleration due to earth gravity g = -9.8 m/s^2 (thus negative as ball is thrown up).

By third equation of motion,

$v^2 = u^2 - 2gs$

Substitute all the values in the above equation

$0 = (49)^2 - 2 \times 9.8 \times s$

$$S = \frac{(49)^2}{2 \times 9.8}$$

s = 122.5m

Total time T = Time to ascend (Ta) + Time to descend (Td)

V = u – gt

0 = 49 – 9.8 x Ta

Ta = (49/9.8) = 5s

Also, Td = 5s

Therefore T = Ta + Td

T = 5 + 5

T = 10s

14. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground.

Solution:

Given data:

Initial velocity

$u = 0$

Tower height = total distance = 19.6m

$g = 9.8\ m/s^2$

Consider third equation of motion

$v^2 = u^2 + 2gs$

$v^2 = 0 + 2 \times 9.8 \times 19.6$

$v^2 = 384.16$

$v = \sqrt{(384.16)}$

$v = 19.6m/s$

15. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking g = 10 m/s^2, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?

Solution:

Given data:

Initial velocity u = 40m/s

$g = 10\ m/s^2$

Max height final velocity = 0

Consider third equation of motion

$v^2 = u^2 – 2gs$ [negative as the object goes up]

$0 = (40)^2 – 2 \times 10 \times s$

$s = (40 \times 40) / 20$

Maximum height s = 80m

Total Distance = s + s = 80 + 80

Total Distance = 160m

Total displacement = 0 (The first point is the same as the last point)

16. Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth = 6×10^{24} kg and of the Sun = 2×10^{30} kg. The average distance between the two is 1.5×10^{11} m.

Solution:

Given data:

Mass of the sun $m_s = 2 \times 10^{30}$ kg

Mass of the earth $m_e = 6 \times 10^{24}$ kg

Gravitation constant G = 6.67 x 10^{-11} N m^2/ kg^2

Average distance r = 1.5×10^{11} m

Consider Universal law of Gravitation

$$F = \frac{(Gm_1m_2)}{d^2}$$

$$F = \frac{(6.67 \times 10^{-11} \times 6 \times 10^{24} \times 2 \times 10^{30})}{(1.5 \times 10^{11})^2}$$

F = 3.56 x 10^{23} N

17. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.

Solution:

Given data:

(i) When the stone from the top of the tower is thrown,

Initial velocity u = 0

Distance travelled = x

Time taken = t

Therefore,

$$s = ut + \frac{1}{2}gt^2$$

$x = 0 + (1/2)\, gt^2$

$x = 5t^2$ ---------(a)

(ii) When the stone is thrown upwards,

Initial velocity u = 25 m/s

Distance travelled = (100 – x)

Time taken = t

$$s = ut + \frac{1}{2}gt^2$$

$(100 - x) = 25t + (1/2) \times 10 \times t^2$

$x = 100 - 25t + 5t^2$ ------- (b)

From equations (a) and (b)

$5t^2 = 100 - 25t + 5t^2$

t = (100/25) = 4sec.

After 4sec, two stones will meet

From (a)

$x = 5t^2 = 5 \times 4 \times 4 = 80m$.

Putting the value of x in (100-x)

= (100-80) = 20m.

This means that after 4sec, 2 stones meet a distance of 20 m from the ground.

18. A ball thrown up vertically returns to the thrower after 6 s. Find

(a) The velocity with which it was thrown up,

(b) The maximum height it reaches, and

(c) Its position after 4s.

Solution:

Given data:

$g = 10m/s^2$

Total time T = 6sec

$T_a = T_d = 3sec$

(a) Final velocity at maximum height v = 0

From first equation of motion:-

$v = u - gt_a$

$u = v + gt_a$

$= 0 + 10 \times 3$

= 30m/s

The velocity with which stone was thrown up is 30m/s.

(b) From second equation of motion

$s = ut_a - \frac{1}{2}g(t_a)^2$

$= 30 \times 3 - (1/2) \times 10 \times (3)^2$

$= 90\text{-}45 = 45m$

The maximum height stone reaches is 45m.

(c) In 3sec, it reaches the maximum height.

Distance travelled in another 1sec = s'

$s = ut_a - \frac{1}{2}g(t_a)^2$

$s = 0 + 10 \times 1 \times 1$

$s = 5m.$

The distance travelled in another 1sec = 5m.

Therefore in 4sec, the position of point p (45 – 5)

= 40m from the ground.

19. In what direction does the buoyant force on an object immersed in a liquid act?

Solution:

The buoyant force on an object that is immersed in a liquid will be in a vertically upward direction.

20. Why a block of plastic does released under water come up to the surface of water?

Solution:

The density of plastic is a smaller amount than that of water, therefore the force of buoyancy on plastic block are going to be bigger than the load of plastic block displaced. Hence, the acceleration of plastic block are going to be in upward direction, and comes up to the surface of water.

21. The volume of 50 g of a substance is 20 cm^3. If the density of water is 1 g cm^{-3}, will the substance float or sink?

Solution:

To find the Density of the substance the formula is

Density = (Mass/Volume)

Density = (50/20) = 2.5g/cm^3

Density of water = 1g/cm^3

Density of the substance is greater than density of water. So the substance will sink.

22. The volume of a 500 g sealed packet is 350 cm^3. Will the packet float or sink in water if the density of water is 1 g cm^{-3}? What will be the mass of the water displaced by this packet?

Solution:

Density of sealed packet = 500/350 = 1.42 g/cm^3

Density of sealed packet is greater than density of water

Therefore the packet will sink.

Considering Archimedes Principle,

Displaced water volume = Force exerted on the sealed packet.

Volume of water displaced = 350cm^3

Therefore displaced water mass = ρ x V

= 1 × 350

Mass of displaced water = 350g.

Chapter 11: Work and Energy

Exercise-11.1 Page: 148

1. A force of 7 N acts on an object. The displacement is, say 8 m, in the direction of the force. Let us take it that the force acts on the object through the displacement. What is the work done in this case?

Solution:

When a force F acts on an object to move it in its direction through a distance S, the work is done

The work on the body is done by force

Work done = Force × Displacement

$W = F \times S$

Where,

$F = 7\ N\ S = 8\ m$

So, work done,

$W = 7 \times 8$

$W = 56\ Nm$

$W = 56\ J$

Exercise-11.2 Page: 149

1. When do we say that work is done?

Solution:

Work is completed whenever the given conditions are satisfied:

(i) A force acts on the body.

(ii) There's a displacement of the body caused by the applied force on the direction of the applied force.

2. Write an expression for the work done when a force is acting on an object in the direction of its displacement.

Solution:

When a force F displaces a body through a distance S within the direction of the applied force, then the work done W on the body is given by the expression:

$W = F \times S$

3. Define 1 J of work.

Solution:

1 J is that the quantity of labor done by a force of one N on associate degree object that displaces it through a distance of one m within the direction of the applied force.

4. A pair of bullocks exerts a force of 140 N on a plough. The field being ploughed is 15 m long.

How much work is done in ploughing the length of the field?

Solution:

Work done by the bullocks is given by the expression:

$W = F \times d$

Where,

Applied force, F = 140 N

Displacement, d = 15 m

W= a hundred and forty × fifteen = 2100 J

Hence, 2100 J of labour is finished in tilling the length of the sector.

Exercise-11.3 Page: 152

1. What is the kinetic energy of an object?

Solution:

The energy possessed by a body by the virtue of its motion is termed mechanical energy or kinetic energy. Every moving object possesses mechanical energy. A body uses mechanical energy to try to work. Kinetic energy of the hammer is employed in driving a nail into a log of wood, mechanical energy of air is employed to run wind mills, etc.

3. Write an expression for the kinetic energy of an object.

Solution:

If a body of mass m is moving with a speed v, then its K.E. E k is given by the expression,

$E_k = 1/2\ m\ v^2$

Its SI unit is Joule (J).

