TEACHER'S HANDBOOK

STELLAR LEARNING

Chemistry

9

On Board! BOOKS

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Contents

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Matter in Our Surroundings

Checkpoint (Page 6)

1. What is common in the three states of matter?

Ans. All of them occupy space and have mass.

2. What do you understand by density of matter?

Ans. Density of matter is defined as the mass per unit volume.

3. What does LPG stand for?

Ans. Liquefied Petroleum Gas

4. Why water should be called a liquid?

Ans. As it has a definite volume but indefinite shape.

5. Why does the level of water not change when sugar is dissolved in it?

Ans. The particles of water have spaces between them into which sugar particles fit. So, the level of water does not change.

6. Name one natural material we get from trees.

Ans. Wood

7. Name one solid, one liquid and one gas that are soluble in water.

Ans. Sugar, lemon juice and oxygen are soluble in water.

8. Rubber band changes its shape. Is it a solid?

Ans. Yes, rubber band is a solid as it can regain its shape.

9. Name two things that are classified as matter and two that are not.

Ans. Wood and water are matter while sound and rainbow are not considered as matter.

10. Why does an inflated balloon kept in the sun burst after sometime?

Ans. As the temperature increases, the space between the particles of an inflated balloon increases. This increases the size of the balloon and thus it bursts.

Milestone 1

(Page 11)

Multiple-Choice Questions

1. When a crystal of potassium permanganate is placed at the bottom of a beaker containing water, the water turns purple on its own even without stirring. This is an example of

(a) distribution. (b) dissolution.
(c) diffusion. (d) crystallization.

Ans. (c) diffusion.

2. Which of the following can be termed as a fluid?

(a) Carbon (b) Sulphur
(c) Oxygen (d) Potassium

Ans. (c) Oxygen

3. A form of matter has no fixed shape but it has a fixed volume. An example of this form of matter is

(a) an iron ball. (b) kerosene.
(c) stainless steel. (d) sulphur dioxide.

Ans. (b) kerosene.

4. Which one of the following statements is incorrect?

(a) The particles of matter are very small.
(b) The particles of matter attract each other.
(c) The particles of only gases move continuously.
(d) The particles of matter have space between them.

Ans. (c) The correct statement is that the particles of matter move continuously.

5. The property to flow is unique to fluids. Which one of the following statements is correct?

(a) Only liquids are fluids.
(b) Only gases behave like fluids.

(c) Gases and liquids behave like fluids.

(d) Gases and solids behave like fluids.

Ans. (c) Gases and liquids behave like fluids.

Very Short Answer Type Questions

6. Name a common characteristic of liquids and gases.

Ans. Fluidity

7. Why do not solids possess fluidity?

Ans. Fluidity means tendency to flow. The constituents of solids are very closely packed and bound together by strong interparticle attractive forces. So, solids do not possess fluidity.

8. How are the particles of a solid packed?

Ans. The particles of a solid are closely packed.

9. Are liquids less dense than solids?

Ans. Yes, liquids are less dense than solids.

10. I am a substance having definite volume but no definite shape. Which state of matter do I possess?

Ans. Matter in a liquid state.

11. How will you prove that the particles of matter are moving continuously?

Ans. Using the concept of diffusion, we can prove that the particles of matter are moving continuously.

12. What are solids, liquids and gases?

Ans. Solids, liquids and gases are the three states of matter.

13. What is the full form of CNG? Mention its one property that makes it so important.

Ans. The full form of CNG is compressed natural gas. It does not create pollution. It is a clean fuel.

Short Answer Type-I Questions

14. Define diffusion. Is it faster in winter or summer season? Explain.

Ans. Diffusion is the intermixing of two different substances on their own. The process of diffusion becomes faster with an increase in temperature due to increase in kinetic energy of particles. So, diffusion is faster in summer than in winter.

15. By placing a finger in the running stream of water, you are not able to break the stream of water. What do you conclude from this?

Ans. From this we conclude the following:

i. There is a force of attraction between the particles of matter.

ii. This force of attraction keeps the particles together in the matter.

16. Osmosis is a special type of diffusion. Comment.

Ans. In both the phenomenon, we observe the movement of particles from higher concentration to lower concentration. However, in osmosis, the movement of particles is through a semi-permeable membrane.

17. How big are the particles of matter?

Ans. Matter is made up of extremely small-sized particles. The diameter of the molecules of matter, in general, is of the order of 10^{-9} m.

18. Give two examples of diffusion.

Ans. (a) The fragrance of perfumes can be felt from a distance because of diffusion of vapours of perfumes in the air around.

(b) The odour of the food being cooked in the kitchen can be known without even entering into the kitchen.

19. Although sponge is a solid, we are able to compress it. Why?

Ans. Sponge has tiny holes in which air is trapped. When we press a sponge, air is expelled out and hence, we are able to compress a sponge.

Short Answer Type-II Questions

20. A substance has high compressibility and it can take the shape of the container in which it is kept. Predict the nature of the substance. List any four properties of this state of matter.

Ans. The given substance is a gas. It has high compressibility and it can take the shape of the container in which it is kept.

Properties of gases are as follows:

i. Gases have no fixed shape and volume.

ii. Gases can be compressed to liquids by applying pressure.

iii. Gas particles move in all possible directions with all possible speeds.

iv. Gases show the property of diffusion.

