Exercise-1.1-1.2 Page: 3

1. Which of the following are matter?

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

Solution:

The following substances are matter:

Chair

Air

Almonds

Lemon water

The smell of perfume (Smell is considered as a matter due to the presence of some volatile substances in air that occupy space & have mass.)

2. 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 fuelled 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.

3. 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.

4. What are the characteristics of the particles of matter?

Solution:

The characteristics of particles of matter are as follows:

(a) Presence of intermolecular spaces between particles

(b) Particles are in constant motion

(c) They attract each other

(d) All matter is composed of very small particles which can exist independently.

Exercise-1.3 Page: 6

1. 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 increasing density:

Air

Exhaust from chimney

Cotton

Water

Honey

Chalk

Iron

2. 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 shape	No Fixed 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 property of matter to continue to remain in its shape when treated

with an external force.

(ii) **Compressibility:** It is the attribute of the particles to contract their 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 their 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 = 1/2 mv^2, 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

3. 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) There is a low force of attraction between gas particles. The particles in the filled vessel are free to move about.

(b) Gaseous particles have the weakest attraction force. They are always moving in a haphazard manner. When a gas particle collides with the container's walls, it exerts force and, thus pressure on the wall.

(c) There is a distinct contour and volume to the hardwood table. The wood particles are tightly packed. They do not conform to the container's shape. As a result, the solid features of a hardwood table are satisfied.

(d) The boundaries between air particles are quite loose. They are a long way apart and have a lot of space between them. As a result, we may move our hands freely in the air. The particles in a solid block, on the other hand, are bound together by a strong force of attraction. As a result, there is either some or no space between them. As a result, we will require a karate expert.

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

Solution:

In general, the volume of a liquid is more than the volume of a solid because liquid particles are freer to move, resulting in more volume. Ice, on the other hand, has a maximum density of water at 4 degrees Celsius. Ice is lighter than water and has a lower density. As a result, it floats on water.

Exercise – 1.4

Page: 9

1. Convert the following temperature to Celsius scale:

a. 300 K **b. 573 K**

Solution:

a. 0 °C=273 K

300 K= (300-273)°C = 27°C

b. 573 K= (573-273)°C = 300°C

2. 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 states.

3. 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.

4. Suggest a method to liquify 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: 10

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

Solution:

It is because the temperature is high and less humid on a hot dry day, enabling 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 the 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 evaporate when they come in contact with air. Evaporation is facilitated as it uses energy from the 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, promoting 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 evaporation, and hence causing a cooling effect on the skin.

Chapter Exercise – Page: 12

1. Convert the following temperature to Celsius scale.

(a) 293 K (b) 470 K

Solution:

0°C=273 K

(a) 293 K= (293 – 273)°C = 20°C

(b) 470 K= (470 – 273)°C = 197°C

2. Convert the following temperatures to the Kelvin scale.

(a) 25°C **(b) 373**°C

Solution:

0°C = 273 K

(a) 25°C = (25+273) K = 298 K

(b) 373°C = (373+273) K = 646 K

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 substances that are volatile, which scatter quickly in air, becoming less concentrated over a distance. Hence, we are able to smell perfume sitting several metres away.

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

Solution:

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

5. 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 states of water (water vapour) are observed.

6. 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) Water persists as a liquid at room temperature since its melting point is lower than room temperature and its boiling point (100^{o}C) is higher.

Similarly,

(i). A fixed volume is occupied by a fixed mass of water.

(ii). At room temperature, water does not have a fixed shape and flows to fit the container's shape.

As a result, water is a liquid at room temperature.

(b) Because it's melting and boiling points are above room temperature, an iron almirah is a solid at room temperature. In the same way,

(i) An iron almirah is rigid and has a predetermined shape.

(ii) Metals have a relatively high density.

As a result, at room temperature, iron almirah is a solid.

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

Solution:

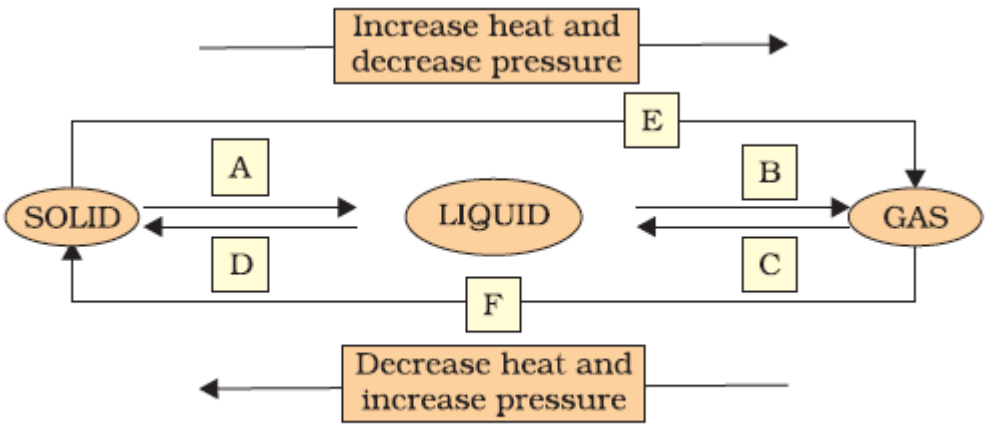
At 273 K, ice will absorb heat energy or latent heat from the medium to overcome fusion and transform into water. As a result, ice has a greater cooling impact than water at the same temperature since water does not absorb the excess heat from the medium.

8. 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.

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



Solution:

Interconversion of three states of matter: Using temperature or pressure, any state of matter can be turned into another.

(A) Solid to Liquid → Melting (or) fusion (or) liquefaction

(B) Liquid to Gas → Evaporation (or) vaporization

(C) Gas to liquid → Condensation

(D) Liquid to Solid → Solidification

(E) Solid to Gas → Sublimation

(F) Gas to Solid → solidification

Exercise-2.1 Page: 15

1. What is meant by a substance?

Solution:

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

2. List the points of difference 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
Examples: Seawater, blood, etc.	Examples: 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	$10^{-7} – 10^{-5}$ cm	Less than 1nm	More than 100nm
Tyndall effect	Exhibited	Not exhibited	May or may not be exhibited
Appearance	Usually glassy and clear	Unclouded and clear	Cloudy and opaque

Visibility	Visible with an ultramicroscope	Not visible	Visible with the 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, 36 g 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%

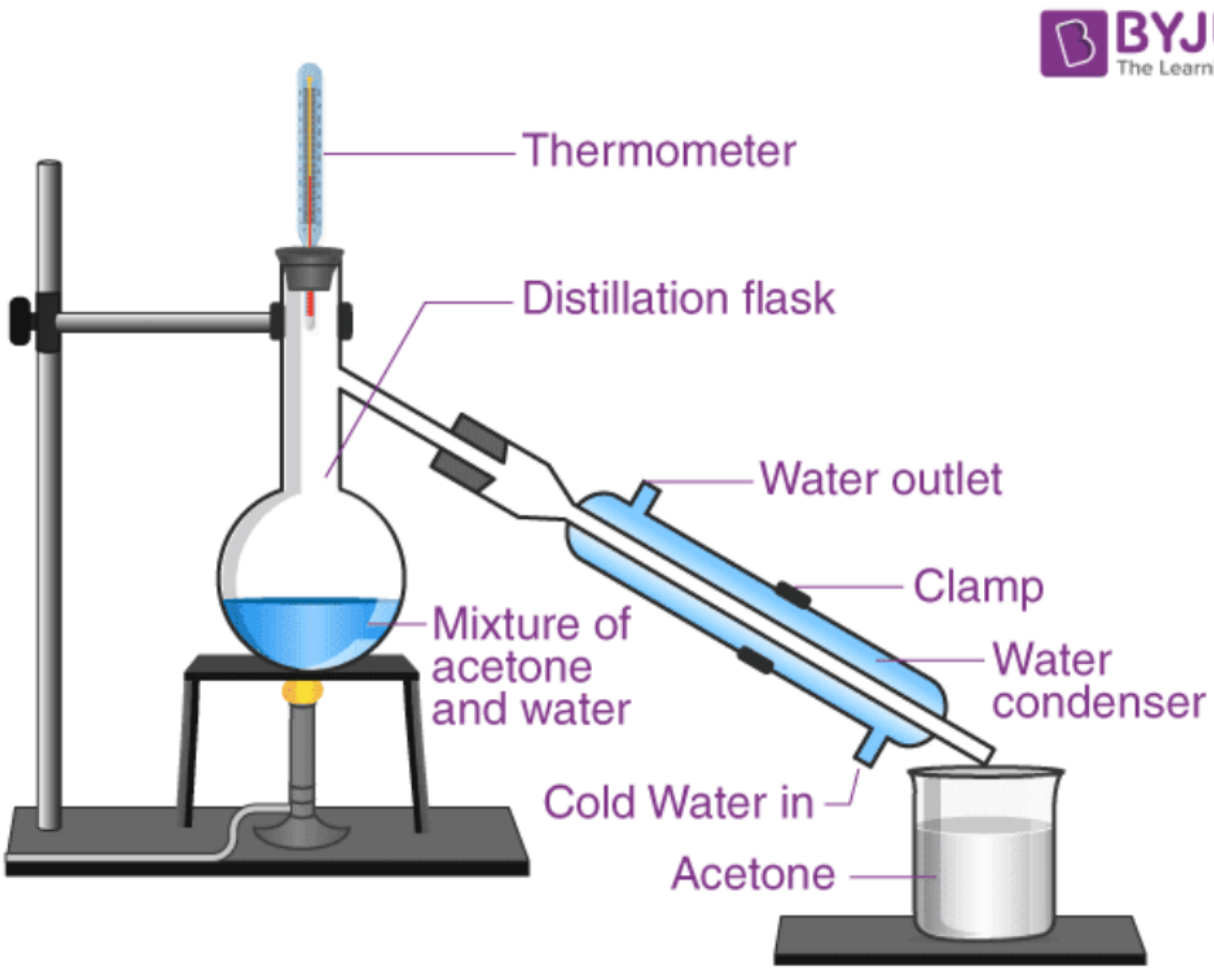
Hence, the concentration of the solution is 26.47%

Exercise-2.3

Page: 24

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

Solution:



According to the question, kerosene and petrol are miscible, and their boiling points differ by more than 25 degrees Celsius, which is a significant difference. Therefore they can be separated using a simple distillation procedure.

Distillation can separate kerosene and petrol since their boiling points differ by more than 25 degrees Celsius. The kerosene and petrol combination will be poured into a hot distillation flask. Because petrol has a lower boiling point, it will evaporate and create vapours first as the temperature of the mixture rises. A condenser condenses the vapours of gasoline and collects them through the condenser output. In the distillation flask, kerosene with a higher boiling point will be left behind.

Because their vapours will develop within the same temperature range if the difference in boiling points of two liquids is not great, a simple distillation procedure cannot be utilised to separate them. Fractional distillation separates these liquids by passing the vapours through a fractionating column before condensation.

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 by 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 types of mixtures are separated by the technique of crystallisation?

Solution:

The technique of crystallisation 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 crystallisation 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 the engine oil of a 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, using a 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 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, and 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 dissolve completely in the tea solution, reaching saturation.

(g) Once the raw smell of tea leaves vanishes and the tea solution is boiled enough, take the solution off the heat, filter or strain it to separate the 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 313 K?

(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 its solubility at low temperatures.

(c) As per the given data, that is

Solubility of potassium nitrate at 293 K = 32 g

Solubility of sodium chloride at 293 K = 36 g

Solubility of potassium chloride at 293 K = 35 g

Solubility of ammonium chloride at 293 K = 37 g

We can observe from this data that ammonium chloride has the highest solubility at 293K.

(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 the state in a solution at a specific temperature when a solvent is no more soluble without an increase in 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 only one kind of molecule, atom or compound without adulteration with any other substance or any divergence in the structural arrangement. Examples: Sulphur, diamonds etc.

(c) Colloid: A Colloid is an intermediate between solution and suspension. It has particles of various sizes that range between 2 to 1000 nanometres. 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. Examples: Milk and gelatin.

(d) Suspension: It is a heterogeneous mixture that comprises 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, and filtered tea.

Solution:

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

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 mixtures:

- 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

11. Which of the following are chemical changes?

(a) Growth of a plant

(b) Rusting of iron

(c) Mixing of iron filings and sand

(d) Cooking of food

(e) Digestion of food

(f) Freezing of water

(g) Burning of candle

Solution:

Out of the given list, the following are chemical changes:

Growth of a plant, rusting of iron, cooking of food, digestion of food and burning of candle.

Exercise-3.1 Page: 32

1. In a reaction, 5.3g of sodium carbonate reacted with 6g of acetic acid. The products were 2.2g of carbon dioxide, 0.9g of water and 8.2g 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, L.H.S. = R.H.S. i.e., 5.3g + 6g = 2.2g + 0.9g + 8.2g = 11.3g

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

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

Solution:

We know hydrogen and water mix in a 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 relative number and types of atoms are constant in a given composition, says Dalton's atomic theory, which is based on the rule of conservation of mass.

"Atoms cannot be created nor be destroyed in a chemical reaction."

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 that 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 the 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 the naked eyes?

Solution:

Firstly, atoms are minuscule in nature, measured in nanometres. Secondly, except for atoms of noble gases, 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 formulas are used to describe the different types of atoms and their numbers in a compound or element. Each element's atoms are symbolised by one or two letters. A collection of chemical symbols that depicts the elements that make up a compound and their quantities.

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 is as follows:

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

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

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 = (2 x 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 = 23u, K=39u, C = 12u, and O=16u.

Solution:

Given:

The atomic mass of Zn = 65u

The atomic mass of Na = 23u

The atomic mass of K = 39u

The atomic mass of C = 12u

The 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

The formula unit mass of K_2CO_3 = 2 x Atomic mass of K + Atomic mass of C + 3 x Atomic mass of O = (2 x 39)u + 12u + (3 x 16)u = 78u + 12u + 48u = 138u

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}

The 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 the atomic mass of Na = 23u, Fe = 56 u)?