4. The kinetic energy of an object of mass, m moving with a velocity of 5 ms^{-1} is 25 J. What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?

Solution:

The kinetic energy of the object = 25J

The formula for kinetic energy is

$$Kinetic\ energy = \frac{mv^2}{2}$$

m = 2 kg

Therefore increased velocity = $\{3\times5\}\frac{m}{s}$ = 15 m/s

Kinetic energy increase = $\frac{1}{2} \times 2 \times (15)^2$ = 225J

Exercise-11.4 Page: 156

1. What is power?

Solution:

Power is that the rate of doing work or the speed of transfer of energy. If W is that the quantity of work wiped out time t, then power is given by the expression,

$$Power = \frac{Work}{Time}$$

P = W/T

It is expressed in watt (W).

2. Define 1 watt of power.

Solution:

A body is claimed to possess power of one watt if it will work on the speed of 1 joule in 1 s.

That is,

One W = 1 J/1 S

3. A lamp consumes 1000 J of electrical energy in 10 s. What is its power?

Solution:

Power = Work/Time

P = W/T

Time = 10 s

Work done = Energy consumed by the lamp = 1000 J

Power = 1000/10 = 100 Js^{-1} =100 W

4. Define average power

Solution:

The average Power of an agent could also be outlined because the total work done by it within the total time taken.

$$\text{Average Power} = \frac{\text{Total Work Done}}{\text{Total Time Taken}}$$

Exercises – 11.5 Page: 158

1. Look at the activities listed below. Reason out whether or not work is done in the light of your understanding of the term 'work'.

(a) Suma is swimming in a pond.

(b)A donkey is carrying a load on its back.

(c) A wind-mill is lifting water from a well.

(d) A green plant is carrying out photosynthesis.

(e) An engine is pulling a train.

(f) Food grains are getting dried in the sun.

(g) A sailboat is moving due to wind energy.

Solution:

Work is finished whenever the given 2 conditions are satisfied:

(i) A force acts on the body.

(ii) There's a displacement of the body by the applying of force in or opposite to the direction of force.

(a) Whereas swimming, Suma applies a force to push the water backwards. Therefore, Suma swims within the forward direction caused by the forward

reaction of water. Here, the force causes a displacement. Hence, work is finished by Seema whereas swimming.
(b) Whereas carrying a load, the donkey should apply a force within the upward direction. But, displacement of the load is within the forward direction. Since, displacement is perpendicular to force, the work done is zero.
(c) A wind mill works against the gravity to elevate water. Hence, work is finished by the wind mill in lifting water from the well.
(d) During this case, there's no displacement of the leaves of the plant. Therefore, the work done is zero.
(e) An engine applies force to tug the train. This permits the train to maneuver within the direction of force. Therefore, there's a displacement within the train in the same direction. Hence, work is finished by the engine on the train.
(f) Food grains don't move within the presence of alternative energy. Hence, the work done is zero during the method of food grains obtaining dried within the Sun.
(g)Wind energy applies a force on the sailing ship to push it within the forward direction. Therefore, there is a displacement within the boat in the direction of force. Hence, work is finished by wind on the boat.

2. An object thrown at a certain angle to the ground moves in a curved path and falls back to the ground. The initial and the final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object?

Solution:

Work done by the force of gravity on an object depends solely on vertical displacement. Vertical displacement is given by the distinction within the initial and final positions/heights of the thing that is zero.
Gravity-related work is expressed as,
W= m g h
Where,
h= Vertical displacement = zero

W = m g × zero = 0 J

Consequently, the work done on the given object by gravity is zero joule.

3. A battery lights a bulb. Describe the energy changes involved in the process.

Solution:

When a bulb is connected to a battery, then the energy of the battery is transferred into voltage. Once the bulb receives this voltage, then it converts it into light-weight and warmth energy. Hence, the transformation of energy within the given situation may be shown as:

Chemical Energy → Electrical Energy → Light Energy + Heat Energy.

E k = K.E. of the thing moving with a rate, v

K.E. once the thing was moving with a rate five m s^{-1}

1 (E k) 5 = two × twenty × (5)

= 250 J

Kinetic energy once the thing was moving with a rate two m s^{-1} one

(E k) 2 = two x twenty × (2)

= 40 J

4. Certain force acting on a 20 kg mass changes its velocity from 5 m s^{-1} to 2 m s^{-1}. Calculate the work done by the force.

Solution:

Given data:

Initial velocity u=5 ms^{-1}

Mass of the body = 20kg

Final velocity v = 2 ms^{-1}

The initial kinetic energy

Ei = (1/2) mu^2 = (1/2) x 20 x (5 ms^{-1})^2 =250kgms^{-2}

= 250Nm = 250J

Final kinetic energy Ef = (1/2) mv^2 = (1/2) x 20 x (2 ms^{-1})^2 =40kgms^{-2} = 40 Nm =40J

Therefore,

Work done = Change in kinetic energy

Work done = $E_f - E_i$

Work done =40J – 250J

Work done = -210J

Where negative sign indicates that force acts contrary to motion direction.

5. A mass of 10 kg is at a point A on a table. It is moved to a point B. If the line joining A and B is horizontal, hat is the work done on the object by the gravitational force? Explain your answer.

Solution:

Work done by gravity depends solely on the vertical displacement of the body. It doesn't rely on the trail of the body. Therefore, work done by gravity is given by the expression,

W= m g h

Where,

Vertical displacement, h = 0

∴ W= mg × zero = 0

Therefore the work done on the body by gravity is therefore zero.

6. The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?

Solution:

No, the method doesn't violate the law of conservation of energy. This is because once the body falls from a height, then its mechanical energy changes into kinetic energy increasingly. A decrease within the mechanical energy is capable a rise in the kinetic energy of the body. Throughout the method, total energy of the body remains conserved. Therefore, the law of conservation of energy isn't desecrated.

7. What are the various energy transformations that occur when you are riding a bicycle?

Solution:

During riding a bicycle, the muscular energy of the rider is regenerate into heat and mechanical energy.

Kinetic energy provides rate to the bicycle and warmth energy heats our body.

Muscular energy mechanical energy + heat

8. Does the transfer of energy take place when you push a huge rock with all your might and fail to move it? Where is the energy you spend going?

Solution:

When we push a large rock, there's no transfer of muscular energy to the stationary rock. Also, there's no loss of energy as a result of muscular energy is transferred into energy, which causes our body to become hot.

9. A certain household has consumed 250 units of energy during a month. How much energy is this in joules?

Solution:

1 unit of energy is up to one B.T.U. (kWh).

1 unit = one kWh

1 kWh = 3.6×10^6 J

Therefore, 250 units of energy = $250 \times 3.6 \times 10^6$

= 9×10^8 J.

10. An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.

Solution:

Gravitational mechanical energy is given by the expression,

W = mgh

Where,

h = Vertical displacement = 5 m, m = Mass of the item = 40 kg

g = Acceleration because of gravity = 9.8 m s^{-2}

$\therefore$ W = $40 \times 5 \times 9.8 = 1960$ J.

At half-way down, the mechanical energy of the item are going to be 1960/2

At this time, the item has an equal quantity of potential and K.E.

This can be due to law of conservation of energy. Hence, half-way down, the K.E. of the item can be 980 J.

11. What is the work done by the force of gravity on a satellite moving round the earth? Justify your answer.

Solution:

Work is completed whenever the given 2 conditions are satisfied:

→ a force acts on the body.

→ there's a displacement of the body by the appliance of force in or opposite to the direction of force.

If the force direction is perpendicular to the displacement, the work performed is zero. When a satellite moves round the Earth, then the direction of force of gravity on the satellite is perpendicular to its displacement. Hence, the work done on the satellite by the planet is zero.

12. Can there be displacement of an object in the absence of any force acting on it? Think. Discuss this question with your friends and teacher

Solution:

Yes, consider a uniformly moving object,

Suppose an object is moving with constant rate. The web force performing on its zero. But, there is a displacement on the motion of the article. Hence, there will be a displacement while not a force.