21. Write any three properties of particles of matter.

Ans. Properties of particles of matter are as follows:

i. Particles of matter have space between them.

ii. Particles of matter are continuously moving.

iii. Particles of matter attract each other.

Long Answer Type Questions

22. Describe an activity to demonstrate that the particles of matter are continuously moving.

Ans. Put an unlit incense stick in a corner of the class. Find out how close you have to go near to the incense stick so as to get its smell. Record your observation. Now light the incense stick with the help of a matchstick. Do you get the smell at a distance from the incense stick? Record your observation.

When the temperature is increased, the kinetic energy of the particles increases and they move faster. In case of unlit incense stick, the temperature is low and the kinetic energy of the particles of incense is less. Under this condition, the particles of incense do not mix with the particles of air rapidly. Due to this we have to go near to the incense stick to get the smell of its particles. When the incense stick is lit, the temperature increases leading to the increase of kinetic energy of the particles of incense. As a result, the particles of incense move very rapidly and they intermix with the particles of air very rapidly. This is why, the aroma of particles of the lit incense stick can be felt even when we are at a distance from it. So, it is concluded that the particles of matter are moving continuously and the particles of matter intermix on their own with each other.

23. Describe an activity to find out the relative strength of intermolecular attractive forces in the states of matter.

Ans. Take a piece of chalk, a rubber band and an iron nail (about 5 inch length). Try to break these materials by cutting with a knife, stretching or hammering. Record your observations regarding the material in which the particles are held together with greater intermolecular attractive forces.

It is very difficult to break the iron nail and hence the particles of iron nails are held together by very strong intermolecular attractive forces. The strength of the intermolecular attractive forces is weaker in chalk. The particles of rubber band are held by the weakest attractive forces. So, it is concluded that the strength of attractive forces differ from one kind of matter to the other.

24. Describe the factors which determine the state of matter of a substance.

Ans. The intermolecular attractive forces are responsible for bringing the molecules closer while the motion of the molecules tend to move them away from each other. The physical state of a substance depends on the net effect of these two opposing factors. When the intermolecular attractive forces are very strong and kinetic energy is very small, the matter exists as a solid. When the intermolecular attractive forces are strong and the kinetic energy is large enough for the molecules to move to-and-fro, the matter exists as a liquid. When the intermolecular attractive forces are negligible and the kinetic energy is very large, the matter exists as gas.

Milestone 2

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Multiple-Choice Questions

1. The quantity of heat required to change 1 kg of a solid into liquid at atmospheric pressure at its melting point is called

(a) latent heat of vaporisation.

(b) latent heat of fusion.

(c) latent heat of sublimation.

(d) latent heat of evaporation.

Ans. (b) latent heat of fusion.

2. During summer, water kept in an earthen pot becomes cool due to the phenomenon of

(a) evaporation. (b) diffusion.

(c) transpiration. (d) osmosis.

Ans. (a) evaporation.

3. Which of the following will increase the evaporation of water?

(a) Adding common salt to water

(b) Reducing the surface area of water

(c) Decrease in temperature of water

(d) Increase in temperature of water

Ans. (d) Increase in temperature of water

Very Short Answer Type Questions

4. Define evaporation.

Ans. The phenomenon of change of a liquid into vapour at any temperature below the boiling point of the liquid is called evaporation.

5. Define boiling point.

Ans. The temperature at which a liquid changes into a gas (or vapour) is called the boiling point of the liquid.

6. Define melting point.

Ans. The temperature at which a solid changes into a liquid is called the melting point of the solid.

7. Is boiling a surface phenomenon or a bulk phenomenon?

Ans. Boiling is a bulk phenomenon.

8. What is the SI unit of latent heat of fusion?

Ans. J/kg

9. Does the rate of evaporation increase with increase in surface area?

Ans. Yes, evaporation, being a surface phenomenon, increases with increase in surface area.

Short Answer Type-I Questions

10. What is dry ice? What happens when the pressure under which it is stored is decreased to 1 atm?

Ans. Solid carbon dioxide is known as dry ice. When pressure is decreased to 1 atm, it gets directly converted into vapours.

11. What happens to the boiling point of a liquid when atmospheric pressure of a liquid decreases?

Ans. The temperature at which a liquid changes into vapour at the atmospheric pressure is called the boiling point of the liquid. Thus, when atmospheric pressure decreases, boiling point of liquid also decreases.

Short Answer Type-II Questions

12. What type of clothes should we wear in summer? Give reason for your answer.

Ans. During summer, we sweat more because of the mechanism of our body which keeps us cool. We know that evaporation causes cooling. Cotton clothes, being the good absorber of water helps in absorbing the sweat and exposing it to the atmosphere for easy evaporation which causes cooling.

13. Why does evaporation cause cooling? Explain.

Ans. Evaporation causes cooling because during vaporisation the evaporating vapour carries away heat.The liquid particles absorb energy from the surrounding in order to regain the energy lost during the evaporation process and as a result the surrounding becomes cooler.

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

Ans. The particles present in acetone, petrol or perfume absorb energy from our palm or surroundings and evaporate causing the palm to feel cold.

Long Answer Type Questions

15. Define sublimation. How is sublimation different from melting? Name two substances from your daily life that sublime on heating.

Ans. Sublimation is defined as a process in which a solid on heating, changes directly into the vapour phase without passing through the intermediate liquid state.