Solution:

(a) In 100 grams of Na:

m = 100g, Molar mass of Na atom = 23g, $N_0 = 6.022 \times 10^{23}$, N =?

N = (Given mass x N_0)/Molar mass

N = $(100 \times 6.022 \times 10^{23})/ 23$

N = 26.18×10^{23} atoms

(b) In 100 grams of Fe:

m = 100 g, Molar mass of Fe atom = 56 g, $N_0 = 6.022 \times 10^{23}$, N =?

N = (Given mass x N_0)/ Molar mass

N = $(100 \times 6.022 \times 10^{23})/ 56$

N = 10.75×10^{23} atoms

Therefore, the number of atoms is more in 100g of Na than in 100g of Fe.

Exercise

Page: 43

1. A 0.24g sample of a 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 the 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:

When 3.0 g of carbon is burnt in 8.00 g of oxygen, 11.00 g of carbon dioxide is produced.

Given that

3.0 g of carbon combines with 8.0 g of oxygen to give 11.0 of carbon dioxide.

Find out

We need to find out the mass of carbon dioxide that will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen.

Solution

First, let us write the reaction taking place here.

$C + O2 \rightarrow CO2$

As per the given condition, when 3.0 g of carbon is burnt in 8.00 g of oxygen, 11.00 g of carbon dioxide is produced.

3g + 8g →11 g (from the above reaction)

The total mass of reactants = mass of carbon + mass of oxygen

=3g+8g

=11g

The total mass of reactants = Total mass of products

Therefore, the law of conservation of mass is proved.

Then, it also depicts that carbon dioxide contains carbon and oxygen in a fixed ratio by mass, which is 3:8.

Thus, it further proves the law of constant proportions.

3 g of carbon must also combine with 8 g of oxygen only.

This means that (50−8)=42g of oxygen will remain unreacted.

The remaining 42 g of oxygen will be left un-reactive. In this case, too, only 11 g of carbon dioxide will be formed

The above answer is governed by the law of constant proportions.

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, the 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 a 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 = 3.2g

(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 = 9g

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

Solution:

To calculate the molecular mass of sulphur,

Molecular mass of Sulphur (S_8) = 8 x Mass 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 x 16) = 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 = 6.022 x 10^{23} / 102 x 0.051

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

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

= 6.022 x 10^{20}

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 – the 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 particles neutralise 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.

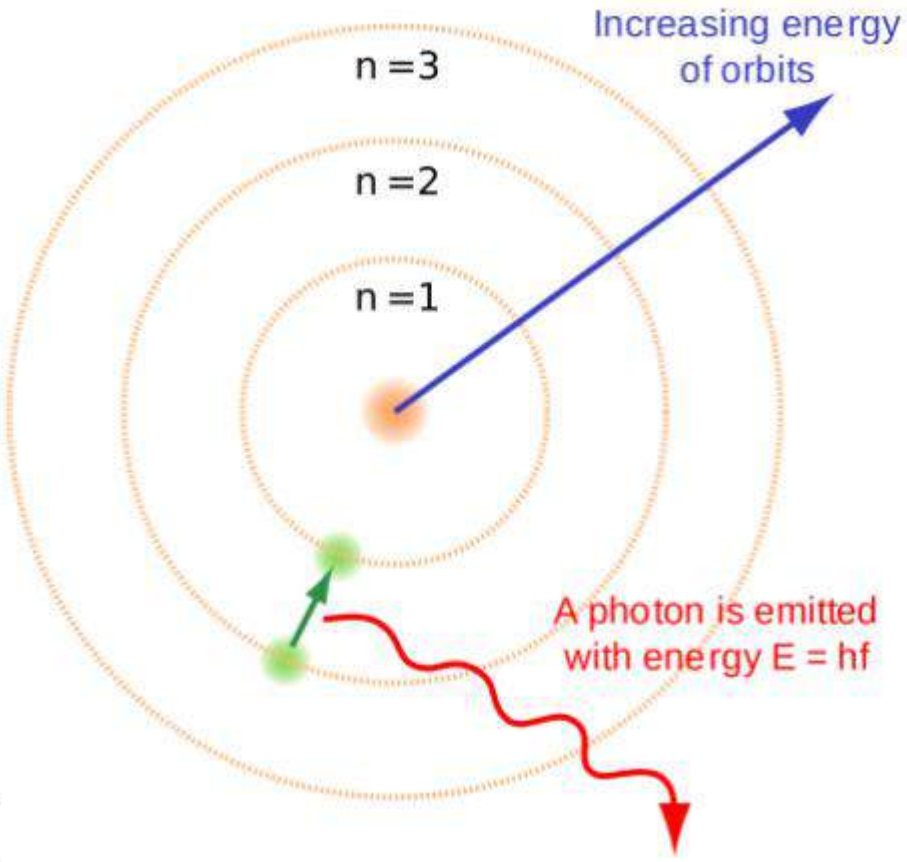
2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

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:

A carbon atom contains a total of 6 electrons. The following equation describes the electron distribution in a carbon atom: first orbit or K-shell = 2 electrons; second orbit or K-shell = 2 electrons; third orbit or K-shell = 2 electrons; fourth orbit or K-shell

L-shell or second orbit = 4 electrons

We can also express the electron distribution in a carbon atom as 2, 4.

In a sodium atom, there are 11 total electrons. The electron distribution in the sodium atom is described by: first orbit or K-shell = 2 electrons; second orbit or K-shell = 2 electrons; third orbit or K-shell = 2 electrons; fourth orbit or K-shell = 2

L-shell or second orbit = 8 electrons

M-shell or third orbit = 1 electron

Alternatively, we can express the electron distribution in a sodium atom as 2, 8, and 1.

2. If the 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:

We know that an element's valency refers to its proclivity for accepting or losing electrons in order to complete its octet and achieve a stable electronic state.

It is the smallest number of electrons that must be added or removed to entirely occupy an element's outermost shell.

Mathematically, if an atom's outermost shell contains 4 or fewer electrons, the element's valency is equal to the number of electrons present in the outermost shell; if it contains more than 4, the valency is determined by subtracting the total number of electrons present in the outermost shell from 8.

Calculation of valency:

Valency of chlorine:

The electronic configuration of chlorine = 2, 8, 7

Chlorine has 7 (more than 4) electrons in its outermost shell.

Therefore, the valency of chlorine = 8 – the number of electrons in the outermost shell

= 8−7

= 1

Valency of Sulphur:

The electronic configuration of Sulphur = 2, 8, 6

Sulphur has 6 (more than 4) electrons in its outermost shell.

Therefore, the valency of chlorine = 8 – the number of electrons in the outermost shell

= 8−6

= 2

Valency of magnesium:

The electronic configuration of Magnesium = 2, 8, 2

Magnesium has 2 (less than 4) electrons in its outermost shell.

Therefore, the valency of magnesium= Number of electrons in its outermost shell

= 2

Exercise-4.5

Page: 52

1. If the number of electrons in an atom is 8 and the 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

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

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

2. With the help of the 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, the 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 symbols 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 atomic number. The 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 towards positively charged	Attracted towards negatively charged	Do not get 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 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 the majority of these alpha particles pass through the gold foil, while some diverted through small and big angles, while some others rebound completely, returning 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:

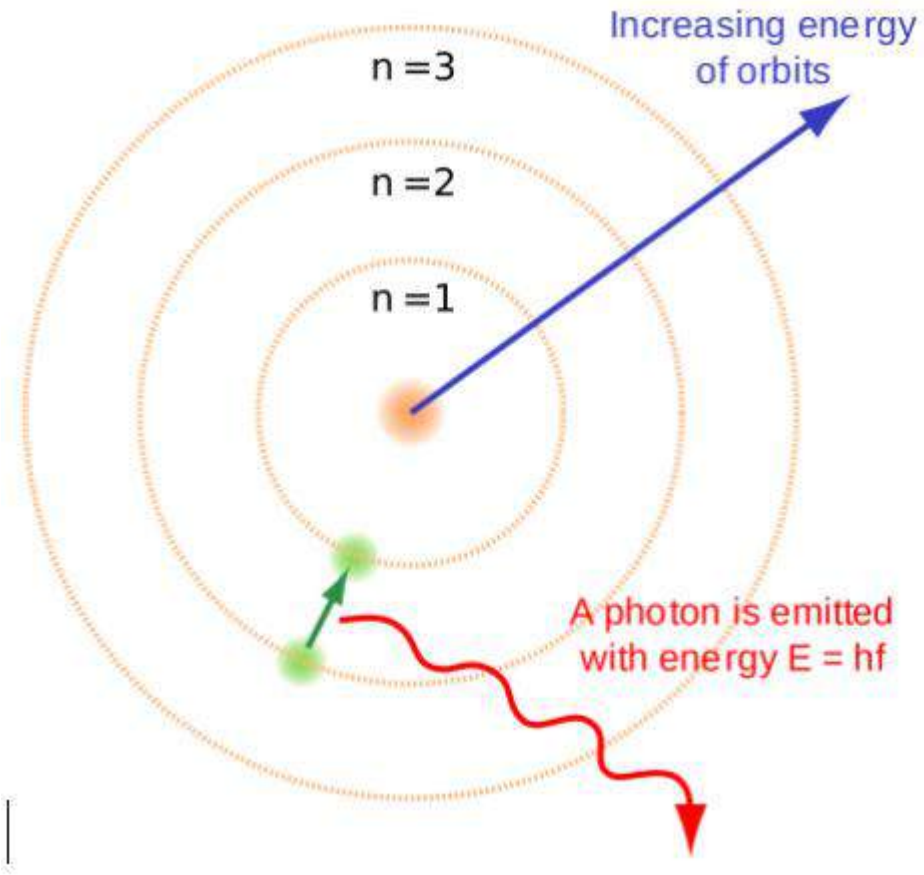
The following are the limitations of Rutherford's model of the atom:

- 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. The matter would not exist in its 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 contain distinct orbits of electrons.
- Electrons do not radiate energy when they are in their orbits.
- The distinct orbits are named K, L, M, and N orbits. Numbers used to denote them are n=1, 2, 3, 4

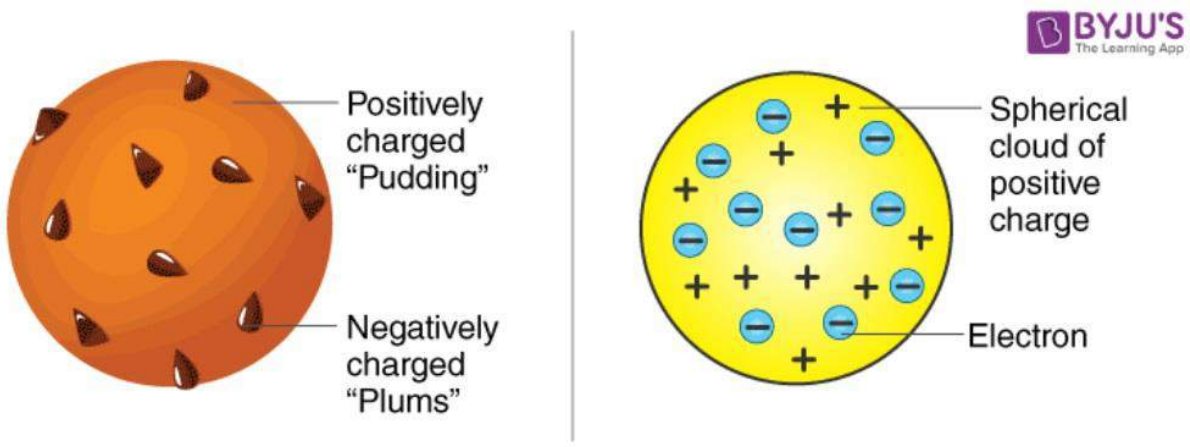


5. Compare all the proposed models of an atom given in this chapter.

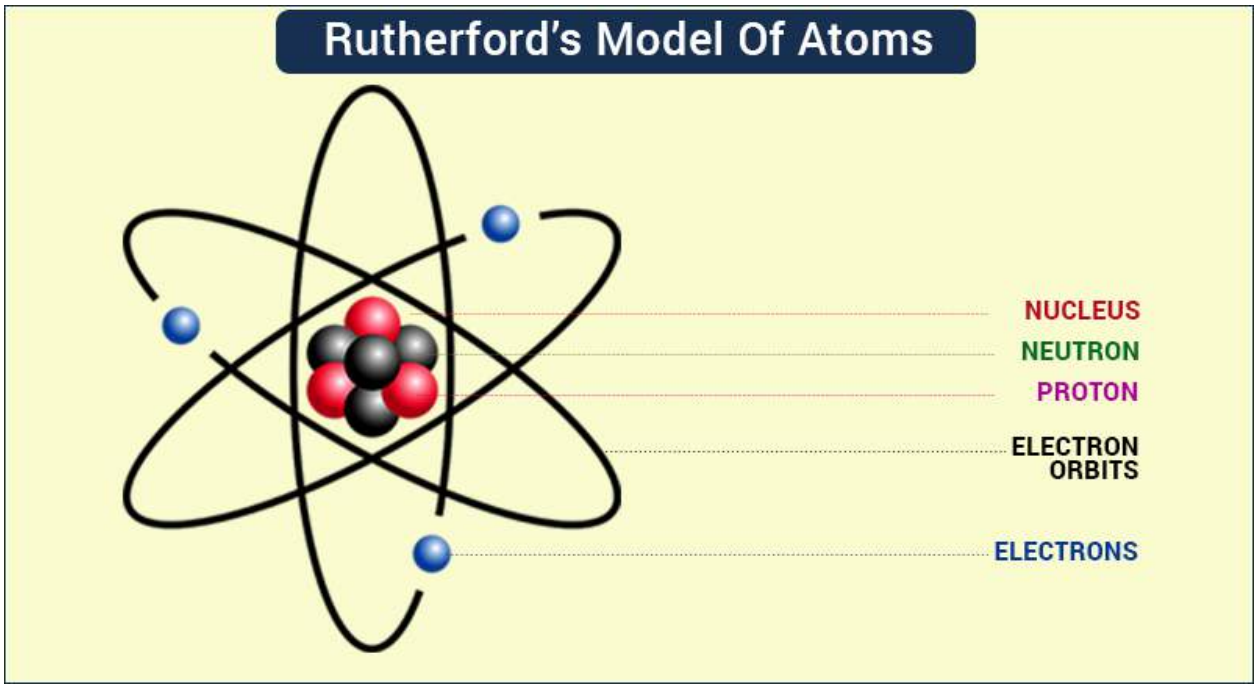
Solution:

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. ● Force of attraction of the electrons towards the nucleus is balanced by centrifugal force acting away from it. As a result, electrons are not drawn close to the nucleus.	● 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, and N

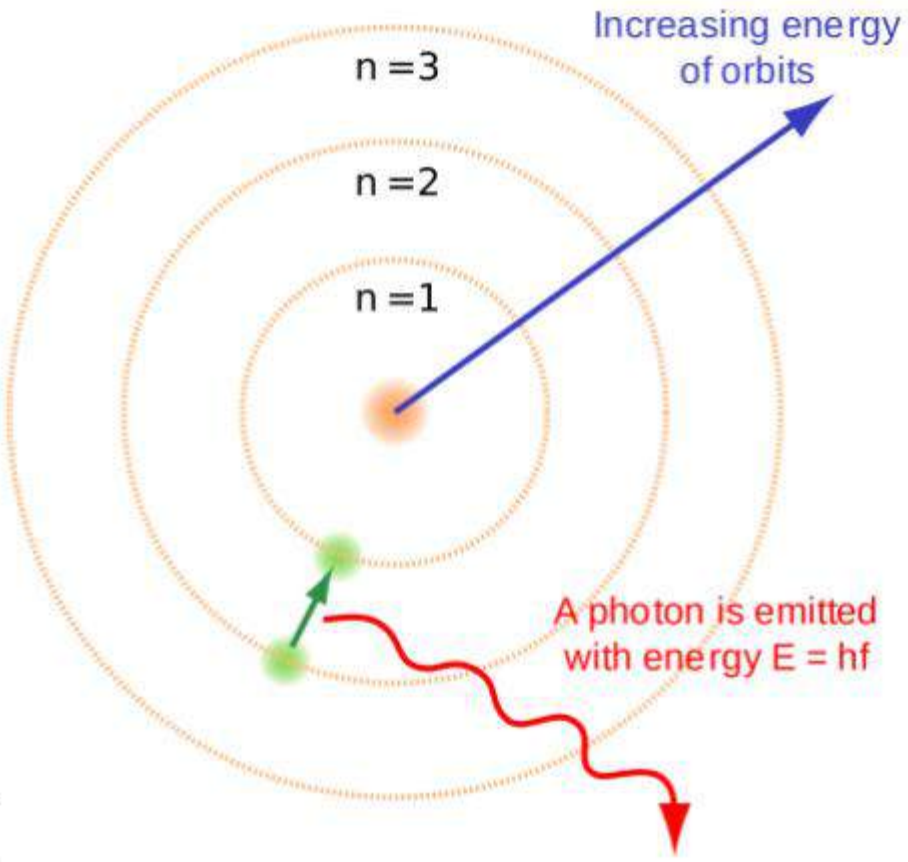
6. Thomson's Model of Atom.



7. Rutherford's Model of Atoms.



8. Bohr's model of the atom.



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

Solution:

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

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

The distribution of electrons in silicon atoms 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.

The 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. $_{20}Ca^{40}$. The mass number is 40. The atomic number is 20.

(iii) The atoms which have the same number of protons but a 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 atomic number.

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

Uses of isotopes

- The isotope of the Iodine atom is used to treat goitre, an 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 the 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 the Bromine atom.

Solution:

The atomic mass of an element is the mass of one atom of that element. Average atomic mass takes into account the isotopic abundance.

Isotope of bromine with atomic mass 79 u = 49.7%

Therefore, Contribution of $^{35}Br_{79}$ to atomic mass = (79 × 49.7)/100

⇒ **39.26 u**

Isotope of bromine with atomic mass 81 u = 50.3%

Contribution of $^{35}Br_{81}$ to the atomic mass of bromine = (81 × 50.3)/100

⇒ 40.64u

Hence, the average atomic mass of the bromine atom = 39.26 + 40.64 u = **79.9u**

13. The average atomic mass of a sample of 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 the given data,

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

1620 = 16a + 1800 – 18a

1620 = 1800 – 2a

a = 90%

Hence, the percentage of the 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, and 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 a proton.

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

Solution:

(a) The statement is False.

(b) The statement is False.

(c) The statement is True.

(d) The statement is False.

17. Put a tick (✓) against the correct choice and cross(x) against the 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

The 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 16 – – –	– 32 24 2 1	10 – – – 0	– – 12 1 1	– – – – 0	– Sulphur – – –

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 16 12 1 1	19 32 24 2 1	10 16 12 1 0	9 16 12 1 1	9 16 12 1 0	Fluorine Sulphur Magnesium Deuterium Hydrogen

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. The 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 outside 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 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 the 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 is 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 is more than one chromosome. 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 the 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	With distinct edges, the shape is either rectangular or square-shaped.	Round and irregular shape
Nucleus	Present. It lies on one side of the cell	Present. It lies in the centre of the cell
Lysosomes	Rarely present	Always present
Plastids	Present	Absent
Structure of Vacuoles	Single or a few large vacuoles that are centrally located	Presence of numerous and small vacuoles

2. How is a 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	1. Size: Generally large (5-100 μm) 2. Nuclear region: well-defined and girdled by a nuclear membrane. 3. There is more than one chromosome.

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.	4. Membrane-bound cell organelles present.

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

Solution:

If the plasma membrane ruptures or breaks down, then molecules of some substances will freely move in and out of the cells. As the plasma membrane acts as a mechanical barrier, the 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 the 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 the 'energy currency of the cell'.

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

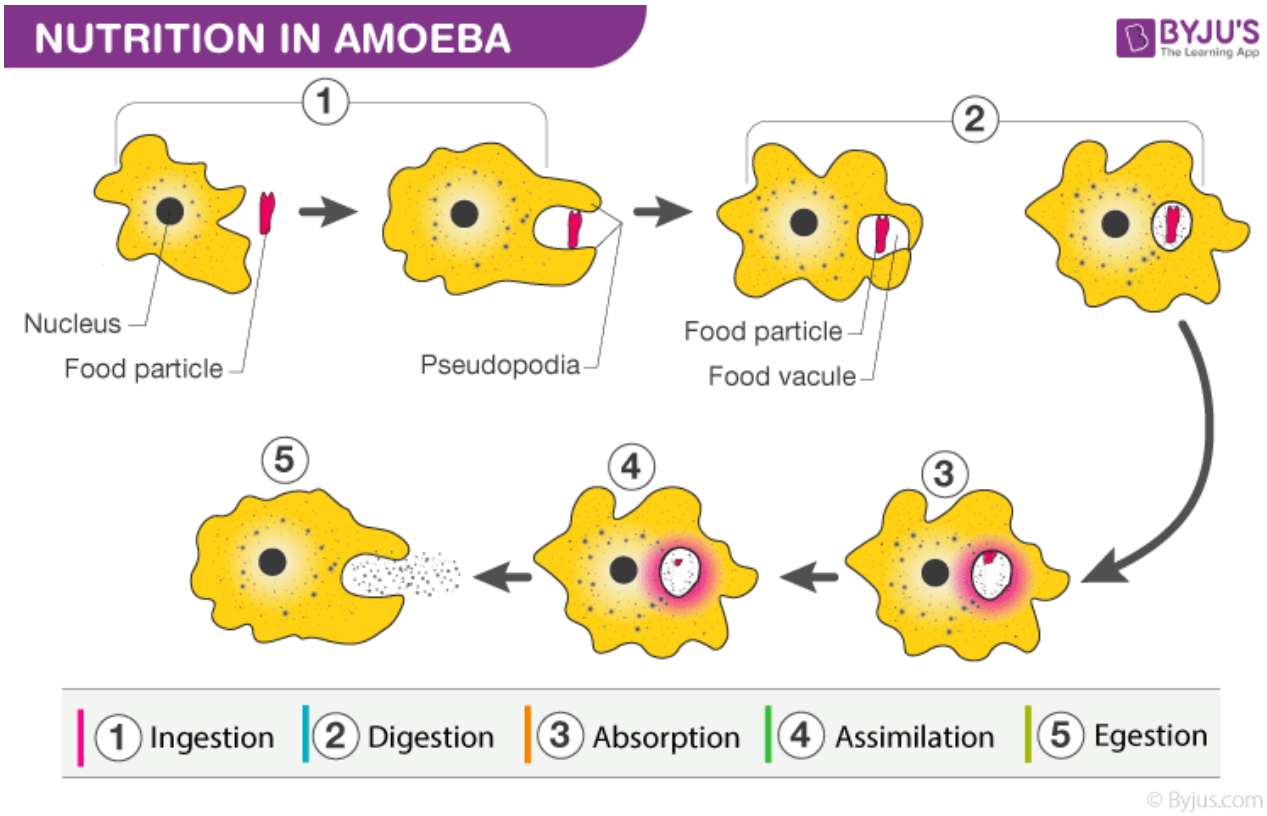
Solution:

Lipids and proteins are synthesised in the ER (Endoplasmic Reticulum).

7. 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 the food is trapped.



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

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 the 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 is typically found at:

- The tip of the shoot
- Root of the plant

5. Which tissue makes up the husk of a 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:

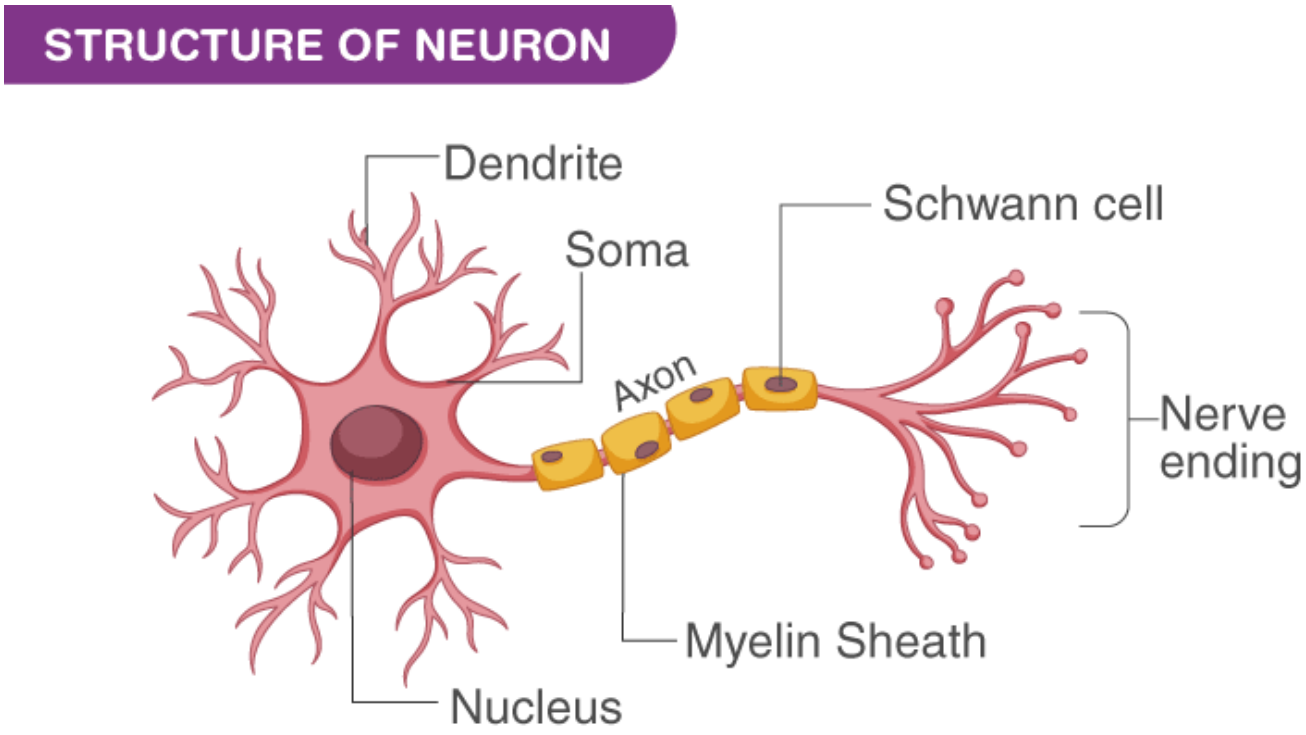
➢ Muscular tissue

➢ 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:

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

The following are the features of cardiac muscles:

➢ They are cylindrical in shape.

➢ Striated muscle fibres.

➢ 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 between different tissues based on cell wall:

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.

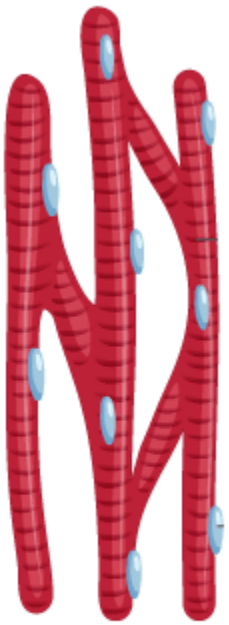
6. Show the difference between the three types of muscle fibres diagrammatically.