13. A person holds a bundle of hay over his head for 30 minutes and gets tired. Has he done some work or not? Justify your answer.

Solution:

Work is completed whenever the given 2 conditions are satisfied.

(i) A force acts on the body.

(ii) There's a displacement of the body by the applying of force in or opposite to the direction of force.

When an individual holds a bundle of fodder over his head, then there's no displacement within the bundle of fodder. Although, force of gravity is

functioning on the bundle, the person isn't applying any force thereon. Hence, within the absence of force, work done by the person on the bundle is zero.

14. An electric heater is rated 1500 W. How much energy does it use in 10 hours?

Solution:

With the help of the expression, energy consumed by an electric heater will be obtained,

P = T

Where,

Power rating of the heater,

P = 500 W = 1.5 power unit Time that the heater has operated,

T = ten h Work done = Energy consumed by the heater

Therefore, energy consumed = Power × Time

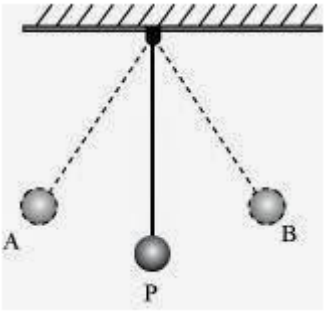
= 1.5 × 10 = 15 kWh

Hence, the energy consumed by the heater in 10h is 15 kWh.

15. Illustrate the law of conservation of energy by discussing the energy changes which occur when we draw a pendulum bob to one side and allow it to oscillate. Why does the bob eventually come to rest? What happens to its energy eventually? Is it a violation of the law of conservation of energy?

Solution:

Consider the case of oscillation pendulum.



When an apparatus moves from its mean position P to either of its extreme positions A or B, it rises through a height h on top of the mean level P. At this time, the K.E. of the bob changes fully into P.E. The K.E. becomes zero, and also the bob possesses solely P.E. Because it moves towards purpose P, its P.E.

decreases increasingly. Consequently, the K.E. will increase. Because the bob reaches purpose P, its P.E. becomes zero and also the bob possesses solely K.E. This method is perennial as long because the apparatus oscillates.
The bob doesn't oscillate forever. It involves rest as a result of air resistance resists its motion. The apparatus loses its K.E. to beat this friction and stops once a while. The law of conservation of energy isn't desecrated as a result of the energy lost by the apparatus to beat friction is gained by its surroundings. Hence, the overall energy of the apparatus and also the encompassing system stay preserved.

16. An object of mass, m is moving with a constant velocity, v. How much work should be done on the object in order to bring the object to rest?

Solution:

The formula for kinetic energy = $\frac{1}{2}mv^2$

The kinetic energy of the object at rest = 0

Change in kinetic energy = Work done on an object

$$= \frac{1}{2}mv^2 - 0$$

$$= \frac{1}{2}mv^2$$

17. Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h?

Solution:

Given data:

The mass of the body = 1500kg

Velocity v = 60km/hr

$$= \frac{60 \times 1000m}{3600s}$$

$$= \frac{50}{3}m/s$$

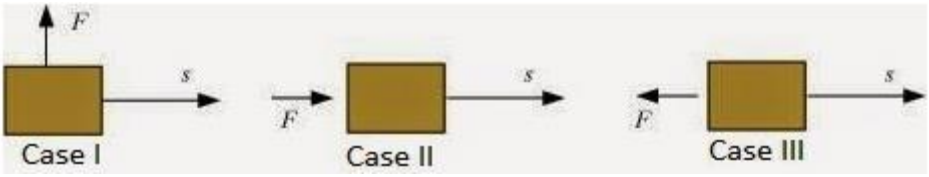
The work required to stop the car = kinetic energy change of the car

$$= \frac{1}{2}mv^2 - \frac{1}{2}\text{m } (0)^2$$

$$= \frac{1}{2} \times (1500) \times (\frac{50}{3})^2$$

= 208333.3 J

18. In each of the following a force, F is acting on an object of mass, m. The direction of displacement is from west to east shown by the longer arrow. Observe the diagrams carefully and state whether the work done by the force is negative, positive or zero.



Solution:

Case I

In this case, the direction of force functioning on the block is perpendicular to the displacement. Therefore, work done by force on the block are going to be zero.

Case II

In this case, the direction of force functioning on the block is within the direction of displacement. Therefore, work done by force on the block are going to be positive.

Case III

In this case, the direction of force on the block is contrary to the direction of displacement. Therefore, work done by force on the block are going to be negative.

19. Soni says that the acceleration in an object could be zero even when several forces are acting on it. Do you agree with her? Why?

Solution:

Acceleration in associate object might be zero even once many forces are working on it. This happens once all the forces get rid of one another i.e., the online force working on the thing is zero. For a uniformly moving object, the online force working on the thing is zero. Hence, the acceleration of the thing is zero. Hence, Soni is correct.

20. Find the energy in kW h consumed in 10 hours by four devices of power 500 W each.

Solution:

Energy consumed by an electrical device will be obtained with the assistance of the expression for power,

P = T

Where,

Power rating of the device,

P = five hundred W = 0.50 power unit Time that the device runs,

T= ten h Work d consumed by the device thus, energy c × Time

= 0.50 × 10 = 5 kWh

Hence, the energy consumed by four equal rating devices in

10 h = 4 × 5 kWh = 20 kWh = 20 Units.

21. A freely falling object eventually stops on reaching the ground. What happens to its kinetic energy?

Solution:

When the object falls freely towards the bottom, its mechanical energy decreases and K.E. will increase, because the object touches the bottom, all its mechanical energy gets reborn into K.E. Because the object hits the laborious ground, all its K.E. gets reborn into heat and sound energy. It may also deform the bottom relying upon the character of the ground and therefore the quantity of K.E. possessed by the thing.

Chapter 12- Sound

Section 12.1 Page: 162

1. How does the sound produced by a vibrating object in a medium reach your ear?

Solution:

When an object vibrates, it necessitates the surrounding particles of the medium to vibrate. The particles that are adjacent to vibrating particles are forced to vibrate. Hence the sound produced by a vibrating object in a medium is transferred from particle to particle till it reaches your ear.

Section 12.2 Page: 163

1. Explain how sound is produced by your school bell.

Solution:

When the school bell is hit with a hammer, it moves forward and backwards producing compression and rarefaction due to vibrations. This is how sound is produced by the school bell.

2. Why are sound waves called mechanical waves?

Solution:

Sound waves require a medium to propagate to interact with the particles present in it. Therefore sound waves are called mechanical waves.

3. Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Solution:

No. Sound waves require a medium to propagate. Due to the absence of atmosphere on the moon and since sound cannot travel in vacuum, I will not be able to hear any sound produced by my friend.

Section 12.2.3 Page: 166

1. Which wave property determines (a) loudness, (b) pitch?

Solution:

(a). Amplitude – The loudness of the sound and its amplitude is directly related to each other. Larger the amplitude louder is the sound.

(b). Frequency – The pitch of the sound and its frequency is directly related to each other. If the pitch is high then the frequency of sound is also high.

2. Guess which sound has a higher pitch: guitar or car horn?

Solution:

The pitch of a sound is directly proportional to its frequency. Therefore, the guitar has a higher pitch when compared to a car horn.

3. What are wavelength, frequency, time period and amplitude of a sound wave?

Solution:

(a) Wavelength – Wavelength can be defined as the distance between two consecutive rarefactions or two consecutive compressions. The SI unit of wavelength is meter (m).

(b) Frequency – Frequency is defined as the number of oscillations per second. The SI unit of frequency is hertz (Hz).

(c) Amplitude – Amplitude can be defined as the maximum height reached by the trough or crest of a sound wave.

(d) Time period – The time period is defined as the time required to produce one complete cycle of a sound wave.