The process in which a solid substance changes into a liquid on heating is called melting. So, in sublimation, a solid changes directly into vapour while in melting, a solid changes into liquid on heating. Camphor and ammonium chloride are the substances that sublime on heating.

16. Why does water get cooled in an earthen pot? Explain how evaporation of sweat helps our body feel cool?

Ans. Water kept in an earthen pot undergoes evaporation through the tiny pores present on the walls of the earthen pot. During evaporation, the water molecules absorb heat energy from the water kept in the earthen pot.

Evaporation of sweat from our body causes cooling. When sweat evaporates, it absorbs energy from our body equal to the latent heat of vaporisation of water. This keeps our body cool.

Higher Order Thinking Skills (HOTS) Questions

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1. A fluorescent tube glows when electrical energy is passed through it. Explain.

Ans. When electric energy is passed through a fluorescent tube, the gases present in it get ionised to form plasma. This plasma makes a fluorescent tube to glow.

2. Why do people sprinkle water on the open ground or roof after a hot sunny day?

Ans. The sprinkling of water on an open ground or roof causes water molecules to absorb energy from the open ground, roof, surroundings and get evaporated. The evaporation of water causes a cooling effect since it makes use of the very large latent heat of vaporisation of water.

3. Water boils at 100 °C. Can it be made to boil at 95 °C or 105 °C?

Ans. The boiling point of a liquid depends upon the pressure acting on it. Water boils at 100 °C at atmospheric pressure. If the pressure acting on a liquid is reduced from 1 atm , it can be made to boil at 95 °C. If we increase the atmospheric pressure of a liquid, then its boiling point also increases and it can be made to boil at 105 °C .

4. Does ice sublime? Justify your answer.

Ans. Ice does sublime. For example, when food is frozen in an airtight plastic bag for a long time dried out, deep freezing is recommended to avoid this situation.

Self-Assessment

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Multiple-Choice Questions

1. In liquids, the interparticle attractive forces are weaker than those in

(a) gases.

(b) solids.

(c) both gases and solids.

(d) none of these.

Ans. (b) solids.

2. The correct arrangement of water, water vapour and ice in the increasing order of forces of attraction between their constituent particles is
   (a) water vapour, water, ice.
   (b) water, water vapour, ice.
   (c) ice, water, water vapour.
   (d) ice, water vapour, water.

Ans. (a) water vapour, water, ice.

3. Which of the following sets of properties is possessed by liquids?
   (a) Definite shape, definite volume
   (b) Fluidity, definite shape
   (c) Rigidity, definite volume
   (d) Fluidity, definite volume

Ans. (d) Fluidity, definite volume

4. The change of state of a substance directly from solid to gas is known as
   (a) freezing.
   (b) sublimation.
   (c) evaporation.
   (d) fusion.

Ans. (b) sublimation.

5. Which of the following substances exhibit the strongest intermolecular attractive forces?
   (a) Water (b) Ethanol
   (c) CO_2 (d) Sugar

Ans. (d) Sugar

Assertion–Reason Type Questions

For question numbers 6 to 14, two statements are given – one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of the assertion.
(b) Both A and R are true but R is not the correct explanation of the assertion.
(c) A is true but R is false.
(d) A is false but R is true.

6. **Assertion:** When a spoonful of sugar is added to a glass of water and stirred, the level of water does not change.

   Reason: The particles of sugar occupy the spaces between particles of water.

Ans. (a) Particles of matter have space between them. Thus, when a spoonful of sugar is added to a glass of water and the mixture is stirred, the particles of sugar get into the spaces between the particles of water. This is why the level of water does not change.

7. **Assertion:** Salt dissolves faster in hot water than in cold water.

   Reason: Rate of diffusion decreases with heating.

Ans. (c) Particles of matter possess kinetic energy. On heating, their kinetic energy increases. Hence, on heating, the intermixing of particles of matter also increases. So, salt dissolves faster in hot water than in cold water because the diffusion of particles increases with increase in temperature.

8. **Assertion:** Melting point of iron is more than the melting point of ice.

   Reason: Forces of attraction between the particles of ice are stronger than the forces of attraction between the particles of iron.

Ans. (c) The melting point of a solid indicates the strength of forces of attraction between its particles. Stronger the forces of attraction, more is the melting point. The forces of attraction between the particles of iron are stronger than the forces of attraction between the particles of ice (water). This is why melting point of iron is more than the melting point of ice.

9. **Assertion:** Liquids are called fluids.

   Reason: Liquids can flow and change their shape.

Ans. (a) Particles in liquids are packed loosely. Also, the forces of attraction between the particles in liquids are less strong as compared to solids. Thus, particles of liquid can move from one position to another. So, liquids can flow and change their shape and are called fluids.

10. **Assertion:** Natural gas is transported by storing in cylinders.

    Reason: Gases do not have fixed shape and volume.

Ans. (b) Particles of gases have large spaces between them and the forces of attraction between the particles of gases are very weak. Thus, gases can be compressed easily. Due to their high compressibility, gases can be compressed in cylinders and transported.

11. **Assertion:** When ice starts melting, its temperature starts increasing.

    Reason: Heat absorbed by ice is first used in overcoming the forces of attraction between the particles of ice.