Solution:

There are three types of muscle fibres, they are:

1. Cardiac muscles

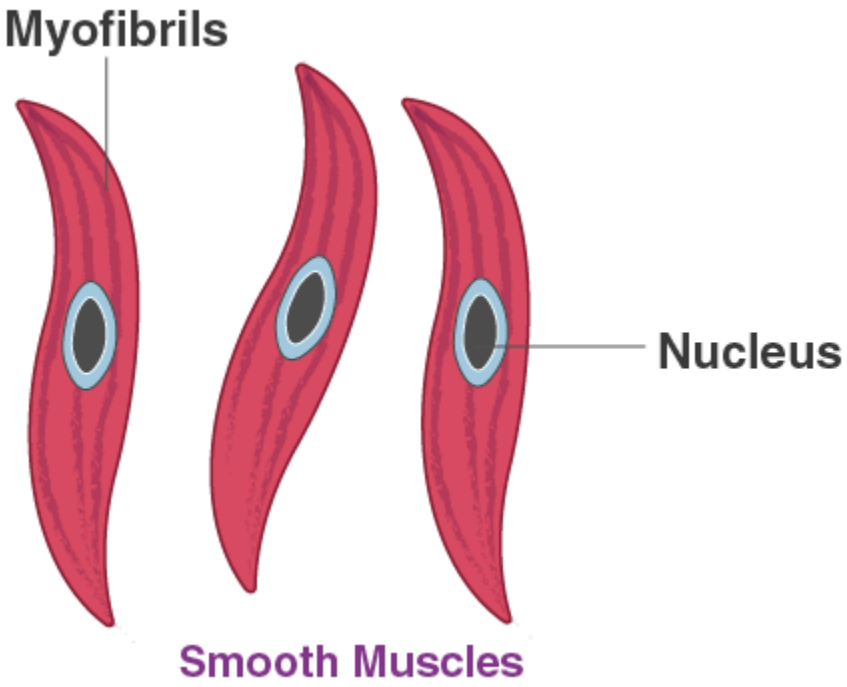
- Present in the heart.
- Involuntary in nature.
- They have 1 nucleus.
- The muscle fibers are branched.



Cardiac Muscles

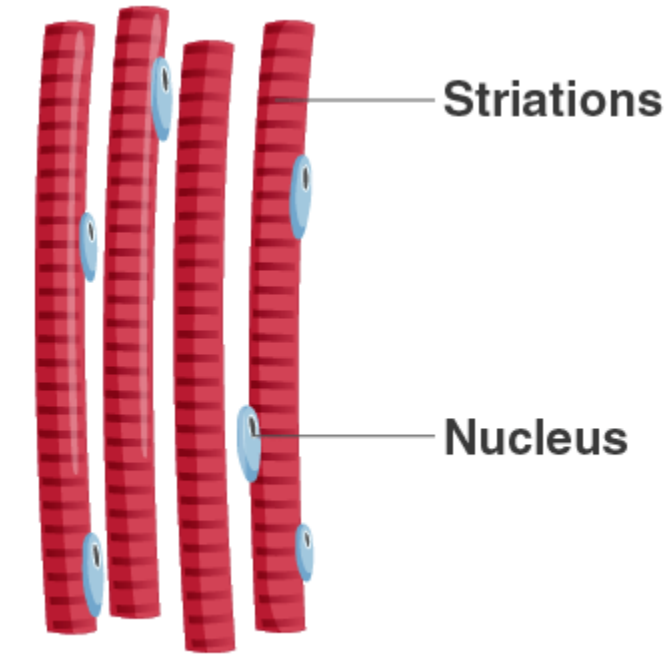
2. Smooth muscles

- Found in lungs and alimentary canal.
- Involuntary in nature.
- They have 1 nucleus.
- They are spindle-shaped.



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. The cardiac muscles bring about a rhythmic contraction and relaxation throughout one's lifetime.

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.

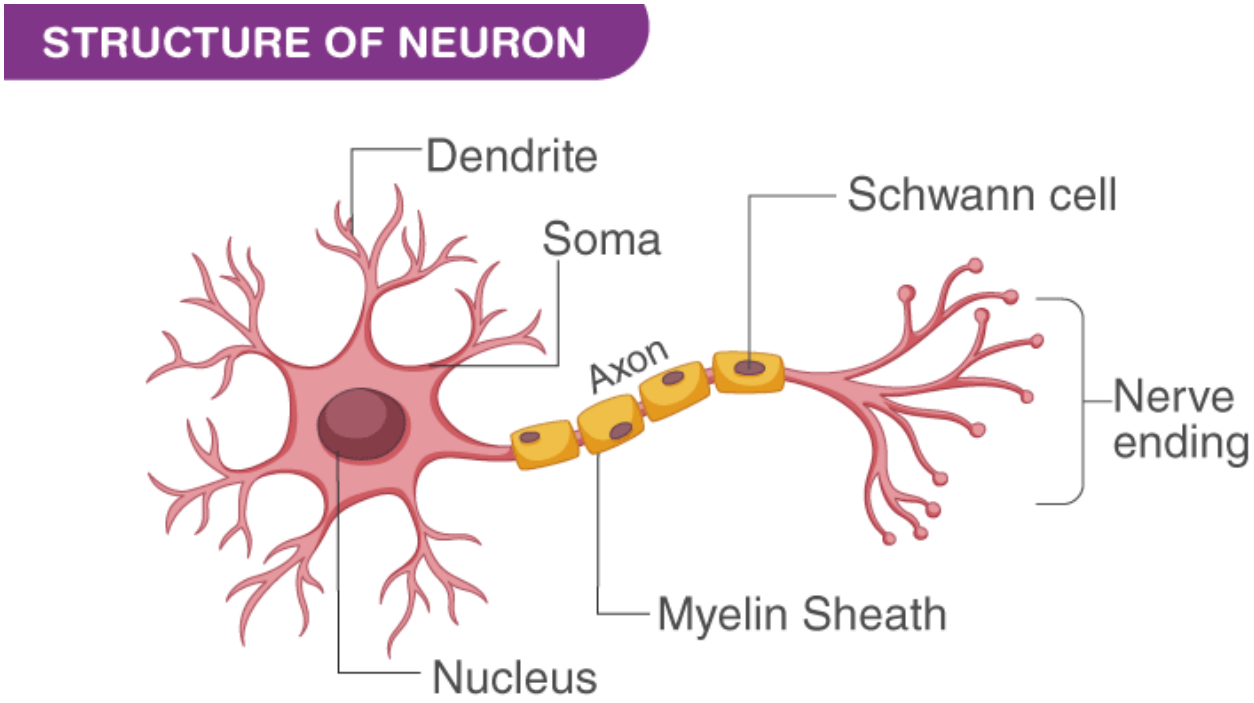
Character	**Striated muscles**	**Un-striated muscles**	**Cardiac muscles**
Shape/Structure	Long, cylindrical, non – tapering. They are un-branched.	Long and tapering. They are un-branched.	Cylindrical and non – tapering. They are branched.
Location in body	Hands, legs and skeletal muscles	Wall of stomach, intestine, ureter and bronchi	Heart
Dark and light	Present	Absent	Present but less

bands			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: Stratified 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 a 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:

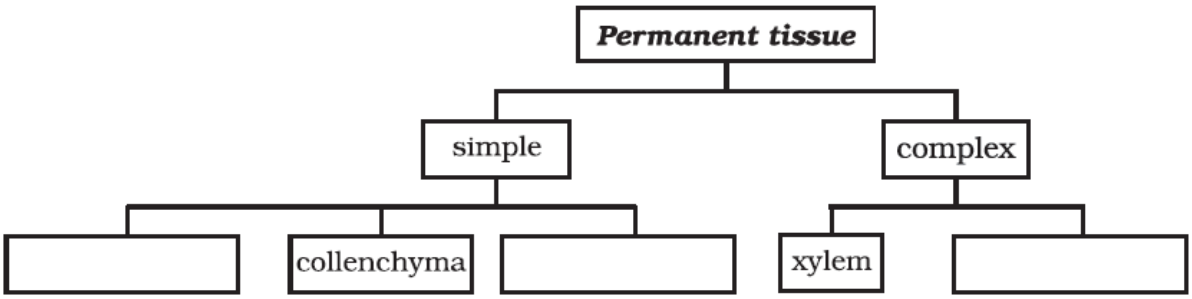
The epidermis in plants forms an uninterrupted and continuous layer that has no intercellular spaces. It provides protection.

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

Solution:

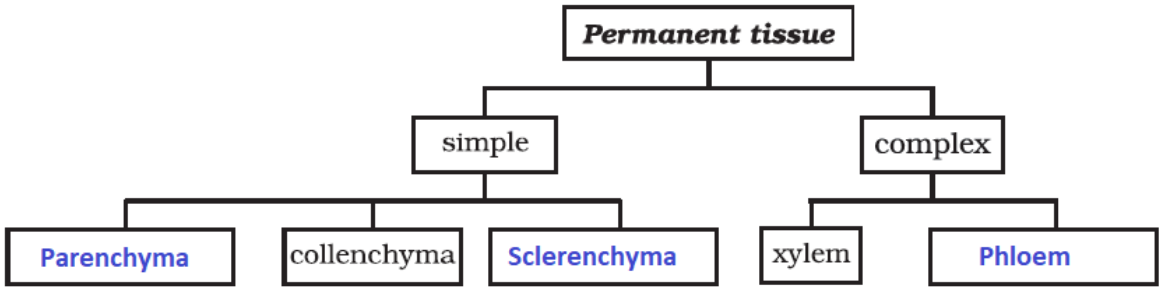
Cork cells are dead. The arrangement of cells is so dense, that there is no intercellular space. Deposition of suberin is observed on the walls of the cells that make them impervious to water and gases.

15. Complete the following chart.



Solution:

The completed chart is as follows:



Exercise – 7

Page: 80

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 categorise 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

Exercise-7.1 Page: 82

Q3. Which of the following 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 arrangements 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 the categorisation 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.

Exercise-7.2

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 organisms possessing millions of cells that are grouped into various organs performing different functions, 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.

Exercise-7.3

Page: 83

Q8. What is the criterion for the classification of organisms as belonging to the 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 the 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.

Exercise-7.4

Page: 88

Q11. Which division among plants has the simplest organisms?

Ans:

Algae or Thallophyta has the simplest organism among plants.

Q12. How are pteridophytes different from phanerogams?

Ans:

The following are the differences between pteridophytes and phanerogams:

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.

Exercise-7.5

Q14. How do poriferan animals differ from coelenterate animals?

Ans:

Listed below are the differences between poriferan and coelenterate animals:

Porifera	**Coelenterata**
Division of labour is not noticed	Division of labour is observed
The cellular level of the organisation exhibited	The tissue level of the organisation exhibited
Coelom absent	Coelom present

Q15. How do annelid animals differ from arthropods?

Ans:

Listed below are the differences between annelid and arthropods:

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

Q16. What are the differences between amphibians and reptiles?

Ans:

Listed below are the differences between amphibians and reptiles:

Amphibia	Reptilia
Skin is moist and soft	Skin is hardened
In water, they breathe through their skin	They 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 between animals belonging to the Aves group and the mammalian group:

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 the body is not observed (except for whales)

Exercise Page: 97

Q1. What are the advantages of classifying organisms?

Ans:

Listed below are the advantages of the 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 further steps will be taken care of by the fine character.

For instance:

- Human beings are categorised under vertebrates as they possess the vertebral column
- For categorisation 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 criterion.
- Next is the arrangement and the number of layers present.
- Another important factor for classification is the existence of the cell wall.
- Classification of complex organisms is also based on the mode of intake of nutrition.
- To classify, we consider the organisation 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 categorise plants into Thallophytes and Bryophytes is the basic cell structure.
- Gymnosperms and Angiosperms are classified on the basis of the 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, and 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 the Pisces subclass have streamlined bodies with tails and fins, which help them in their movement (swimming), 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 on the land as well as in water. They show the presence of specialised 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 helps 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.

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 which has moved through a distance can have zero displacement if it comes back to its initial position.

Example: If a person jogs in a circular park which is circular and completes one round. His initial and final position is the same.

Hence, his displacement is 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,

Side of the given square field = 10m

Hence, the perimeter of a square = 40 m

Time taken by the farmer to cover the boundary of 40 m = 40 s

So, in 1 s, the farmer covers a distance of 1 m

Now,

Distance covered by the farmer in 2 min 20 sec = 1 x 140 = 140 m

So,

The total number of rotations taken by the farmer to cover a distance of 140 m = total distance/perimeter

= 3.5

At this point, let us say the farmer is at point B from the origin O

Therefore, from Pythagoras theorem, the displacement $s = \sqrt{(10^2+10^2)}$

$s = 10\sqrt{2}$

s = 14.14 m

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 is true.

(a) Given statement is false because the displacement of an object which travels a certain distance and comes back to its initial position is zero.

(b) Given statement is false because the displacement of an object can be equal to, but never greater than the distance travelled.

Intext Questions – 2 **Page: 102**

1. Distinguish between speed and velocity.

Solution

Difference Between Speed and Velocity	
Velocity	**Speed**
Velocity can be defined as the rate at which an object changes position in a certain direction	The rate at which an object covers a certain distance is known as speed
The velocity of the object changes with the change in direction, therefore the object must follow one direction	The average speed will continue to count even if the object changes direction
Vector quantity	Scalar quantity
Velocity can be zero, negative, or positive	Speed can never be negative or zero

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 travelled 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 travelled is equal to the displacement.

3. What does the odometer of an automobile measure?

Solution

An odometer, or odograph, is a device that measures the distance travelled by an automobile based on the perimeter of the wheel as the wheel rotates.

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 travelled 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: When an object is travelling in a straight line with an increase in velocity at equal intervals of time, then the object is said to be in uniform acceleration.

The free-falling of an object is an example of uniform acceleration.