4. How are the wavelength and frequency of a sound wave related to its speed?

Solution:

Wavelength, speed, and frequency are related in the following way:

Speed = Wavelength x Frequency

$v = \lambda \nu$

5. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Solution:

Given that,

Frequency of sound wave = 220 Hz.

Speed of sound wave = 440 m/s.

Calculate wavelength.

We know that,

Speed = Wavelength × Frequency

$v = \lambda \nu$

440 = Wavelength × 220

Wavelength = 440/220

Wavelength = 2

Therefore, the wavelength of the sound wave = 2 meters.

6. A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?

Solution:

The time interval between successive compressions from the source is equal to the time period and time period is reciprocal of the frequency. Therefore, it can be calculated as follows:

T= 1/F

T= 1/500

T = 0.002 s.

7. Distinguish between loudness and intensity of sound.

Solution:

The amount of sound energy passing through an area every second is called intensity of a sound wave. Loudness is defined by its amplitude.

Section 12.2.4 Page: 167

1. In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Solution:

Sound travels faster in solids when compared to any other medium. Therefore, at a particular temperature, sound travels fastest in iron and slowest in gas.

Section 12.3.2 Page: 168

1. An echo is heard in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 ms^{-1}?

Solution:

Speed of sound (v) = 342 ms^{-1}

Echo returns in time (t) = 3 s

Distance travelled by sound = v × t = 342 × 3 = 1026 m

In the given interval of time, sound must travel a distance which is twice the distance of reflecting surface and source.

Therefore, the distance of reflecting surface from the source =1026/2 = 513 m.

Section 12.3.3 Page: 169

1. Why are the ceilings of concert halls curved?

Solution:

Ceilings of concert halls are curved to uniformly spread sound in all directions after reflecting from the walls.

Section 12.4 Page: 170

1. What is the audible range of the average human ear?

Solution:

20 Hz to 20,000 Hz. Any sound less than 20 Hz or greater than 20,000 Hz frequency is not audible to human ears.

2. What is the range of frequencies associated with (a) Infrasound? (b) Ultrasound?

Solution:

(a). 20 Hz

(b). 20,000 Hz.

Section 12.5.1 Page: 172

1. A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is 1531 m/s, how far away is the cliff?

Solution:

Time (t) taken by the sonar pulse to return = 1.02 s

Speed (v) of sound in salt water = 1531 m s^{-1}

Distance travelled by sonar pulse = Speed of sound × Time taken

= 1531 x 1.02 = 1561.62 m

Distance of the cliff from the submarine = (Total distance travelled by sonar pulse) / 2

= 1561.62 / 2

= 780.81 m.

Exercise Questions Page: 174

1. What is sound and how is it produced?

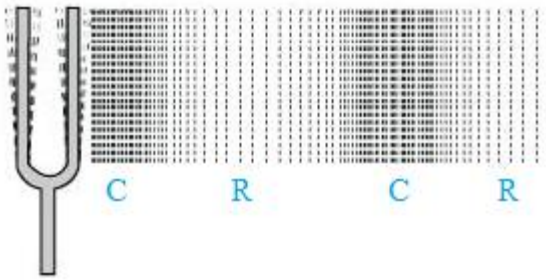
Solution:

Sound is produced due to vibrations. When a body vibrates, it forces the adjacent particles of the medium to vibrate. This results in a disturbance in the medium, which travels as waves and reaches the ear. Hence sound is produced.

2. Describe with the help of a diagram, how compressions and rarefactions are produced in the air near a source of sound.

Solution:

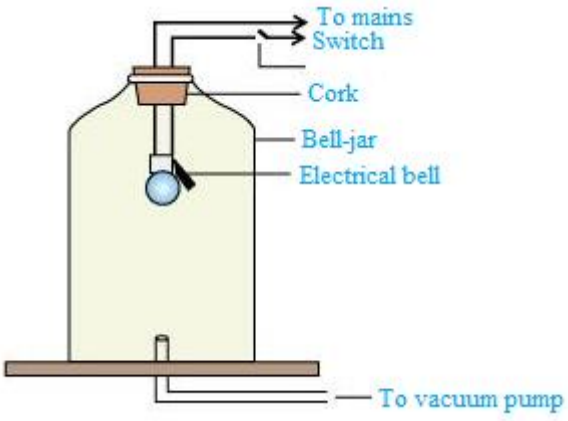
When the school bell is hit with a hammer, it moves forward and backwards producing compression and rarefaction due to vibrations. When it moves forward, it creates high pressure in its surrounding area. This high-pressure region is known as compression. When it moves backwards, it creates a low-pressure region in its surrounding. This region is called rarefaction.



3. Cite an experiment to show that sound needs a material medium for its propagation.

Solution:

Take an electric bell and hang it inside an empty bell-jar which is fitted with a vacuum pump (as shown in the figure below).



Initially, one can hear the sound of the ringing bell. Now, pump out some air from the bell-jar using the vacuum pump. You will realize that the sound of the ringing bell decreases. If you keep on pumping the air out of the bell-jar, then glass-jar will be devoid of any air after some time. Now try to ring the bell. No sound is heard but you can see bell prong is still vibrating. When there is no air present in the bell jar, a vacuum is produced. Sound cannot travel through vacuum. Therefore, this experiment shows that sound needs a material medium for its propagation.

4. Why sound wave is called a longitudinal wave?

Solution:

The vibration of the medium that travels parallel to the direction of the wave or along in the direction of the wave, is called a longitudinal wave. The direction of particles of the medium vibrates parallel to the direction of the propagation of disturbance. Therefore, a sound wave is called a longitudinal wave.

5. Which characteristics of the sound help you to identify your friend by his voice while sitting with others in a dark room?

Solution:

Quality of sound is a characteristic that helps us identify the voice of a particular person. Two people may have the same pitch and loudness, but their qualities will be different.

6. Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?

Solution:

The speed of sound is 344 m/s whereas the speed of light is 3×10^8 m/s. The speed of light is less when compared to that of light. Due to this reason, the thunder takes more time to reach the Earth as compared to the light speed which is faster. Hence, lightning is seen before whenever we hear the thunder.

7. A person has a hearing range from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as 344 m s^{-1}.

Solution:

For sound waves,

Speed = Wavelength × frequency

$v = \lambda \times v$

Speed of sound wave in air = 344 m/s

(a) For v = 20 Hz

$\lambda_1 = v/v_1 = 344/20 = 17.2$ m

(b) For v_2 = 20,000 Hz

$\lambda_2 = v/v_2 = 344/20{,}000 = 0.0172$ m

Therefore, for human beings the hearing wavelength is in the range of 0.0172 m to 17.2 m.

8. Two children are at opposite ends of an aluminum rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in the air and in aluminum to reach the second child.

Solution:

Consider the length of aluminum rod = d

Speed of sound wave at 25° C, V Al = 6420 ms-1

Time taken to reach other end

T Al = d/ (V Al) = d/6420

Speed of sound in air, V air = 346 ms-1

Time taken by sound to each other end,

T air = d/ (V air) = d/346

Therefore, the ratio of time taken by sound in aluminum and air,

T air / t Al = 6420 / 346 = 18.55

9. The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?

Solution:

Frequency = (Number of oscillations) / Total time

Number of oscillations = Frequency × Total time

Given,

Frequency of sound = 100 Hz

Total time = 1 min (1 min = 60 s)

Number of oscillations or vibrations = 100 × 60 = 6000

The source vibrates 6000 times in a minute and produces a frequency of 100 Hz.

10. Does sound follow the same laws of reflection as light does? Explain.

Solution:

Yes. Sound follows the same laws of reflection as light. The reflected sound wave and the incident sound wave make an equal angle with the normal to the surface at the point of incidence. Also, the reflected sound wave, the normal to the point of incidence, and the incident sound wave all lie in the same plane.