Ans. (d) When a substance is heated, its particles start vibrating faster. The heat energy supplied is used in changing the state of the substance by

overcoming the forces of attraction between the particles. Hence, when ice starts melting, its temperature does not rise. The temperature increases only when the ice completely changes into water.

12. **Assertion:** Clothes dry slowly on a rainy day than on a sunny day.

Reason: Rate of evaporation increases with increase in wind speed.

Ans. (b) The amount of water vapour present in the air is called humidity. Air can hold only a certain amount of water vapour. On a rainy day, the humidity in the air is high. Hence, rate of evaporation of water from wet clothes is slower on a rainy day than on a sunny day.

13. **Assertion**: When we put some acetone on our palm, we feel warm.

Reason: Evaporation causes cooling.

Ans. (d) Acetone is a volatile liquid, that is, it evaporates very quickly. So, when we put some acetone on our palm, it absorbs heat from our palm (or surroundings) and evaporates. This makes the palm feel cold.

14. **Assertion:** We are able to sip hot tea faster from a cup than a saucer.

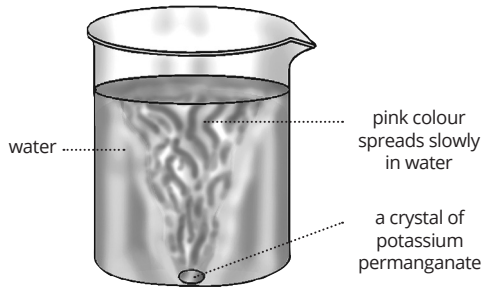
Reason: Rate of evaporation increases with increase in surface area.

Ans. (d) The rate of evaporation increases with the increase in surface area. The surface area of a saucer is more than that of a cup. Hence, evaporation occurs faster in a saucer than in a cup. Thus, tea cools faster in a saucer than in a cup, so it is easier to sip hot tea from a saucer than a cup.

Source-based/Case-based/Passage-based/ Integrated assessment questions

Answer the questions on the basis of your understanding of the following passages and the related studied concepts. (any four)

15. Potassium permanganate is a dark purple salt which is used for medicinal purpose and treatment of water. It is quite soluble in water. When we add 2–3 crystals of potassium permanganate to 100 mL of water and stir the mixture, the water turns pink. If we take a small volume (say 10 mL) of this solution and mix it with some clear water (say 90 mL), we will get a coloured solution. Even after diluting the solution repeatedly, we will still get a coloured solution.



I. (a) Even after diluting the potassium permanganate solution repeatedly, a coloured solution is obtained. What does this show about the particles of matter?

(b) List any two characteristics of particles of matter.

(c) When a spoonful of salt is dissolved in a beaker containing water, the level of water does not rise. Why?

(d) If we use copper sulphate instead of potassium permanganate, will we get the same results?

Ans. (a) If a coloured solution is obtained even after diluting an aqueous solution of potassium permanganate repeatedly, it shows that particles of matter are very small in size. There must be many particles in a single crystal of potassium permanganate due to which the solution appears coloured.

(b) Two characteristics of particles of matter are as follows:

(i) Particles of matter are continuously moving.

(ii) Particles of matter attract each other.

(c) Particles of matter have space between them. Hence, when a spoonful of salt is dissolved in a beaker containing water, the particles of salt get into the spaces between the particles of water. This is why the level of water does not rise when salt is dissolved in it.

(d) We will get the same results if we use copper sulphate in place of potassium permanganate. Matter is made up of particles which are extremely small in size. A tiny crystal of copper sulphate is also made up of many small particles. Hence, dissolving a few crystals of copper sulphate in water will give a blue solution. After repeatedly diluting this solution, the intensity of blue colour will reduce but the solution will still appear blue.

II. (a) If a coloured solution is obtained even after diluting an aqueous solution of potassium permanganate repeatedly, it shows that

(i) potassium permanganate do not get distributed in water uniformly.

(ii) the particles of potassium permanganate are very small in size.

(iii) a single crystal of potassium permanganate is made up of only few particles.

(iv) only one crystal of potassium permanganate cannot change the colour of a large volume of water.

Ans. (ii) the particles of potassium permanganate are very small in size.

(b) Which of the following is a correct statement?

(i) Particles of matter are continuously moving.

(ii) Particles of matter do not attract each other.

(iii) Particles of matter do not have space between them.

(iv) Particles of matter are not continuously moving.

Ans. (i) Particles of matter are continuously moving.

(c) When a spoonful of salt is dissolved in a glass of water,

(i) the level of water rises slowly.

(ii) the particles of salt get into the spaces between the particles of water.

(iii) the particles of salt do not get into the spaces between the particles of water.

(iv) the level of water rises rapidly.

Ans. (ii) the particles of salt get into the spaces between the particles of water.

(d) When temperature increases, the kinetic energy of particles of matter

(i) decreases.

(ii) increases and then decreases.

(iii) increases.

(iv) decreases and then increases.

Ans. (iii) increases.

(e) Which of the following statements is incorrect regarding the characteristics of matter?

(i) Particles of a matter are randomly moving in all directions.

(ii) Particles of matter have empty space between them, called voids.

(iii) Kinetic energy of the particles of matter remains the same at a particular temperature.

(iv) Particles of matter diffuse into each other on their own.

Ans. (iii) Kinetic energy of the particles of matter remains the same at a particular temperature.