Non-Uniform Acceleration: When an object is travelling with an increase in velocity but not at equal intervals of time is known as non-uniform acceleration.

Bus moving or leaving from the bus stop is an example of non-uniform acceleration.

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 parameters

Initial velocity (u) = 0

Final velocity (v) = 40 km/h

v = 40 × (5/18)

v = 11.1111 m/s

Time (t) = 10 minute

t = 60 x 10

t = 600 s

Acceleration (a) =?

Consider the formula

v = u + at

$11.11 = 0 + a \times 600$

$11,11 = 600\ a$

$a = 11.11/600$

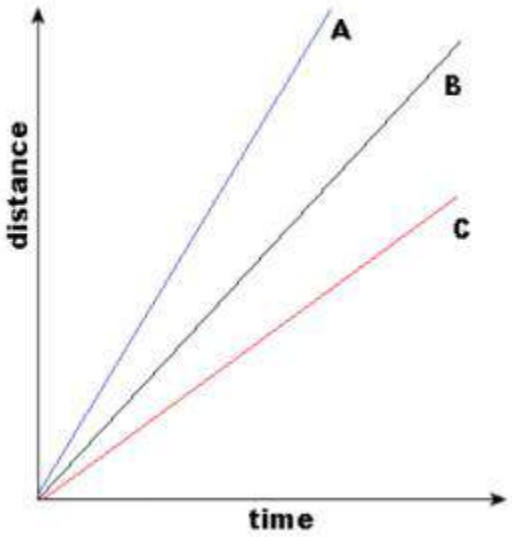
$a = 0.0185\ ms^{-2}$

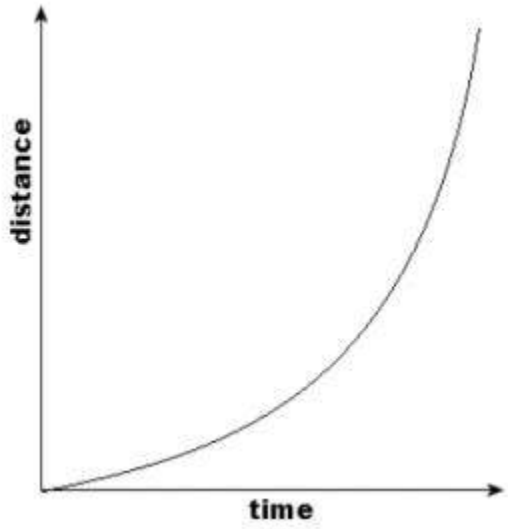
Intext Questions – 4 **Page: 107**

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.



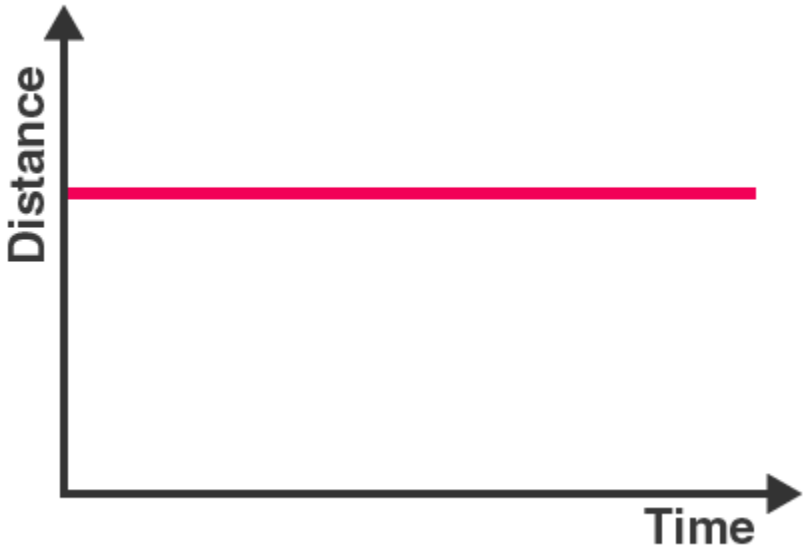


The first graph describes the uniform motion and the second one describes the non-uniform motion.

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

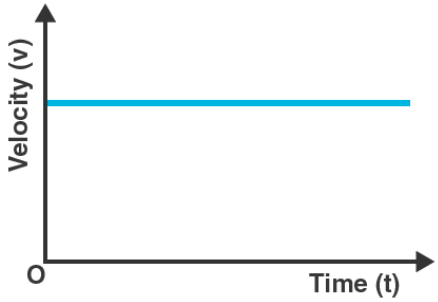
The distance-time graph can be plotted as follows.



When the slope of the distance-time graph is a straight line parallel to the time axis, the object is at the same position as time passes. That means 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



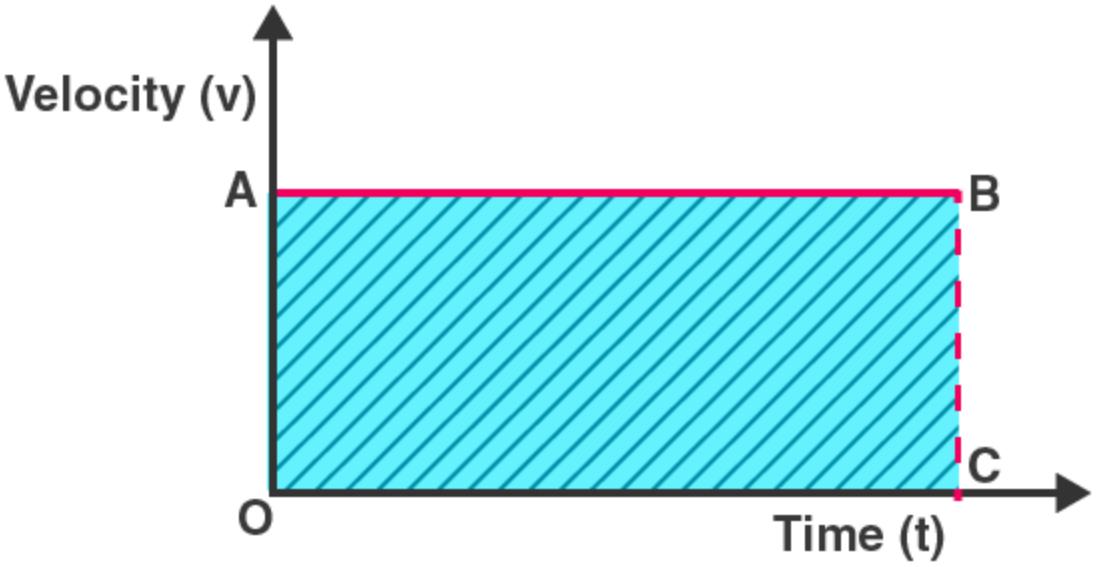
The speed-time graph can be plotted as follows.

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 bus 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 $m.s^{-2}$ * 120 s) + 0 $m.s^{-1}$

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

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

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

Since a = 0.1 $m.s^{-2}$, v = 12 $m.s^{-1}$, u = 0 $m.s^{-1}$, and t = 120 s, 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 = 720 m.

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

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^{-1}

Therefore, the velocity of the trolley after 3 seconds will be 6 $cm.s^{-1}$

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 travelled 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, the 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 rounds 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 sec + 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 travelled to reach the school = distance travelled 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 = $2d/(d/20+d/30)$kmph

= $2/[(3 + 2)/60]$

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

Therefore, Abdul's 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 travelled by boat in 8 seconds = $0 + 1/2\ (3)(8)^2$

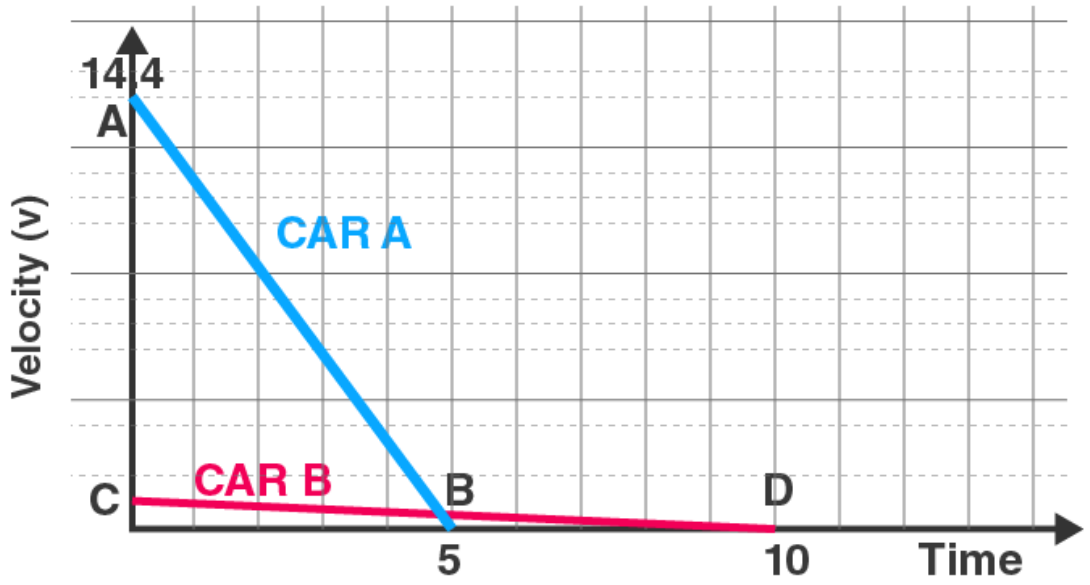
= 96 meters

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

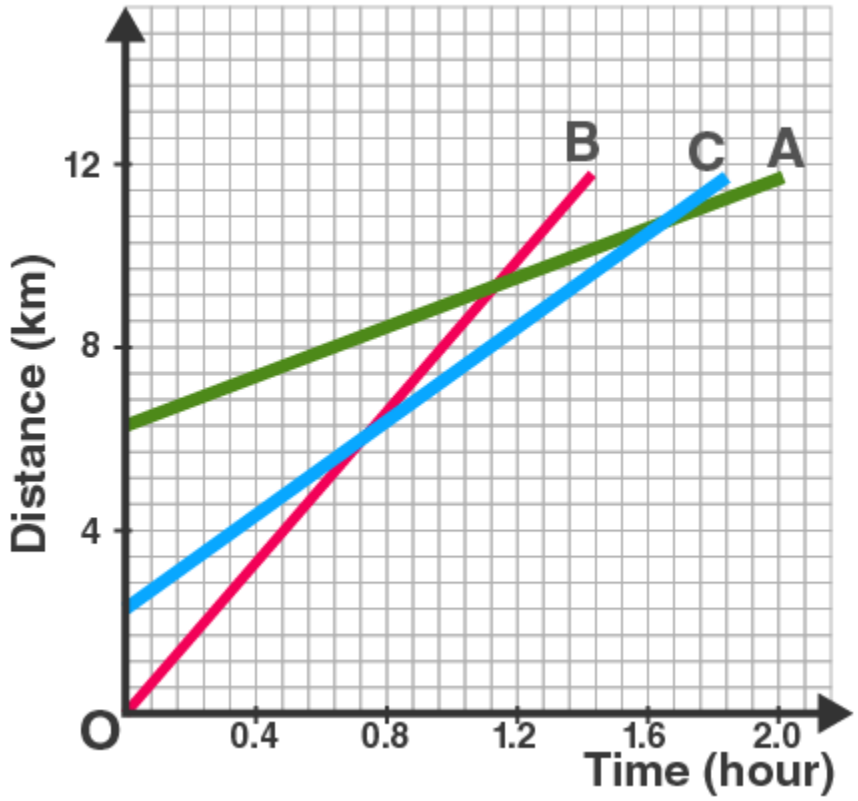
= (1/2)*(OD)*(OC)

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) travelled 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 travelling 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 an 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 B passes A, the distance between the origin and C is 8km

Therefore, total distance travelled 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 travelled 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 travelled by the ball (s) = 20m

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

As per the third motion equation,

$v^2 – u^2 = 2as$

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,

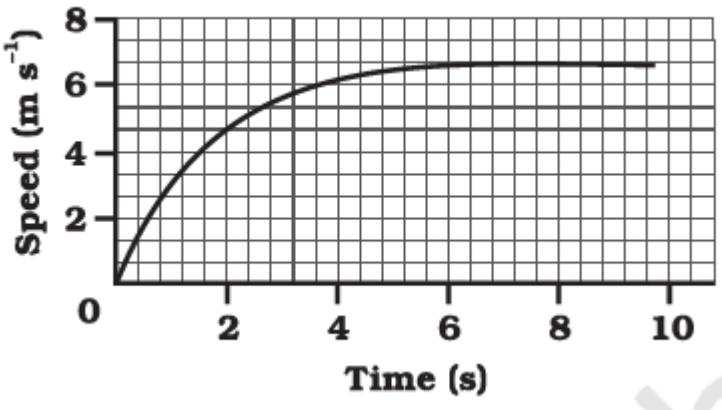
Therefore, t = (v-u)/a

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

= 2 seconds

Therefore, the ball reaches the ground after 2 seconds.

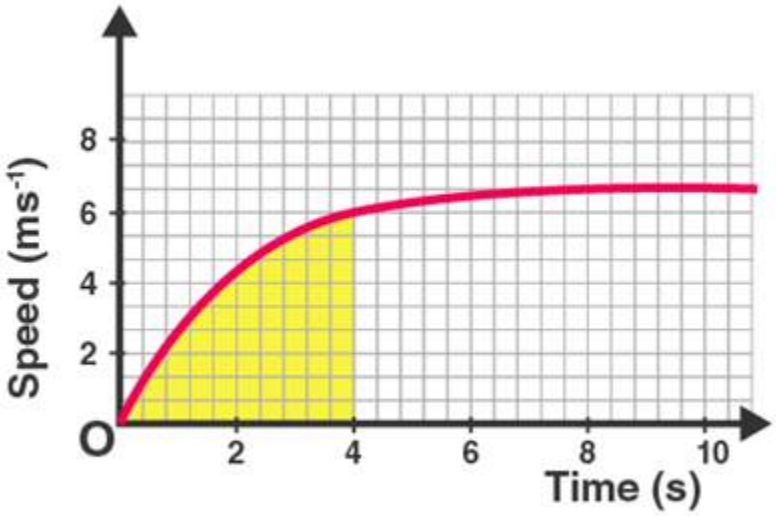
8. The speed-time graph for a car is shown in Fig. 8.12



(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 6th to the 10th 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 possible; acceleration implies an increase or decrease in speed, and uniform speed implies that the speed does not change over time

Circular motion is an example of an object moving with acceleration but with uniform speed.