11. When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remains the same. Do you hear echo sound on a hotter day?

Solution:

An echo is heard when time interval between the reflected sound and the original sound is at least 0.1 second. As the temperature increases, the speed

of sound in a medium also increases. On a hotter day, the time interval between the reflected and original sound will decrease and an echo is audible only if the time interval between the reflected sound and the original sound is greater than 0.1 s.

12. Give two practical applications of reflection of sound waves.

Solution:

(i) Reflection of sound is used to measure the speed and distance of underwater objects. This method is called SONAR.

(ii) Working of a stethoscope – the sound of patient's heartbeat reaches the doctor's ear through multiple reflections of sound.

13. A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower. When is the splash heard at the top? Given, g = 10 m s^{-2} and speed of sound = 340 m s^{-1}.

Solution:

Height (s) of tower = 500 m

Velocity (v) of sound = 340 m s^{-1}

Acceleration (g) due to gravity = 10 m s^{-1}

Initial velocity (u) of the stone = 0

Time (t_1) taken by the stone to fall to tower base

As per second equation of motion:

$s = ut_1 + (½)\ g\ (t_1)^2$

$500 = 0 \times t_1 + (½)\ 10\ (t_1)^2$

$(t_1)^2 = 100$

$t_1 = 10$ s

Time (t_2) taken by sound to reach top from tower base = 500/340 = 1.47 s.

$t = t_1 + t_2$

$t = 10 + 1.47$

$t = 11.47$ s.

14. A sound wave travels at a speed of 339 m s^{-1}. If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?

Solution:

Speed (v) of sound = 339 m s^{-1}

Wavelength (λ) of sound = 1.5 cm = 0.015 m

Speed of sound = Wavelength × Frequency

v = v = λ X v

v = v / λ = 339 / 0.015 = 22600 Hz.

The frequency of audible sound for human beings lies between the ranges of 20 Hz to 20,000 Hz. The frequency of the given sound is more than 20,000 Hz, therefore, it is not audible.

Page: 175

15. What is reverberation? How can it be reduced?

Solution:

The continuous multiple reflections of sound in a big enclosed space is reverberation. It can be reduced by covering walls and ceiling of enclosed space with the help of sound absorbing materials such as loose woollens, fibre boards.

16. What is loudness of sound? What factors does it depend on?

Solution:

Loud sounds have high energy. Loudness directly depends on the amplitude of vibrations. It is proportional to the square of the amplitude of vibrations of sound.

17. Explain how bats use ultrasound to catch prey.

Solution:

Bats have the ability to produce high-pitched ultrasonic squeaks. These squeaks get reflected by objects like preys and return to their ears. This helps a bat to know how far his prey is.

18. How is ultrasound used for cleaning?

Solution:

Objects that need to be cleansed are put in a cleaning solution and ultrasonic sound waves are passed through the solution. The high frequency of

ultrasound waves helps in detaching the dirt from the objects. In this way ultrasound is used for cleaning purposes.

19. Explain the working and application of a sonar.

Solution:

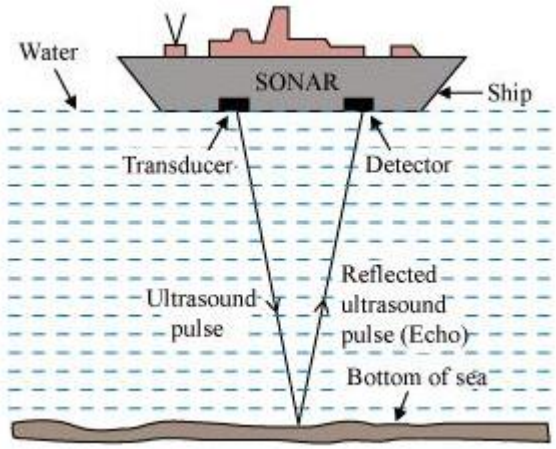
SONAR is an abbreviation of Sound Navigation and Ranging**.** It is an acoustic device used in measuring the direction, speed, and depth of under-water objects viz. ship wrecks and submarines using ultrasound.

Also, it is used to determine the depth of oceans and seas.

A beam of ultrasonic sound is produced and travels through the sea water which is transmitted by the transducer. When it reflects an echo is produced which is detected and recorded by the detector. It is then converted into electrical signals. The distance is represented by 'd' of the under-water object is calculated from the time (represented as 't') taken by the echo to return with speed (represented as '*v*') is expressed as,

$2d = v \times t$.

This method of measuring distance is also referred to as echo-ranging.



20. A sonar device on a submarine sends out a signal and receives an echo 5 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3625 m.

Solution:

Time (t) taken to hear the echo = 5 s

Distance (d) of object from submarine = 3625 m

Total distance travelled by SONAR during reception and transmission in water = 2d

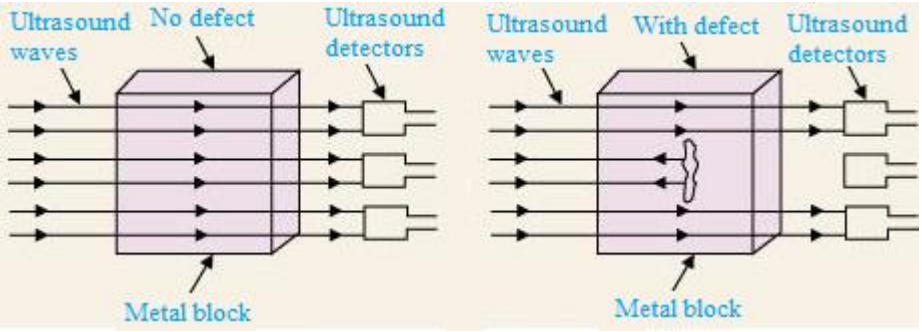
Velocity (v) of sound in water = 2d/t = (2 × 3625) / 5

= 1450 ms^{-1}

21. Explain how defects in a metal block can be detected using ultrasound.

Solution:

Defective metal blocks will not allow ultrasound to pass through it and reflect it back. This technique is used in detecting defects in metal blocks. Make a set up as shown in the figure with ultrasound being passed through one end and detectors placed on the other end of a metal block. Since the defective part of the metal block does not allow ultrasound to pass through it.it will not be detected by the detector. In this way, defects in metal blocks can be detected with the help of ultrasound.