16. On the basis of physical properties, matter is classified into solids, liquids and gases. In solids, particles are arranged very close to each other. They are held together by strong forces of attraction. Because of these strong forces, particles in solids can only vibrate about their positions. They cannot move from one place to another like liquids and gases.

I. (a) What is the effect of the given arrangement of particles in solids on their shape and volume?

(b) Can solids be compressed? What will happen when an excess force is applied on solids?

(c) What happens to the particles in a solid when it is heated? When does a solid melt?

(d) Compare the arrangement of particles in solids with that in liquids.

Ans. (a) Since particles are arranged very close to each other in solids and are held together by strong forces of attraction, solids are hard and rigid. They have fixed shape and volume.

(b) Solids cannot be compressed. This is because the particles in solids are packed very close to each other and there is negligible space between them. If an excess force is applied on solids, they may break.

(c) When a solid is heated, the kinetic energy of its particles increases and they start vibrating faster. A solid melts when its particles gain sufficient kinetic energy to overcome the forces of attraction between them. Then, the particles leave their positions and start moving freely.

(d) In solids, the constituent particles are held very close to each other. There is negligible space between the particles and the forces of attraction holding these particles are very strong. On the other hand, in liquids, the forces of attraction between particles are slightly weaker. The particles are not so closely packed due to which they can move freely.

II. (a) In solids, particles are held together by strong forces of attraction and

(i) have high compressibility.

(ii) do not have fixed shape and volume.

(iii) have very low compressibility.

(iv) have low density.

Ans. (iii) have very low compressibility.

(b) Which of the following is an incorrect statement?

(i) The molecules in a solid vibrate about a fixed position.

(ii) The molecules in a liquid are arranged in a regular pattern.

(iii) The molecules in a gas exert negligibly small forces on each other, except during collisions.

(iv) The molecules of a gas occupy all the space available.

Ans. (ii) The molecules in a liquid are arranged in a regular pattern.

(c) Which of the following describes the liquid state?

(i) It has a definite shape and a definite volume.

(ii) It has a definite shape but not a definite volume.

(iii) It has a definite volume but not a definite shape.

(iv) It has neither a definite shape nor a definite volume.

Ans. (iii) It has a definite volume but not a definite shape.

(d) What happens to the particles in a solid when it is heated?

(i) The kinetic energy of the particles increases and they start vibrating faster.

(ii) The kinetic energy of the particles decreases and they start vibrating slower.

(iii) The kinetic energy of the particles decreases and they start vibrating faster.

(iv) The kinetic energy of the particles remains the same.

Ans. (i) The kinetic energy of the particles increases and they start vibrating faster.

(e) Which of the following states has the least energetic molecules?

(i) Solid (ii) Liquid

(iii) Gas (iv) Plasma

Ans. (i) Solid

17. Natural gas is a fossil fuel. It is mainly composed of methane. Under high pressure, natural gas is stored as compressed natural gas (CNG). Large volumes of CNG can be compressed in small cylinders and transported easily. CNG is used as a fuel for power generation and in vehicles. It causes very less pollution in comparison to petrol and diesel and therefore is a much cleaner fuel.

I. (a) How are particles arranged in gases?

(b) Why are gases highly compressible?

(c) If a small volume of natural gas is compressed into a large cylinder, why does it occupy the entire volume of the cylinder?

(d) Can CNG be supplied through any other method apart from being transported through cylinders?

Ans. (a) In gases, the constituent particles are packed very loosely. There is negligible force of attraction and large space between these particles due to which the particles move with high speeds in different directions.

(b) Gases are highly compressible due to the presence of large interparticle empty space.

(c) Particles of a gas have negligible forces between them and move with high speeds in different directions. As a result, gases fill their containers completely. Hence, even if a small volume of natural gas is compressed into a large cylinder, it can occupy the entire volume of the cylinder.

(d) In addition to being transported through cylinders, CNG can also be transported through pipes. This is because gases are highly compressible.

II. (a) Which of the following statements is incorrect regarding the arrangement of particles in gases?

(i) The constituent particles are packed very loosely.

(ii) There are negligible forces of attraction between the particles.

(iii) There are large spaces between the particles.

(iv) The constituent particles are packed very closely.

Ans. (iv) The constituent particles are packed very closely.

(b) Gases are highly compressible because

(i) there are small spaces between their particles.

(ii) there are large spaces between their particles.

(iii) they have a definite volume.

(iv) their particles exhibit least kinetic energy.

Ans. (ii) there are large spaces between their particles.

(c) If a small volume of natural gas is compressed into a large cylinder, it occupies the entire volume of the cylinder because

(i) particles of a gas have strong forces between them.

(ii) particles of a gas move with very low speed in different directions.

(iii) interparticle distances are the smallest in gases.

(iv) particles of a gas have negligible force between them and move with very high speed in different directions.

Ans. (iv) particles of a gas have negligible force between them and move with very high speed in different directions.

(d) Identify the correct set of conditions required to compress large volume of a gas.

(i) High pressure and high temperature

(ii) High pressure and low temperature

(iii) Low pressure and low temperature

(iv) Low pressure and high temperature

Ans. (ii) High pressure and low temperature

(e) Which of the following statements is correct?

(i) In gases, the particles are free to move in any direction.