An object moving in a circular path with uniform speed is still under acceleration because the velocity changes due to continuous changes in the direction of motion.

(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, the radius of the orbit = 42250 km

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

Time is 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.

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.

1. Stone
2. Train
3. 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

The velocity of football changes four times.

First, when a football player kicks a football to another player, second when that player kicks the football to the goalkeeper. Third when the goalkeeper stops the football. Fourth, when the goalkeeper kicks the football towards his team player.

Agent supplying the force:

a) The First case is the First player

b) The Second case is the Second player

c) The Third case is Goalkeeper

d) The Fourth case is Goalkeeper

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 forward (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. As a result, the cart moves forward.

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

Solution

When a fireman holds a hose, which is ejecting large amounts of water at a high velocity, then a reaction force is exerted on him by the ejecting water in the backward direction. This is because of Newton's third law of motion. As a result of the backward force, the stability of the fireman decreases. Hence, it is difficult for him to remain stable while holding the hose.

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

The 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, $m_1v_1 + m_2v_2 = 0$

$$\text{This implies that } v_2 = -\frac{m_1 v_1}{m_2}$$

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

= -0.4375 m/s

The negative sign indicates that recoil velocity is opposite to the bullet's motion.

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

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

The 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 travelled by the stone (s) = 50 m

As per the third equation of motion

$v^2 = u^2 + 2as$

Substituting the values in the above equation we get,

$0^2 = (20)^2 + 2(a)(50)$

$-400 = 100a$

$a = -400/100 = -4m/s^2$ (retardation)

We know that

$F = m \times a$

Substituting above obtained value of a = -4 in F = m x a

We get,

$F = 1 \times (-4) = -4N$

Here the negative sign indicates the opposing force which is Friction

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, the 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

Hence, the force between the automobile and the road is -2550 N, in the opposite direction of the automobile's 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

The momentum of an object is defined as the product of its mass m and velocity v

Momentum = mass x velocity

Hence, the correct answer is mv i.e option (d)

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 first object, $m_1 = 1.5$ kg

Mass of second object, $m_2 = 1.5$ kg

Velocity of first object before collision, $v_1 = 2.5$ m/s

The velocity of the second object which is moving in the opposite direction, $v_2 = -2.5$ m/s

We know that,

Total momentum before collision = Total momentum after collision

$m_1v_1 + m_2v_2 = (m_1 + m_2)v$

$1.5(2.5) + 1.5(-2.5) = (1.5 + 1.5)v$

$3.75 – 3.75 = 3v$

$v = 0$

Therefore, the velocity of the combined object after the collision is 0 m/s

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

Let the distance of penetration be s

As per the first law of motion

$v = u + at$

$0 = 150 + a (0.03)$

$a = -5000\ ms^{-2}$

$v^2 = u^2 + 2as$

$0 = 150^2 + 2 \times (-5000)s$

$s = 2.25\ m$

As per the second law of motion, $F = ma$

$F = 0.01kg \times (-5000\ ms^{-2})$

$F = -50\ N$

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

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

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}

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

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

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 assumption is partially right. Since the mass of the car is very high, the force exerted on the insect during the collision is also very high.

Kiran's statement is false. The change in momentum of the insect and the motorcar is equal by conservation of momentum. The velocity of insect changes accordingly due to its mass as it is very small compared to the motorcar. Similarly, the velocity of motorcar is very insignificant because its mass is very large compared to the insect.

Rahul's statement is completely right. 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 law of motion

$v^2 – u^2 = 2as$

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

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 ms^{-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 0.2 ms^{-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

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 as the force of attraction between an object on the surface of earth and the earth

Also, consider ‘m’ as the mass of the object on the surface of earth and ‘M’ as the mass of earth

The distance between the earth’s centre and object = Radius of the earth = R

Therefore, the formula for the magnitude of the gravitational force between the earth and an object on the surface is given as

$F = G\ Mm/R^2$

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 due to gravity?

Solution:

When an object falls freely from a certain height towards the earth's surface, its velocity keeps changing. This velocity change produces acceleration in the object known as acceleration due to gravity and denoted by 'g'.

The value of the acceleration due to gravity on Earth 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 mass of the moon is 1/100 times and its radius 1/4 times that of earth. As a result, the gravitational attraction on the moon is about one-sixth when compared to earth. The moon's gravitation force is determined by the mass and the size of the moon. Hence, the weight of an object on the moon is 1/6th its weight on the earth. The moon is far less massive than the Earth and has a different radius(R) as well.

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 school bag having a skinny strap because of the pressure that is being applied on the shoulders. The pressure is reciprocally proportional to the expanse on which the force acts. So, the smaller the surface area, the larger is going to be the pressure on the surface. In the case of a skinny strap, the contact expanse is quite small. 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 floats or sinks 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:

A weighing machine measures the body weight and is calibrated to indicate the mass. If we stand on a weighing machine, the weight acts downwards while the upthrust due to air acts upwards. So our apparent weight becomes less than the true weight. This apparent weight is measured by the weighing machine and therefore the mass indicated is less than the actual mass. So our actual mass will be more than 42 kg.

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 correct answer is the cotton bag is heavier than an iron bar. The bag of cotton is heavier than the bar of iron. The cotton bag experiences a larger air thrust than the iron bar. Therefore, the weighing machine indicates less weight than its actual weight for the cotton bag. The reason is

True weight = (apparent weight + up thrust)

The cotton bag's density is less than that of the iron bar, so the volume of the cotton bag is more compared to the iron bar. So the cotton bag experience more upthrust due to the presence of air.

Therefore, in the presence of air, the cotton bag's true weight is more compared to the true weight of the iron bar.

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 from the top with a constant acceleration called acceleration due to gravity (g). This is constant on earth and therefore the value of ‘g’ doesn’t depend on the mass of an object. Hence, heavier 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

$$F = \frac{(Gm_1m_2)}{r^2}$$

$$F = \frac{6.67 \times 10^{-11} \quad (6.0 \times 10^{24} \times 1)}{(6.4 \times 10^{6})^2}$$

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 a force same as the force with which the moon attracts the earth. 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 and 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 the universal law of gravitation and Newton's third law, we all know that the force of attraction between two objects is the same, however in the opposite directions. So the earth attracts the moon with a force same as the moon attracts the earth but in opposite directions. Since earth is larger in mass compared to that of the moon, it accelerates at a rate lesser than the acceleration rate of the moon towards the Earth. Therefore, for this reason the earth does not move towards the moon.

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 the force is also doubled.

(ii)

If the distance between the objects is doubled and tripled

If it's doubled

Hence,

$F = (Gm_1m_2)/(2R)^2$

$F = 1/4\ (Gm_1m_2)/R^2$

F = F/4

Force thus becomes one-fourth of its initial force.

Now, if it's tripled

Hence,

$F = (Gm_1m_2)/(3R)^2$

$F = 1/9\ (Gm_1m_2)/R^2$

F = F/9

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 responsibility of gravity on the weight of the body which keeps us on the ground

(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:

Acceleration due to gravity is the acceleration gained by an object due to gravitational force. On Earth, all bodies experience a downward force of gravity which Earth's mass exerts on them. The Earth's gravity is measured by the acceleration of the freely falling objects. At Earth's surface, the acceleration of gravity is 9.8 ms^{-2} and it is denoted by 'g'. Thus, for every second an object is in free fall, its speed increases by about 9.8 metres per second.

9. What do we call the gravitational force between the earth and an object?

Solution:

The gravitation force between the earth and an object is called weight. Weight is equal to the product of acceleration due to the gravity and mass of the 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 (where m = mass of the body and g = acceleration due to gravity)

The value of g is larger at poles when compared to the equator. So gold can weigh less at the equator as compared to the 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 larger surface area when compared to a crumpled paper ball. A sheet of paper will face a lot of air resistance. Thus, 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's mass, 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 = 49 m/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,

$2gH = v^2 - u^2$

$2 \times (-9.8) \times H = 0 - (49)^2$

$-19.6\ H = -2401$

$H = 122.5$ m

Total time T = Time to ascend (T_a) + Time to descend (T_d)

$v = u + gt$

$0 = 49 + (-9.8) \times T_a$

$Ta = (49/9.8) = 5$ s

Also, $T_d = 5$ s

Therefore $T = T_a + T_d$

$T = 5 + 5$

$T = 10$ s

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

$v^2 = u^2 + 2gs$

$v^2 = 0 + 2 \times 9.8 \times 19.6$

$v^2 = 384.16$

$v = \sqrt{(384.16)}$

$v = 19.6$m/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 $G = 6.67 \times 10^{-11}$ N m^2/ kg^2

Average distance $r = 1.5 \times 10^{11}$ m

Consider Universal law of Gravitation

$$F = \frac{(Gm_1m_2)}{d^2}$$

$$F = \frac{(6.67 \times 10^{-11} \times 6 \times 10^{24} \times 2 \times 10^{30})}{(1.5 \times 10^{11})^2}$$

$F = 3.56 \times 10^{22}$ 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)

$x = 5t^2 = 5 \times 4 \times 4 = 80$m.

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:

$g = 10 m/s^2$

Total time T = 6sec

$T_a = T_d = 3$sec

(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 when released under water come up to the surface of water?

Solution:

The density of plastic is lesser than that of water. Therefore, the force of buoyancy on plastic block will be greater than the weight of plastic block. Hence, the acceleration of plastic block is going to be in the upward direction. So, the plastic block 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.

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, 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 by applying force in or opposite to the direction of the 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 the amount of work done on an object when a force of 1 N displaces it by 1 m along the line of action of the 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

$W = 140 \times 15 = 2100$ J

Therefore, 2100 J of work is done in ploughing the length of the field.

Exercise-11.3 **Page: 152**

1. What is the kinetic energy of an object?

Solution:

The energy possessed by a body by 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. The kinetic energy of the hammer is employed in driving a nail into a log of wood, the mechanical energy of air is employed to run wind mills, etc.

2. 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).

3. 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:

Given

K.E. of the object = 25J

Velocity of the object (v) = 5 m/s

K.E. = (½) mv^2

25 = (½) m $(5)^2$

50 = 25 x m

m = 50/25

m = 2 kg

Now, when velocity is doubled

v = 10 m/s

m = 2 kg

K.E. = (½) x 2 x $(10)^2$

K.E. = 10^2

K.E. = 100 J

When velocity is increased three times, then

v = 15 m/s

m = 2 kg

K.E. = (½) x 2 x $(15)^2$

K.E. = $(15)^2$

K.E. = 225 J

Exercise-11.4 **Page: 156**

1. What is power?

Solution:

Power is defined as the rate of doing work or the rate of transfer of energy. If an agent does a work W in time t, then power is given by:

$$Power = \frac{Work}{Time}$$

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 works at 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

Hence, the power of the lamp is 100 W

4. Define average power.

Solution:

Average power is defined as the ratio of total work done by the body to the total time taken by the body.

$$\text{Average Power} = \frac{\text{Total Work Done}}{\text{Total Time Taken}}$$

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 applying force in or opposite to the direction of the force.

(a) While swimming, Suma applies a force to push the water backwards. Therefore, Suma swims in the forward direction caused by the forward reaction of water. Here, the force causes a displacement. Hence, the work is done by Seema while swimming.

(b) While carrying a load, the donkey has to apply a force in the upward direction. But, displacement of the load is in the forward direction. Since displacement is perpendicular to force, the work done is zero.

(c) A windmill works against gravity to elevate water. The windmill lift water by applying a force in an upward direction, and thus the water is moving in the same upward direction itself. Hence, work is done by the windmill to lift water from the well.

(d) No force is required when a green plant is carrying out photosynthesis. The plant does not exert any force to move. Since there is no displacement or force. Hence, no work is done.

(e) When an engine is pulling a train, it is applying a force in the forward direction. So, it is moving in the forward direction. Since displacement and force are in the same direction. Hence, work is done by the engine.

(f) There is no force involved in the process of drying food grains in the sun and the grains do not move. Since there is no force or displacement. Hence, no work is done.

(g) When a sailboat is moving due to wind energy, it is applying force in the forward direction. So, it is moving in the forward direction. Since displacement and force are in the same direction. Hence, work is done.

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 in the initial and final positions/heights of the object which is zero.

Work done by gravity is given by the expression,

$W = m \times g \times h$

Where,

h= Vertical displacement = 0

$W = m\ g \times 0 = 0$ J

Hence, the work done by the gravity on the given object 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 and heat energy. Hence, the transformation of energy in the given situation can be shown as:

Chemical Energy → Electrical Energy → Light Energy + Heat Energy.