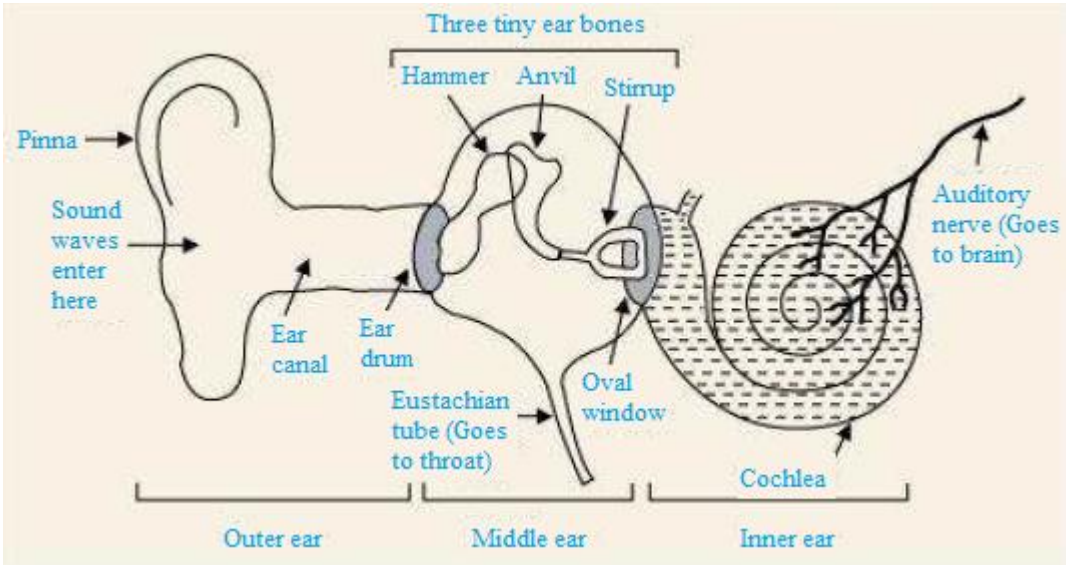


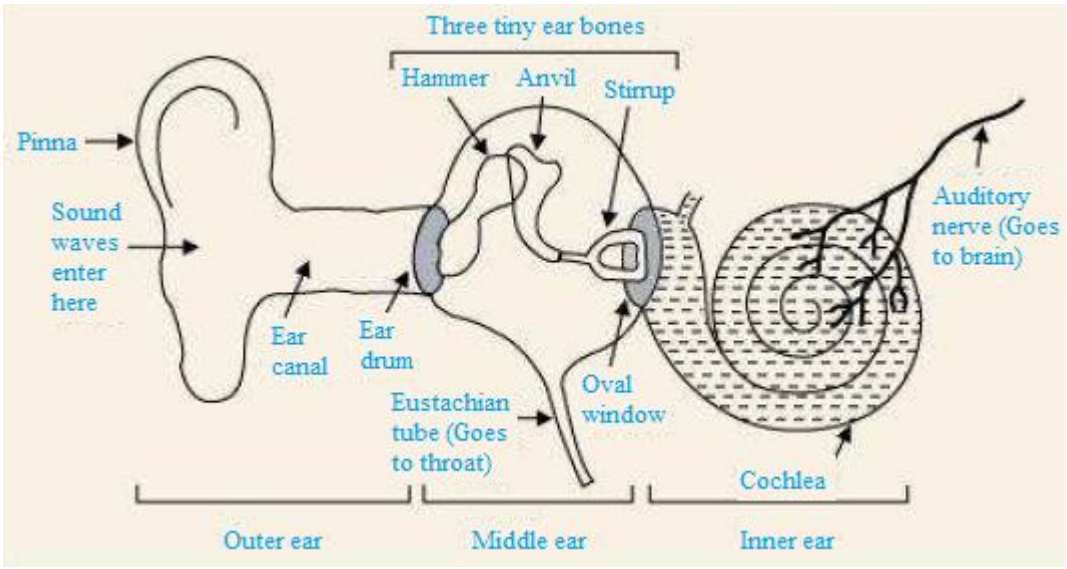
22. Explain how the human ear works.

Solution:

Various sounds produced by particles in our surroundings are collected by pinna that transfers these sounds to the ear drum through the ear canal. The eardrum begins to vibrate back and forth briskly as soon as the sound waves fall on it. The vibrating

Eardrum initiates the small bone hammer to vibrate. These vibrations are passed from the hammer to the third bone stirrup via the second bone anvil. The stirrup strikes the membrane of the oval window to pass its vibration to the cochlea. The liquid in the cochlea produces electrical impulses in the nerve cells. These electrical impulses are carried to the brain by the auditory nerve. They are interpreted by the brain as sound and hence we get a sensation of hearing.


Three tiny ear bones
Hammer
Anvil
Stirrup
Pinna
Sound waves enter here
Ear canal
Ear drum
Eustachian tube (Goes to throat)
Oval window
Auditory nerve (Goes to brain)
Cochlea
Outer ear
Middle ear
Inner ear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Cochlea
Outer ear
Middle ear
Inner ear

Chapter 13 – Why Do We Fall Ill?

1. State any two conditions essential for good health.

Solution:

Good economic condition and earnings

Social environment

2. State any two conditions essential for being free of disease.

Solution:

Living in a healthy and hygienic environment.

Getting vaccination against infectious disease whenever required.

3. Are the answers to the above questions necessarily the same or different? Why?

Solution:

The answers to the above questions are different because a person may be free of disease but not be good mentally, socially and economically.

In-Text Questions 13.2.5

1. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?

Solution:

(a). Headache, fever

(b). Muscle pain

(c). Dysentery

Usually, we do not visit a doctor if any one of the symptoms is observed as it does not affect the general health of the ability to work. But, if these symptoms are seen for a long period of time then we should consult a doctor for proper treatment.

2. In which of the following case do you think the long-term effects on your health are likely to be most unpleasant?

if you get jaundice

if you get lice

if you get acne. Why?

Solution:

Jaundice causes a long term effect on our health. This chronic disease lasts for a long period of time. Jaundice develops slowly and does not spread rapidly.

In-Text Questions 13.3.5

1. Why are we normally advised to take bland and nourishing food when we are sick?

Solution:

When we fall sick, normal body functioning gets disturbed and do not function normally. As a result, improper digestion ability, we lose appetite and absorption of food is slow. Therefore, we are advised to take bland and nourishing food during sickness as it is easily digested and contains adequate nutrients, vitamins and minerals to produce energy.

2. What are the different means by which infectious diseases are spread?

Solution:

Infectious diseases are generally spread through the following modes – Water, air, vector such as mosquito, sexual contact, physical contact with the affected, or by using affected person's clothes, bedding, utensils, etc.

3. What precautions can you take in your school to reduce the incidence of infectious diseases?

Solution:

Some of the precautions that we can take in our school to reduce the incidence of infectious diseases are –

(a). Trying to stay away from students who are infected.

(b). Covering mouth and nose while coughing and sneezing.

(c). Keeping the school environment clean so that there are no multiplication vectors.

(d). Consuming safe aqua guard water.

4. What is immunization?

Solution:

The method to boost our immune system with the help of vaccines that help the body to fight against infectious diseases is called immunization.

5. What are the immunization programs available at the nearest health center in your locality? Which of these diseases are the major health problems in your area?

Solution:

The immunization programs available at the nearest health centers are Measles, Mumps, and Rubella (MMR), polio vaccine, jaundice, Diptheria, Pertusis, and Tetanus (DPT), typhoid, hepatitis B.

From above typhoid and jaundice create major health problems.

Exercise Questions

1. How many times did you fall ill in the last one year? What were the illnesses? (a). Think of one change you could make in your habits in order to avoid any of/most of the above illnesses.

(b). Think of one change you would wish for in your surroundings in order to avoid any of/most of the above illnesses.

Solution:

I fell ill twice in the last year. I suffered from diarrhea first and then dengue fever.

(a) The changes made by me in my habits after suffering from these diseases are –

(i) I will always drink purified and clean water and wash my hands before eating any food item.

(ii) I will live in a clean environment where disease spreading vectors will not multiply.

Example of multiplying vectors are mosquitoes.

(b) One change I would wish for in our surroundings in order to have a healthy society is by making pure drinking water available for the people. Consuming impure water is the root cause of many infectious diseases.

2. A doctor/nurse/health-worker is exposed to more sick people than others in the community. Find out how she/he avoids getting sick herself/himself.

Solution:

Some important precautions that need to be taken by the doctor/nurse/health-worker while treating people who are sicker than others in the community are –

(a). When in contact with a diseased person not to forget to wear a mask.

(b). Drinking purified water.

(c). Not neglecting cleanliness and personal hygiene.

(d). Keeping themselves covered appropriately when moving in an infected region

(e). Eating nutritious food and maintaining a healthy diet.

3. Conduct a survey in your neighborhood to find out what the three most common diseases are. Suggest three steps that could be taken by your local authorities to bring down the incidence of these diseases.

Solution:

The following three are the most common diseases in any neighborhood: Cold and cough, loose motions, and malaria.

Some of the preventive measures that can be taken are:

(a). By drinking fresh, uncontaminated, and clean water.

(b). By maintaining hygienic sanitary conditions.

(c). By educating people about various preventive measures with the help of posters, and pamphlets.

Exercise Questions 188

4. A baby is not able to tell her/his caretakers that she/he is sick. What would help us to find out

(a) that the baby is sick?

(b) what is the sickness?