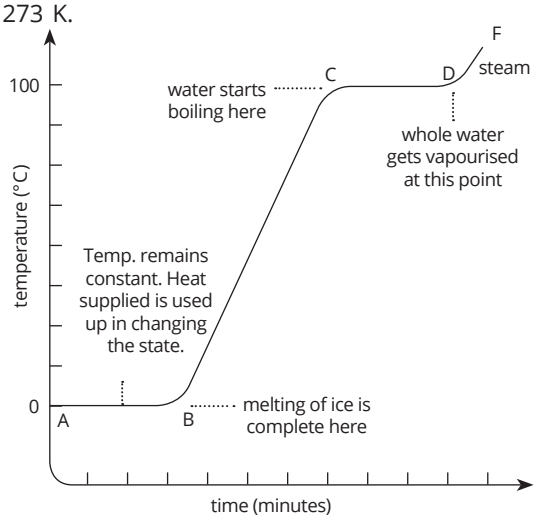
(ii) Gases possess high density.

(iii) Interparticle attractive forces are the strongest in gases.

(iv) Due to the immobility of particles in gases, the particles do not diffuse into each other.

Ans. (i) In gases, the particles are free to move in any direction.

18. Water is the only substance which is commonly found in the solid state, liquid state and gaseous state in nature. Ice, the solid state of water, is less dense and therefore floats on the surface of water. Its melting point is 273 K or 0 °C. When ice melts, it absorbs energy without showing any increase in temperature. This energy is known as latent heat of fusion. The latent heat of fusion of ice is 334 J/g. Thus, particles of water at 273 K possess more energy than particles of ice at 273 K.



I. (a) Why doesn't ice show any increase in temperature while melting?

(b) What is meant by latent heat of fusion?

(c) What causes more cooling – ice at 273 K or water at 273 K?

(d) If ice does not show any increase in temperature when it melts, does water show any increase in temperature when it vapourises?

Ans. (a) Ice doesn't show any increase in temperature while melting because the energy supplied by heat is used in overcoming the forces of attraction between its particles. The temperature of water rises only when the entire ice has melted.

(b) The amount of heat energy required to change 1 kg of a solid into liquid at its melting point is known as latent heat of fusion.

(c) Ice at 273 K causes more cooling than water at the same temperature. This is because particles of water (at 273 K) possess more energy than particles of ice in the form of latent heat of fusion.

(d) When water vapourises, it does not show any increase in temperature. When heat is supplied to water, its particles start moving faster. As they gain sufficient energy to overcome the forces of attraction between them, water starts changing into water vapour. The temperature rises after vapourisation of water is complete.

II. (a) Ice doesn't show any increase in temperature while melting because

(i) the energy supplied by heat is not used in overcoming the forces of attraction between its particles.

(ii) ice being the solid state of water is less denser.

(iii) ice being the solid state of water is more denser.

(iv) the energy supplied by heat is used in overcoming the forces of attraction between its particles.

Ans. (iv) the energy supplied by heat is used in overcoming the forces of attraction between its particles.

(b) Which of the following has highest kinetic energy?

(i) Particles of ice at 0 °C

(ii) Particles of water at 0 °C

(iii) Particles of water at 100 °C

(iv) Particles of steam at 100 °C

Ans. (iv) Particles of steam at 100 °C

(c) The latent heat of fusion can be defined as the

(i) amount of heat required to change 1000 kg of a solid into liquid at its melting posint.

(ii) amount of heat required to change 10 kg of a solid into liquid at its melting point.

(iii) amount of heat required to change 1 kg of a solid into liquid at its melting point.

(iv) amount of heat required to change 100 kg of a solid into liquid at its melting point.

Ans. (iii) amount of heat required to change 1 kg of a solid into liquid at its melting point.

(d) When heat is constantly supplied to boiling water, then the temperature of water during vaporisation

(i) rises very slowly.

(ii) rises rapidly until steam is produced.

(iii) first rises and then becomes constant.

(iv) does not rise at all.

Ans. (iv) does not rise at all.

(e) Ice at 273 K causes more cooling than water at the same temperature because

(i) particles of water possess more energy than particles of ice in the form of latent heat of fusion.

(ii) particles of ice possess more energy than particles of water in the form of latent heat of fusion.

(iii) when ice melts, it releases energy.

(iv) the energy of particles of ice becomes constant.

Ans. (i) particles of water possess more energy than particles of ice in the form of latent heat of fusion.

19. Air is a mixture of different gases. It contains 78 % of nitrogen and 21% oxygen by volume. The remaining 1% consists of gases such as helium, argon and carbon dioxide. Besides these, water vapour is also present in the air. The percentage of water vapour present in the air is variable. It varies from place to place. Thus, coastal areas are more humid as compared to plains. Humidity also depends upon weather conditions. On a rainy day, the amount of water vapour in the air is much higher than on a sunny day. This water vapour results from the evaporation of water from different water bodies and also due to transpiration.

I. (a) How do the forces of attraction between particles of water change when it changes to water vapour?

(b) How does the presence of water vapour in the air affect the rate of evaporation?

(c) Which process would you regard as the opposite of evaporation? Why?

(d) How would you prove the presence of water vapour in the air?

Ans. (a) When water changes into water vapour, the forces of attraction between its particles become weaker.

(b) The air around us can hold only a definite amount of water vapour at a particular temperature. Hence, if the amount of water vapour in the air is high, the rate of evaporation would be low.