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

Initial velocity u = 5 m/s

Mass of the body = 20kg

Final velocity v = 2 m/s

The initial kinetic energy

$E_i = (1/2)\ mu^2 = (1/2) \times 20 \times (5)^2$

$= 10 \times 25$

$= 250$ J

Final kinetic energy

$E_f = (1/2)\ mv^2 = (1/2) \times 20 \times (2)^2$

$= 10 \times 4$

$= 40$ J

Therefore,

Work done = Change in kinetic energy

Work done = $E_f - E_i$

Work done = 40 J – 250 J

Work done = -210 J

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, what 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= m × g × zero = 0

Therefore the work done on the object by gravity is 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 when the body falls from a height, its potential energy changes into kinetic energy progressively. A decrease in the potential energy is equal to an increase in the kinetic energy of the body. Throughout the method, the total mechanical 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 regenerates into heat and mechanical energy. Kinetic energy provides a 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 huge rock, there's no transfer of muscular energy to the stationary rock. Also, there's no loss of energy since muscular energy is transferred into heat 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 = 1kWh

Given

Energy (E) = 250 units

1 unit = 1 kWh

1 kWh = 3.6 x 10^6 J

Therefore, 250 units of energy = 250 × 3.6 × 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:

Given Mass (m) = 40 kg

Acceleration due to gravity (g) = 10m/s^2

Height (h) = 5m

Potential energy= m × g× h

P.E= 40 × 10 × 5 = 2000J

Potential energy = 2000J (2000 joules)

At a height of 5 metres, the object has a potential energy of 2000 J.

When this object is allowed to fall and it is halfway down, its height above the ground will be half of 5 m= 5/2= 2.5m.

P.E at Halfway down= m× g×h

P.E= 40× 10 × 2.5= 1000J

[h= 2.5 m]

Potential Energy halfway down= 1000 joules.

According to the law of conservation of energy:

Total potential energy= potential energy halfway down+ kinetic energy halfway down

2000 = 1000 + K.E halfway down

K.E at halfway down= 2000- 1000= 1000 J

Kinetic energy at halfway down= 1000 joules.

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 two conditions are satisfied:

(i) A force acts on the body.

(ii) There's a displacement of the body by applying force in or opposite to the direction of the force.

If the direction of force is perpendicular to displacement, then the work done is zero. When a satellite moves around the Earth, then the force of gravity on the satellite is perpendicular to its displacement. Therefore, the work done on the satellite by the Earth 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, there can be displacement of an object in the absence of any force acting on it. If a single force acts on an object, the object accelerates. If an object accelerates, a force is acting on it.

Assume an object is moving with constant velocity. The net force acting on it is zero. But, there is a displacement along with the motion of the object. Therefore, there can be a displacement without 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 applying force in or opposite to the direction of the force.

When an individual holds a bundle of hay over his head, there is no displacement in the hay bundle. Although the force of gravity is acting on the bundle, the person isn't applying any force on it. Therefore, in 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:

Given,

Power of the heater = 1500 W = 1.5 kW

Time taken = 10 hours

Energy consumed by an electric heater can be obtained with the help of the expression,

Power = Energy consumed / Time taken

Hence,

Energy consumed = Power x Time taken

Energy consumed = 1.5 x 10

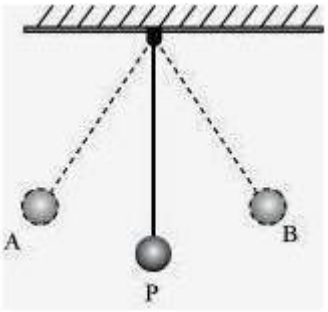
Energy consumed = 15 kWh

Therefore, the energy consumed by the heater in 10 hours 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 an 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 P.E. solely. 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 K.E. solely. This method is perennial as long as the apparatus oscillates.

The bob doesn't oscillate forever. It involves rest as a result of air resistance resisting its motion. The apparatus loses its K.E. to beat this friction and stops once in a while. The law of conservation of energy isn't desecrated because 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 kinetic energy of an object of mass m, moving with a velocity, v, is given by the expression,

K.E = 1/2 mv^2

In order to bring it to rest, its velocity has to be reduced to zero, and in order to accomplish that, the kinetic energy has to be drained off and sent somewhere else.

An external force has to absorb energy from the object, i.e. do negative work on it, equal to its kinetic energy, or

– 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

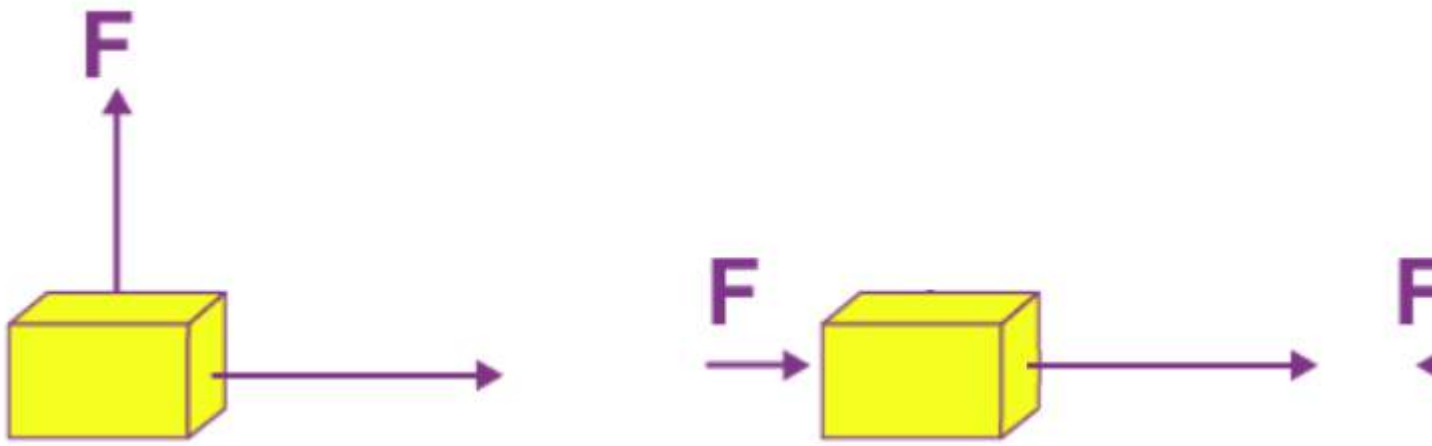
Velocity v = 60km/hr

$$= \frac{60 \times 1000m}{3600s}$$
$$= \frac{50}{3} m/s$$

The work required to stop the moving car = change in kinetic energy

[latex]= \frac{1}{2}mv^{2}\\=\frac{1}{2}\times 1500\times \left (\frac{50}{3} \right)^{2}\\=-208333.3 J[/latex]

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 will be zero.

Case II

In this case, the direction of force functioning on the block is in the direction of displacement. Therefore, work done by force on the block will be positive.

Case III

In this case, the direction of force functioning on the block is contrary to the direction of displacement. Therefore, work done by force on the block will 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 an object could be zero even when many forces work on it. This happens when all the forces get rid of one another, i.e., the online force working on the object is zero. For a uniformly moving object, the online force working on the it 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:

Given,

Power rating of the device (P) = 500 W = 0.50 kW

Time for which the device runs (T) = 10 h

Energy consumed by an electric device can be obtained by the expression

Power = Energy consumed/Time taken

∴ Energy consumed = Power × Time

Energy consumed = 0.50 × 10

Energy consumed = 5 kWh

Thus, the energy consumed by four equal rating devices in 10 h will be

⇒ 4 × 5 kWh

= 20 kWh

21. A freely falling object eventually stops on reaching the ground. What happens to its kinetic energy?

Solution:

When an object falls freely towards the ground, its potential energy decreases, and kinetic energy increases; as the object touches the ground, all its potential energy becomes kinetic energy. Since the object hits the ground, all its kinetic energy becomes heat energy and sound energy. It can also deform the ground depending upon the ground's nature and the amount of kinetic energy possessed by the object.

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 them. 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 an atmosphere on the moon and since sound cannot travel in a 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. The larger the amplitude, the louder 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 the 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 metre (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 metres

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 the time period is reciprocal to 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 the 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 between the reflecting surface and the source.

Therefore, the distance of the 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:

The ceilings of concert halls are curved to spread sound uniformly 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?

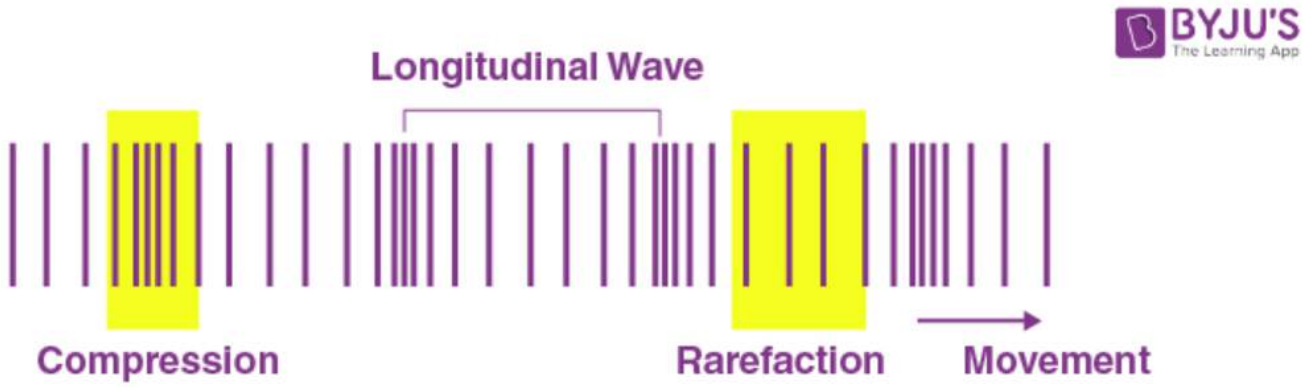
Solution:

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, the sound is produced.

2. Describe, with the help of a diagram, how compressions and rarefactions are produced in the air near a source of the sound.

Solution:

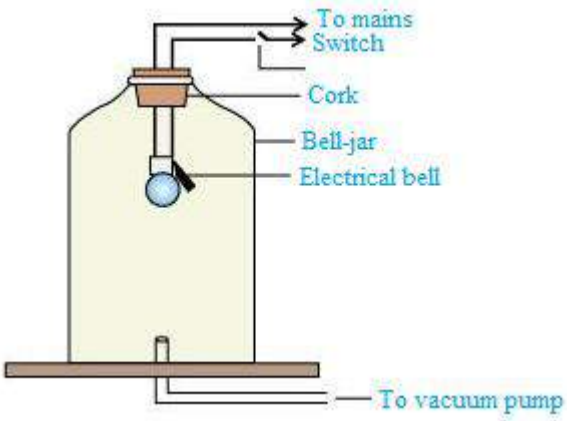
When the school bell is hit with a hammer, it moves forward and backwards, producing compression and rarefaction due to vibrations. When it moves forward, it creates high pressure in its surrounding area. This high-pressure region is known as compression. When it moves backwards, it creates a low-pressure 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 realise that the sound of the ringing bell decreases. If you keep on pumping the air out of the bell jar, then the 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 the bell prong is still vibrating. When there is no air present in the bell jar, a vacuum is produced. Sound cannot travel through a vacuum. Therefore, this experiment shows that sound needs a material medium for its propagation.

4. Why is a sound wave 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, thunder takes more time to reach the Earth as compared to light speed, which is faster. Hence, lightning is seen before whenever we hear 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 aluminium 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 aluminium to reach the second child.

Solution:

Consider the length of the aluminium rod = d

Speed of sound wave at 25° C, V Al = 6420 ms-1

Time taken to reach the other end is,

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 is,

T air = d/ (V air) = d/346

Therefore, the ratio of time taken by sound in aluminium and air is,

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 an echo sound on a hotter day?

Solution:

An echo is heard when the time interval between the reflected sound and the original sound is at least 0.1 seconds. 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 the 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 a 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 the tower base:

As per the 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 the top from the 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

$v = v / \lambda = 339 / 0.015 = 22600$ 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.

15. What is reverberation? How can it be reduced?

Solution:

The continuous multiple reflections of sound in a big enclosed space are reverberation. It can be reduced by covering walls and ceilings of enclosed spaces with the help of sound-absorbing materials, such as loose woollens and fibre boards.

16. What is the 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 prey, and return to their ears. This helps a bat to know how far its 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:

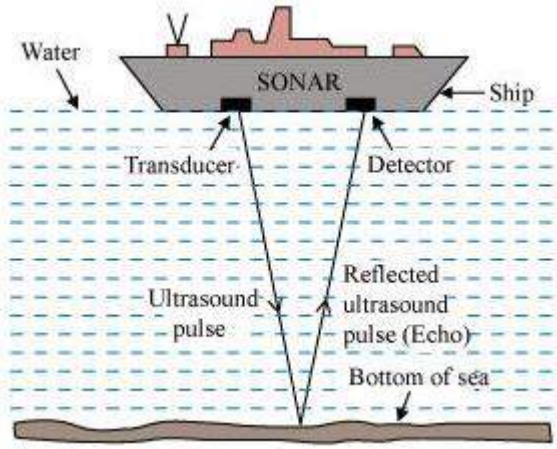
SONAR is an abbreviation for Sound Navigation and Ranging**.** It is an acoustic device used in measuring the direction, speed, and depth of underwater objects, such as shipwrecks and submarines, using ultrasound.

Also, it is used to determine the depth of oceans and seas.