Solution:

(a). It can be found out by observing the behavioral changes of the child such as:

Improper food intake

Constant crying

Mood changes frequently

(b). The sickness can be determined with the help of symptoms or indications shown by the child. The symptoms could be loose motion, vomiting, paleness in body and fever.

5. Under which of the following conditions is a person most likely to fall sick?

(a) when she is recovering from malaria.

(b) when she has recovered from malaria and is taking care of someone suffering from chicken-pox.

(c) when she is on a four-day fast after recovering from malaria and is taking care of someone suffering from chicken-pox. Why?

Solution:

A condition in which a person is most likely to fall sick when she is on a four-day fasting as soon as she has recovered from malaria and is taking care of someone suffering from chicken-pox. Because she has not completely recovered from malaria and she is fasting when her immune system is still weak. At this stage her body will not be able to fight against infection and if she is taking care of someone else suffering from chicken pox even she can get infected with chickenpox virus and will fall sick again.

6. Under which of the following conditions are you most likely to fall sick?

(a) when you are taking examinations.

(b) when you have travelled by bus and train for two days.

(c) when your friend is suffering from measles. Why?

Solution:

A person can most likely fall sick when his/her friend is suffering from measles. It is a highly contagious disease and can easily be transferred

through air and respiration. It is always better to stay away from your friend who is affected with measles, else even you may get infected with the disease.

Chapter 14: Natural Resources

In-text Question 1.1

1. How is our atmosphere different from the atmospheres on Venus and Mars?

Ans: Ans:

Earth's atmosphere is composed of various gases like oxygen, carbon dioxide, nitrogen, water vapour along with various gases in small quantities, hence making it a balanced composition which is livable than other planets. Planets like Venus and Mars have more than 95% of carbon dioxide in the air making the existence of life impossible.

2. How does the atmosphere act as a blanket?

Ans:

⇒ It maintains the consistency in temperature throughout the day making it a comfortable place to stay.

⇒ The ozone in the atmosphere is responsible for maintaining the temperature without letting the harmful ultra-violet ray effect.

3. What causes winds?

Ans:

The uneven heating of the earth's surface is the main cause for the winds. On being heated more the air raises up and hence low pressure is created. Hence the air in high pressure occupy the low-pressure region causing the wind.

4. How are clouds formed?

Ans:

During the day time in the presence of sunlight water from sources like well, lake, pond, sea, river and various other sources get evaporated and this water vapour rises up with the hot air. At a particular height, the air cools and the water vapour condenses to form minute droplets to form clouds.

5. List any three human activities that you think would lead to air pollution'

Ans:

⇒ Burning of fuels like petroleum, kerosene, and coal in the atmosphere
⇒ The smoke released from manufacturing industries
⇒ Smoke from vehicles

In-text Question 1.2

1. Why do organisms need water?

Ans:

Organisms need water for
⇒ Every cellular process need water
⇒ Photosynthesis in plants
⇒ Transportation of substances in the body takes place through water by dissolving the contents in water.
⇒ Required minerals are transported in Terrestrial animals through water and even to eliminate waste from the body water is used.

2. What is the major source of fresh water in the city/town/village where you live?

Ans:

⇒ Rainfall
⇒ Underground water from wells
⇒ Water sources like pond, river, and lake
⇒ Snowfall

3. Do you know of any activity which may be polluting this water Q source?

Ans:

⇒ Dumping waste in the river
⇒ Factory waste
⇒ Sewage

In-text Question 1.3

1. What are the different states in which water is found during the water cycle?

Ans:

Water is found in all three states like

⇒ A solid-state (Snow, ice)

⇒ Liquid state (river water, underground water)

⇒ Gaseous state (water vapour)

2. Name two biologically important compounds that contain both oxygen and nitrogen

Ans:

⇒ DNA (Deoxyribonucleic Acid)

⇒ RNA (Ribonucleic Acid)

⇒ Amino acids

3. List any three human activities which would lead to an increase in the carbon dioxide content of the air

Ans:

⇒ Breathing process where Carbon dioxide is released

⇒ Burning of petrol, coal, and fuel

⇒ Using fridge, air conditioners, and oven

4. What is the greenhouse effect?

Ans:

Gases like Carbon dioxide and methane trap sun's radiation and does not allow it to go back and hence causing warming of the atmosphere, resulting in the greenhouse effect.

5. What are the two forms of oxygen found in the atmosphere?

Ans:

Oxygen is present in two form

⇒ Diatomic molecular form (O_2)

⇒ Triatomic molecular form (O_3)

Exercise Questions 1.1

1. Why is the atmosphere essential for life?

Ans:

⇒ The atmosphere is constituted of various main gases like O_2, N_2, and CO_2 which are the basis of living of microorganisms, plants, and animals.

⇒ Photosynthesis is due to earth's atmosphere
⇒ The constant temperature of the earth is the cause of the earth's atmosphere
⇒ Processes like respiration, burning, and combustion are due to the atmosphere
⇒ The atmosphere is the main reason to restrict UV rays into the earth.

2. Why is water essential for life?

Ans:

⇒ All the biological activities are respiration, digestion and other biological reactions are supported by water
⇒ Living beings are composed of more than 70% of water
⇒ Transportation of substances from one form to another takes place due to the presence of water.

3. How are living organisms dependent on the soil? Are organisms that live in water totally independent of soil as a resource?

Ans:

All living organisms on the earth directly or indirectly dependent on soil for a living. Plants obtain water and minerals through the soil and prepare their food. Other living organisms that live in water are entirely not totally independent of soil because the microbes growing on the soil in water are the primary producers. Primary producers are the main and chief element of the food chain. Various microbes found in soil help in the decomposition of dead plants and animals in water which helps in returning the nutrients and elements back to the water.

4. You have seen weather reports on television and in newspapers. How do you think we are able to predict the weather?

Ans:

Weather is studied as the collection of various elements like high and low temperatures, humidity, rainfall, wind speed and more using various figures

and facts with relevant instruments. Hence on the data collected by the meteorologists, we are able to forecast the weather.

5. We know that many human activities lead to increasing levels of pollution of the air, water-bodies, and soil. Do you think that isolating these activities to specific and limited areas would help in reducing pollution?

Ans:

Human activities are the main reason for the pollution in the air. Air is the medium to spread the pollutants into various sources like water and soil. Hence we can say that limiting activities certain place will definitely help the air pollution to be controlled to some extent.

6. Write a note on how forests influence the quality of our air, soil and water resources.

Ans:

Air:

Forests help in purifying the air by absorbing all kinds of pollutants.

Forests help in increasing the oxygen level in the air by absorbing carbon dioxide during photosynthesis.

Transpiration helps to maintain the temperature of the surrounding and helps in the formation of clouds.

Soil:

Plants in forest hold the soil thereby preventing soil erosion.

Adds nutrients to the soil as a lot of vegetation present in the forest gets decomposed.

Water:

Forest helps in bringing rain and increasing the level of water in underground levels

Chapter 15: Improvement In Food Resources

In Text Question 1.1 Page 204

Q1. What do we get from cereals, pulses, fruits and vegetables?

Ans:

Cereals are the source of carbohydrate and is main reason of energy.

Pulses provide protein for growth and development

Vegetables and fruits are loaded with minerals, vitamins, carbohydrates, proteins and fats for overall development.

In-Text Question 1.2 Page 205

Q1. How do biotic and abiotic factors affect crop production?

Ans:

2 major factors that affect the crop are:

Biotic factors like insects, rodents, pests, and many more spread the disease and reduce crop production.

Abiotic factors like humidity, temperature, moisture, wind, rain, flood and many more destroy the crop raised.

Q2. What are the desirable agronomic characteristics for crop improvement?

Ans:

The essential agronomic features required for crop improvement are:

Profuse branching along with tallness in any fodder crop

Dwarfness in any cereals.

In Text Question 1.3 206

Q1. What are macro-nutrients and why are they called macronutrients?