(c) In evaporation, a substance changes from the liquid state to the gaseous state. Hence, the opposite of evaporation should be a process in which a substance changes from the gaseous state to the liquid state. This process is known as condensation. Hence, condensation is the opposite of evaporation.

(d) We can prove the presence of water vapour in the air by taking a few ice cubes or some ice-cold water in a tumbler. On coming in contact with the cold surface of the tumbler, the water vapour present in the air would condense on the surface of the tumbler and form water droplets.

II. (a) When water changes into water vapours, the forces of attraction between its particles become

(i) strong.

(ii) weak.

(iii) negligible.

(iv) moderately strong.

Ans. (ii) weak.

(b) Which of the following statements is correct?

(i) If the amount of water vapours in the air is high, the rate of evaporation would be low.

(ii) If the amount of water vapours in the air is high, the rate of evaporation would be high.

(iii) If the amount of water vapours in the air is low, the rate of evaporation would be low.

(iv) The amount of water vapours in the air does not effect the rate of evaporation.

Ans. (i) If the amount of water vapours in the air is high, the rate of evaporation would be low.

(c) Which of the following processes is the opposite of evaporation?

(i) Fusion

(ii) Vaporisation

(iii) Sublimation

(iv) Condensation

Ans. (iv) Condensation

(d) Which of the following statements is incorrect?

(i) The rate of evaporation increases with increase in temperature.

(ii) The rate of evaporation increases with increase in kinetic energy.

(iii) The rate of evaporation decreases with increase in temperature.

(iv) The rate of evaporation increases with increase in surface area.

Ans. (iii) The rate of evaporation decreases with increase in temperature.

(e) Which of the following will help to increase the process of evaporation of a liquid kept in an open china dish?

(i) Keeping the china dish in open.

(ii) Blowing air into the liquid.

(iii) Keeping the china dish under a running fan.

(iv) All of these.

Ans. (iv) All of these.

Very Short Answer Type Questions

20. When salt is dissolved in water, why does the level of water not change?

Ans. When salt is dissolved in water, the level of water does not change because the particles of salt occupy the empty spaces between the particles of water.

21. What is the effect of temperature on diffusion?

Ans. Diffusion increases with increase in temperature because the kinetic energy of particles increases on increasing the temperature.

22. What is the full form of BEC?

Ans. Bose-Einstein Condensate

23. What is the SI unit of temperature?

Ans. Kelvin

24. What is the boiling point of water on Fahrenheit scale?

Ans. Boiling point of water = 100 °C

$$°F = \frac{9}{5}(°C) + 32$$

$$= \frac{9}{5}(100) + 32$$

$$= 212\ °F$$

25. What is the common name of solid carbon dioxide?

Ans. Dry ice

26. What is the amount of water vapour present in air known as?

Ans. Humidity

Short Answer Type-I Questions

27. Convert 212 °F to Celsius scale.

Ans. Relation between Fahrenheit and Celsius scale is as follows:

$$°F = \frac{9}{5}\ (°C) + 32$$

So,

$$°C = (°F - 32) \times \frac{5}{9}$$

$$= (212 - 32) \times \frac{5}{9}$$

$$= 180 \times \frac{5}{9}$$

$$= 100\ °C$$

28. Distinguish between evaporation and sublimation with examples.

Ans.

Evaporation	Sublimation
It is the process in which a liquid changes into vapours at any temperature below the boiling point of the liquid.	It is the process during which a solid on heating changes directly into the vapour phase without passing through the intermediate liquid state.
For example, water present in the wet clothes gets evaporated by absorbing heat from sunlight.	For example, solids like dry ice, camphor, iodine undergo sublimation.

Short Answer Type-II Questions

29. Why does temperature remain constant during melting and boiling?

Ans. The temperature remains constant during melting and boiling because the energy gets used up in changing the state by overcoming the forces of attraction between the molecules. This heat is called latent heat.

30. Why steam at 373 K causes more heating than water at the same temperature?

Ans. The water molecules in steam at 373 K(100°C) have more energy than water at the same temperature. This is because the water molecules in steam have extra energy in the form of latent heat of vaporisation .This is why, steam at 373 K causes more heating and severe burns than water at the same temperature

Long Answer Type Questions

31. (a) Define (i) latent heat of fusion (ii) latent heat of vaporisation.

(b) Why are cotton clothes recommended during summers?

(c) Explain the process of evaporative cooling by perspiration.

Ans. (a) (i) The amount of heat energy required to change 1 kg of a solid into liquid at

atmospheric pressure at its melting point is called the latent heat of fusion. The SI unit of latent heat of fusion is J kg^{-1}.

(ii) The amount of heat energy required to change 1 kg of a liquid into vapour at atmospheric pressure at its boiling point is called the latent heat of vaporisation. The SI unit of latent heat of vaporisation is J kg^{-1}.

(b) Cotton clothes absorbs sweat from the body and exposes it to the atmosphere. This increases the rate of evaporation of sweat and makes us feel cool as well as comfortable during summers.

(c) Perspiration is the insensate loss of moisture from the skin due to evaporation.The human body undergoes evaporative cooling by perspiration even when surrounded by a temperature higher than the body temperature. The cooling effect of evaporative perspiration makes use of a very large latent heat of vaporisation of water. This amount of heat is lost by the body during evaporative perspiration.

32. (a) Change in temperature and pressure determine the state of matter. Comment.