A beam of ultrasonic sound is produced and travels through the seawater, 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 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 an object from submarine = 3625 m

Total distance travelled by SONAR during reception and transmission in water = 2d

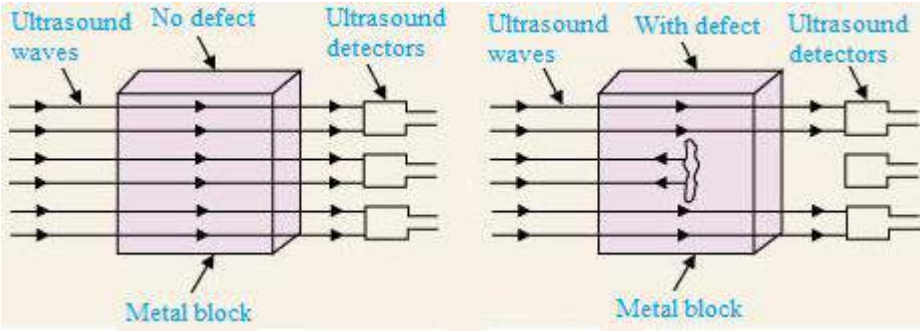
Velocity (v) of sound in water = 2d/t = (2 × 3625) / 5

= 1450 ms^{-1}

21. Explain how defects in a metal block can be detected using ultrasound.

Solution:

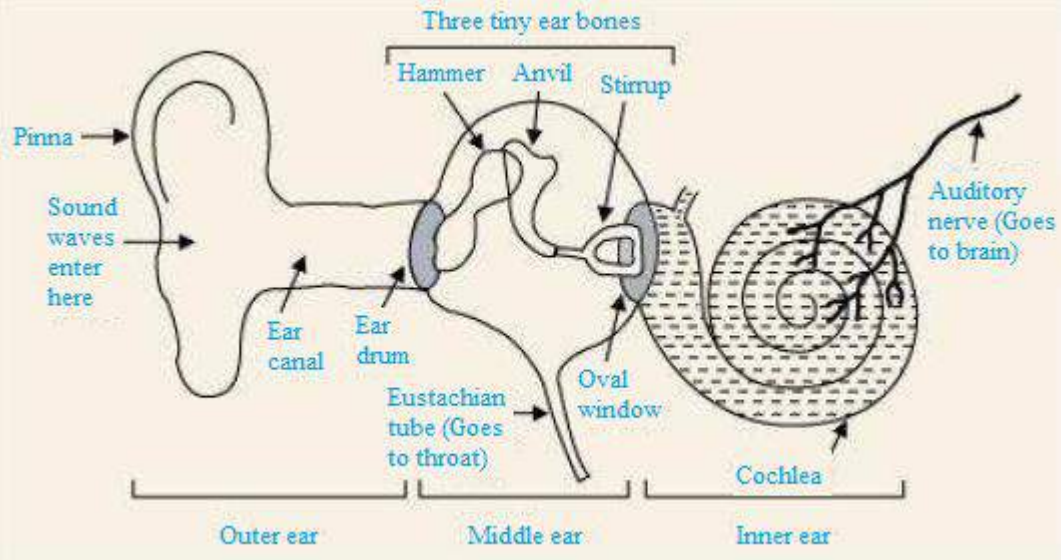
Defective metal blocks will not allow ultrasound to pass through them and reflect it back. This technique is used in detecting defects in metal blocks. Make a set-up as shown in the figure, with ultrasound being passed through one end and detectors placed on the other end of a metal block. Since the 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 eardrum 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.



Section 13. 1. 3 **Page: 178**

1. State any two conditions essential for good health.

Solution:

Two conditions essential for good health are given below:

1. State of physical, mental and social well-being.

2. Better surroundings or environment.

2. State any two conditions essential for being free of disease.

Solution:

Two conditions essential for being free of disease are listed below:

1. Personal and domestic hygiene.

2. Clean environment and surroundings.

3. Are the answers to the above questions necessarily the same or different? Why?

Solution:

The answers to the above questions can be 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:

1. Headache

2. Cough

3. Loose motions

These indicate that there may be a disease, but they don't indicate what the disease is. Hence, one would still visit the doctor for treatment and to know the cause of the above symptoms.

Even if a single symptom is present, one needs to consult the doctor to get 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:

Lice and acne will not cause any long-term effects on the human body. However, the effects of jaundice will be long-term and most unpleasant.

Jaundice is a chronic disease that impacts the whole body and takes a longer time to be cured completely.

In-Text Questions 13.3.5

1. Why are we normally advised to take bland and nourishing food when we are sick?

Solution:

During sickness, the body becomes weak, and the digestive system does not work properly. So easily digested food needs to be taken during this period as well as food rich in nutrients is advised to take. The immunity of the body decreases during disease or infection. Hence, bland and nourishing food is given for speedy recovery.

2. What are the different means by which infectious diseases are spread?

Solution:

Infectious diseases are generally spread through the following modes – Water, air, vectors such as mosquitoes, sexual contact, physical contact with the affected, or by using the 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 as follows:

1. Drinking clean and hygienic water.

2. Preventing the accumulation of water in surroundings.

3. Keeping the toilet neat and clean.

4. Avoiding consumption of uncovered food and other eatables.

5. Taking a bath daily

6. Have a balanced diet.

7. Provide a clean environment which prevents the breeding of mosquitoes. This prevents the spread of vector-borne diseases.

4. What is immunisation?

Solution:

The method to boost our immune system with the help of vaccines that help the body to fight against infectious diseases is called immunisation.

5. What are the immunisation programs available at the nearest health centre in your locality? Which of these diseases are the major health problems in your area?

Solution:

The following immunisation programme is available at the nearest health centre in our locality:

1. Immunisation for infants – DPT, BCG, polio, measles and MMR.

2. For children – Typhoid, TT, DT, smallpox and TAB.

3. For pregnant women— TT and hepatitis B.

The diseases like typhoid, polio, and measles are the major health problems in our locality.

Exercise Questions

1. How many times did you fall ill in the last 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 diarrhoea first and then dengue fever.

(a) The changes made by me in my habits after suffering from these diseases are as given below:

(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.

An example of multiplying vectors is mosquitoes.

(b) One change I would wish for in our surroundings in order to have a healthy society is to make 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 listed below:

(a) Do not forget to wear a mask when in contact with a diseased person.

(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 neighbourhood 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 neighbourhood:

Cold and cough, loose motions, and malaria.

Some of the preventive measures that can be taken are as follows:

(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 caretakers that she 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 behavioural 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 the 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 chickenpox.

(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 person is more likely to fall sick when she is on a four-day fast after recovering from malaria and is taking care of someone who is suffering from chickenpox. This is because she is fasting during recovery, and her immune system is so weak that it is not able to protect its own body from any foreign infection. At this stage, if she is taking care of someone suffering from chickenpox, then she has more chance of getting infected with the chickenpox virus and will get sick again with this disease.

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 is more likely to fall sick when their friend is suffering from measles. This is because measles is highly contagious and can easily spread through the air. This highly contagious virus is spread by coughing and sneezing via close personal contact or direct contact with body secretions. Hence, if a friend is suffering from measles, it is advised to stay away from them to prevent ourselves from getting infected.

In-text Question 1.1 Page No: 193

1. How is our atmosphere different from the atmospheres on Venus and Mars?

Ans:

The Earth's atmosphere is composed of various gases like oxygen, carbon dioxide, nitrogen, and water vapour, along with various gases in small quantities, hence making it a balanced and 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 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 ultraviolet ray affect it.

3. What causes winds?

Ans:

The uneven heating of the earth's surface is the main cause of winds. On being further heated, the air rises up, and low pressure is created. Hence, the air in high pressure occupies 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, lakes, ponds, seas, rivers and various other sources gets evaporated. 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.

⇒ The smoke emitted from vehicles.

In-text Question 1.2

Page No: 194

1. Why do organisms need water?

Ans:

⇒ Every cellular process needs 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 ponds, rivers, and lakes

⇒ Snow

3. Do you know of any activity which may be polluting this water source?

Ans:

⇒ Dumping waste in the river

⇒ Factory waste

⇒ Sewage

In-text Question 1.3

Page No: 201

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 the sun's radiation and do not allow it to go back. This causes the 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 forms, and they are

⇒ 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 the 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, such as 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, are 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 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, we are able to forecast the weather, on the basis of the data collected by the meteorologists.

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 of the air. Air is the medium to spread pollutants into various sources like water and soil. Hence, we can say that limiting activities in certain places will definitely help 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 surroundings and helps in the formation of clouds.

Soil:

- Plants in forests 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

In-text Question 1.1

Page Number: 204

Q1. What do we get from cereals, pulses, fruits and vegetables?

Ans:

Cereals are the source of carbohydrates and are the main source 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 Number: 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

Page Number: 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, and Sulphur are present in proteins.

• Calcium exists in the cell wall.

• Magnesium is a significant component of chlorophyll.

Q2. How do plants get nutrients?

Ans:

There are 16 basic essential nutrients required by plants to grow. Carbon and Oxygen are supplied by water, and the remaining nutrients are supplied through the soil.

In-text Question 1.4

Page Number: 207

Q1. Compare the use of manure and fertilisers in maintaining soil fertility.

Ans:

- Manure improves 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 reduce soil erosion.
- They provide food for soil-friendly bacteria, which are helpful in growing crops.

The effects of fertilisers are

- Fertilisers make the soil become too dry and powdered and raise the rate of soil erosion.
- The organic matter decreases by decreasing the porosity of the soil; hence, the plant roots do not get oxygen properly.
- The nature of soil changes, either basic or acidic.

In-text Question 1.5

Page Number: 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 fertilisers.

(b) Farmers use ordinary seeds, adopt irrigation and use fertiliser.

(c) Farmers use quality seeds, adopt irrigation, use fertiliser and use crop protection measures.

Ans:

Option **(c)** will give the most benefits because the use of good quality seeds is not only sufficient until the soil is properly irrigated, enriched with fertilisers and protected from biotic factors.

In-text Question 1.6

Page Number: 209

Q1. Why should preventive measures and biological control methods be preferred for protecting crops?

Ans:

Over-exposure to chemicals leads to environmental problems; hence, biological methods are preferred for protecting crops from pathogens, insects and rodents, along with increasing production. Since chemicals are harmful to plants and also to the animals which feed on them, bio-pesticides are used as a safe way of crop protection.

Q2. What factors may be responsible for the losses of grains during storage?

Ans:

Biotic and Abiotic factors are responsible for the loss of grains during storage like

- Rodents
- Pests
- Insects
- Fungi
- Bacteria
- Sunlight
- Flood
- Rain
- Temperature
- Moisture

In-text Question 1.7

Page Number: 210

Q1. Which method is commonly used for improving cattle breeds and why?

Ans:

Cross-breading is generally the best method adopted for improving cattle breed quality. In this method, breeding between two good cattle breeds results in a new, improved variety of cattle breeds or offspring. While breeding, care is taken to have a good resultant with a high yield having resistance to climatic conditions.

In-text Question 1.8

Page Number: 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, viruses, or fungi.
- Sunlight-feasible and airy ventilated shelter for animals.

Q2. What are the differences between broilers and layers and their management?

Ans:

Broilers

The poultry bird raised for meat purposes is called a broiler. Broilers feed on protein-rich adequate-fat food. The level of vitamins A and K is kept high in poultry feeds.

Layers

The egg-laying poultry bird is called a layer. The housing, environmental and nutritional requirements of broilers vary from those of egg layers. Layers require proper lighting 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-fibre foodstuff (which is unfit for human consumption) into highly nutritious animal protein food."

Ans:

Poultry farming aims to raise domestic birds for egg and chicken meat purposes. These domestic birds feed on animal feeds which mainly consist of roughages for getting good quality feathers, eggs, chicken and nutrient-rich manure. For these reasons, it is said that "poultry is India's most efficient converter of low-fibre foodstuff into highly nutritious animal protein food."

In-text Question 1.9

Page Number: 213

Q1. How are fish obtained?

Ans:

Fishes are obtained in two ways:

Capture fishing: Obtaining fish from natural resources.

Culture Fishery: Culturing of fishes in freshwater ecosystems, like rivers, ponds and lakes, also including marine.

Q2. What are the advantages of composite fish culture?

Ans:

The 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 themselves
- Food resources can be completely utilised
- Survival of the fish also increases
- More yield

Q3. What are the desirable characteristics of bee varieties suitable for honey production?

Ans:

- The variety of bees should yield a large amount of honey.
- The bees should stay for a longer period in bee hives.
- The bees should not sting much.
- Bees should be disease resistant

Q4. 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. The kinds of flowers available will determine the taste of the honey; hence, Pasturage is the main reason for good quality honey.

Exercise Questions 1.1

Page Number: 214

Q1. Explain any one method of crop production which ensures high yield.

Ans:

Plant breeding is one of the methods 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 hybridisation or cross-breeding is done among these diversities to get a crop/plant of anticipated characteristics.

Q2. Why are manure and fertilisers used in fields?

Ans:

Manures and fertilisers are used to enrich the soil quality and improve the yield. They also help in controlling diseases. Manure and fertilisers replenish the soil by supplying nutrients to the soil. They are excellent sources of potassium, phosphorous and nitrogen which assist in the healthy development of plants. Manures and fertilisers 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 the 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 a minimal amount of fertilisers
- Both fruits and vegetables can be grown easily
- Best use of land with a proper supply of nutrients

Q4. What is genetic manipulation? How is it useful in agricultural practices?

Ans:

Genetic manipulation is a process in which the transfer of genes takes place from one organism to another. Here, a gene of a particular character is introduced inside the chromosome cell, resulting in a transgenic plant.

Example: BT Cotton is a genetically modified crop which carries bacterial genes that protect 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
- Rodents
- Pesticides
- Bacteria
- Mites
- Birds

Q6. How do good animal husbandry practices benefit farmers?

Ans:

Good practice of animal husbandry benefits farmers in the 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:

The benefits of cattle farming are

- Cattle are used for agricultural purposes
- Generation of good quality cattle
- Milking and meat purpose
- The skin of cattle is used for the leather and wool industry

Q8. For increasing production, what is common in poultry, fisheries and bee-keeping?

Ans:

For increasing production, cross-breeding techniques are used adopted in poultry, fisheries and bee-keeping. Along with these techniques, regular and proper maintenance methods are useful in improving production.

Q9. How do you differentiate between capture fishing, mariculture and aquaculture?

Ans:

Capture fishing: It is a technique in which fish are captured from various sources of natural resources like sea, rivers, lakes and ponds.

Mariculture: Culturing of fish in marine fishes like prawns, oysters, bhetki and mullets in marine water for commercial use.

Aquaculture: Involved in culturing of fish in both marine and freshwater.