Ans:

Macro-nutrients are the fundamental elements that are used by plants in more quantity. Macro-nutrients needed by the plants are:

• Macro-nutrients as the constituent of protoplasm
• Phosphorus, Nitrogen, Sulphur are present in proteins
• Calcium is existing in cell wall
• Magnesium is significant component of chlorophyll

Q2. How do plants get nutrients?

Ans:

There are 16 basic essential nutrients required by the plants to grow. Carbon and Oxygen are supplied by water and the remaining nutrients are supplied through soil.

In Text Question 1.4 207

Q1. Compare the use of manure and fertilizers in maintaining soil fertility.

Ans:

Manure improves the soil quality with added nutrients.
Manure provides extra organic matter called humus to the soil and therefore increasing the water retention capacity of sandy soils and drainage in clayey soil.
Manures reduces soil erosion.
They provide food for soil friendly bacteria which are helpful in growing crops.
Effects of fertilizers are:
Fertilizers make the soil to become too dry and powdered and rises rate of soil erosion.
The organic matter decreases by decreasing the porosity of soil hence, the plant roots do not get oxygen properly.
The nature of soil changes either to basic or acidic.

In-Text Question 1.5 Page 208

Q1. Which of the following conditions will give the most benefits? Why?

(a) Farmers use high-quality seeds, do not adopt irrigation or use fertilizers.

(b) Farmers use ordinary seeds, adopt irrigation and use fertilizer.

(c) Farmers use quality seeds, adopt irrigation, use fertilizer and use crop protection measures.

Ans:

Option **(c)** will give the most benefits because use of good quality seeds is not only sufficient until the soil is properly irrigated, enriched with fertilizers and protected from biotic factors.

In Text Question 1.6 209

Q1. Why should preventive measures and biological control methods be preferred for protecting crops?

Ans:

Over exposer of chemicals leads to environmental problems hence, biological methods are preferred for protecting crops from pathogens, insects and rodents along with increasing the production. Since chemicals are harmful for plants and also for the animals which feed on it, hence bio-pesticides are used as the safe way of crop protection.

Q2. What factors may be responsible for losses of grains during storage?

Ans:

Biotic and Abiotic factors are responsible for loss of grains during storage like:

Rodents

Pests

Insects

Fungi

Bacteria

Sunlight

Flood

Rain

Temperature

Moisture

In Text Question 1.7 210

Q1. Which method is commonly used for improving cattle breeds and why?

Ans:

Cross breading is generally the best method adopted for improving the cattle breed quality. In this method, breeding is between two good cattle breed results in a new improved variety of cattle breed or offspring. While breeding it is taken care to have a good resultant with high yield having resistance to climatic conditions.

In Text Question 1.8 211

Q1. What management practices are common in dairy and poultry farming?

Ans:

Well-designed Hygienic shelter for dairy animals and poultry birds.

Good quality proper food and fodder are provided to dairy animals and poultry birds.

Importance for animal health by prevention and cure of disease caused by bacteria, virus, or fungi.

Sunlight feasible and airy ventilated shelter for animals

Q2. What are the differences between broilers and layers and in their management?

Ans:

Broilers

The poultry bird raised for meat purpose is called broiler. Broilers feed on protein rich adequate fat food. The level of vitamins A and K is kept high in the poultry feeds.

Layers

The egg laying poultry bird is called layer. The housing, environmental and nutritional requirements of broilers vary from those of egg layers. Layers require proper lightning and enough space.

Q3. Discuss the implications of the following statement: "It is interesting to note that poultry is India's most efficient converter of low fiber food stuff

(which is unfit for human consumption) into highly nutritious animal protein food."

Ans:

Poultry farming aims in raising domestic birds for egg and chicken meat purpose. These domestic birds feed on animal feeds which mainly consists of roughages for getting good quality feathers, egg, chicken and nutrient rich manure. For this reasons, it is said that, "poultry is India's most efficient converter of low fibre food stuff into highly nutritious animal protein food".

In-Text Question 1.9 Page 213

Q1. How are fish obtained?

Ans:

Fishes are obtained in two ways:

Capture fishing: obtaining fishes from natural resources

Culture Fishery: culturing of fishes in freshwater ecosystem like river, pond and lake also including marine.

Q2. What are the advantages of composite fish culture?

Ans:

Advantages of composite fish culture are:

In a single fish pond, a combination of 5 or 6 types of fish species can be cultured since they do not compete for food among them.

Food resource can be completely utilized

Survival of the fish also increases

More yield

In Text Question 1.9 213

Q1. What are the desirable characters of bee varieties suitable for honey production?

Ans:

The variety of bee should yield large amount of honey.

The bees should stay for a longer period in bee hives
The bees should not sting much.
Bee should be disease resistant.

Q2. What is pasturage and how is it related to honey production?

Ans:

Pasturage refers to the availability of flowers to the bees for easy accessibility for pollen collection and nectar. Kinds of flowers available will determine the taste of the honey, hence Pasturage is the main reason for the good quality honey.

Exercise Questions 1.1 Page 214

Q1. Explain any one method of crop production which ensures high yield.

Ans:

Plant breeding is one of the method adopted for high yield plant breeding and is implemented to improve the varieties of crops by breeding plants. Plants from various places/areas are picked up with preferred traits and then the process of hybridization or cross-breeding is done among these diversities to get a crop/plant of anticipated characteristic.

Q2. Why are manure and fertilizers used in fields?

Ans:

Manures and fertilizers are used to enrich the soil quality and improve the yield. They also help in controlling the diseases. Manure and fertilizers replenish the soil by supply nutrients to the soil. They are excellent source of potassium, phosphorous and nitrogen which assist in healthy development of plants. Manures and fertilizers mainly improve the fertility of the soil.

Q3. What are the advantages of inter-cropping and crop rotation ?

Ans:

Inter-Cropping

Checks pests and rodents and hence decreases the chances of spoiling of whole crops.

Decreased chances of soil erosion.

Reduced loss of crops with high yield.
Less water requirement.
Crop-rotation
Farmers can grow two or three crops annually.
Pulses take nitrogen directly from the atmosphere, and hence require minimal amount of fertilizers.
Both fruits and Vegetables can be grown easily.
Best use of land with proper supply of nutrients.

Q4. What is genetic manipulation? How is it useful in agricultural practices?

Ans:

Genetic manipulation is process in which the transfer of genes takes place from one organism to another. Here gene of a particular character is introduced inside the chromosome cell and hence results in a transgenic plant.

Example: BT Cotton is a genetically modified crop which carry bacterial genes, that protects this plant from insects. These are used in plants like brinjal, cabbage, rice, cauliflower, and maize crops to get protection from insects.

Q5. How do storage grain losses occur?

Ans:

Storage grain losses occur due to various abiotic and biotic factors.
Abiotic factors:
Humidity
Air
Temperature
Flood
Wind
Biotic factors
Insects
Rodent's
pesticides

Bacteria
Mites
Birds

Q6. How do good animal husbandry practices benefit farmers?

Ans:

Good practice of animal husbandry benefits farmers by following ways:
Yields in good quality cattle
Better quality of milk production
Use in agriculture for carting, irrigation and tilling

Q7. What are the benefits of cattle farming?

Ans:

Benefits of cattle farming are:
Cattles are used in agricultural purpose
Generation of good quality cattle
Milking and meat purpose
Skin of cattle is used for leather and wool industry

Q8. For increasing production, what is common in poultry, fisheries and bee-keeping?

Ans:

For increasing the production, cross breeding techniques are used adopted in poultry, fisheries and bee-keeping. Along with these technique regular and proper maintenance methods are useful in improving the production.

Q9. How do you differentiate between capture fishing, mariculture and aquaculture?

Ans:

Capture fishing: It is a technique in which fishes are captured from various sources of natural resources like sea, rives, lake and pond.
Mariculture: culturing of fish in marine fishes like prawns, oyster, bhetki and mullets in marine water for commercial use.
Aquaculture: Involves in culturing of fish in both marine and fresh water.