(b) Conversion of solid to vapour is called sublimation. Name the term used to denote the conversion of vapour to solid.

(c) Water as ice has a cooling effect, whereas water as steam may cause severe burns. Explain.

Ans. (a) In solids, liquids and gases, the intermolecular forces of attraction are strong, moderate and weak, respectively. On increasing the temperature (or heating), the speed of particles increases which results in change of state of matter.

On increasing the pressure, the particles of matter come closer and the distance between the particles decreases while the force of attraction between them increases. Hence, increase or decrease in pressure can change the state of matter.

(b) Direct conversion of vapours to solid is also called sublimation.

(c) When ice melts at 0 °C, it absorbs heat equal to the latent heat of fusion from the surroundings. Therefore, at 0 °C, ice has less heat energy than water at 0 °C and hence, ice is more effective in cooling than water at the same temperature. In contrast, when water at 100 °C is converted into steam, it absorbs energy equal to the latent heat of vaporisation. Therefore, steam at 100 °C has more heat energy than water at 100 °C and hence, steam causes more severe burns than boiling water.

33. (a) Solids and liquids are collectively known as condensed phases. Explain.

(b) At what temperature, solid ice and liquid water exist together?

(c) Why are gases compressible but not liquids?

Ans. (a) Solids and liquids are collectively known as condensed phases because they have much smaller interparticle empty space in comparison to gases.

(b) Solid ice and liquid water coexist at the melting point of ice (0°C).

(c) In gases, the constituent particles have large empty space between them as compared to liquids. So, gases have high compressibility.

Let's Compete

(Page 21)

Multiple-Choice Questions

1. During evaporation, the particles of a liquid change to vapours

(a) from the bulk.

(b) from the surface.

(c) from both the surface and bulk.

(d) neither from the surface nor from bulk.

Ans. (b) Evaporation is a surface phenomenon.

2. When ice melts to water, heat is

(a) evolved.

(b) absorbed.

(c) first evolved then absorbed.

(d) evolved or absorbed depending upon the conditions.

Ans. (b) When ice melts to water, heat is absorbed.

3. Which of the following processes takes place at any temperature in case of water?

(a) Sublimation (b) Condensation

(c) Evaporation (d) Boiling

Ans. (b) Condensation

4. A few substances are arranged in the increasing order of forces of attraction between their particles. Which of the following is a correct arrangement?

(a) Water, air, wind (b) Oxygen, water, sugar

(c) Salt, juice, air (d) Air, sugar, oil

Ans. (b) Oxygen < water < sugar

Increasing order of forces of attraction between the particles: gas < liquid < solid

5. Which of the following statements regarding the interparticle distance in matter is correct?

(a) The interparticle distance is directly proportional to the interparticle attractive force.

(b) The interparticle distance is inversely proportional to the interparticle attractive force.

(c) The interparticle distance in solids is maximum.

(d) The interparticle distance in gases is minimum.

Ans. (b) The interparticle distance is inversely proportional to the interparticle attractive force.

6. The melting point of ice is a temperature at which

(a) no water nor ice is present.

(b) only water is present.

(c) only ice is present.

(d) first ice and then only water is present.

Ans. (a) no water nor ice is present.

7. In which of the following conditions, the distance between the molecules of H_2 gas would increase?

(i) Adding more H_2 gas to the container without increasing the volume of the container.

(ii) Increasing the volume of the container of H_2 gas.

(iii) Causing some H_2 gas to leak out of the container.

(iv) Increasing pressure on H_2 gas contained in a closed container.

(a) (i) and (iii) (b) (ii) and (iii)

(c) (i) and (iv) (d) (ii) and (iv)

Ans. (b) (ii) and (iii)

8. Which one of the following substances has the strongest interparticle forces of attraction?

(a) Glycerine

(b) Sodium chloride

(c) Ethyl alcohol

(d) Sulphur dioxide

Ans. (b) Sodium chloride

9. Which of the following indicates the relative randomness of particles in the three states of matter?

(a) Gas > liquid > solid (b) Liquid > gas > solid

(c) Liquid < solid < gas (d) Solid > liquid > gas

Ans. (a) Gas > liquid > solid

10. What happens to the kinetic energy of the particles when heat is supplied to the solid object at its melting point?

(a) The kinetic energy of the particles remains constant.

(b) The kinetic energy of the particles decreases.

(c) The kinetic energy of the particles increases.

(d) None of these.

Ans. (a) The kinetic energy of the particles remains constant.

Value-based Questions

(Optional) (Page 21)

1. While determining the boiling point of water in the laboratory, the beaker containing hot water accidentally fell on the hand of a student. A fellow student immediately put cold water on his hand and then placed ice cubes. He then took the student to the school dispensary for giving him first aid.

(a) Define boiling point.

(b) Why does temperature remain constant during boiling?

(c) How does boiling differ from evaporation?

(d) State the values displayed by the fellow student.

Ans. (a) The temperature at which a liquid changes into a gas (or vapour) is called the boiling point of a liquid.

(b) The heat supplied to the substance during boiling is used up in changing the state by overcoming the intermolecular forces of attraction between the molecules. Hence, it does not cause a rise in temperature and temperature remains constant during boiling.

(c) Differences between boiling and evaporation

Boiling	Evaporation
It occurs fast.	It occurs slow.
Bubbles are formed during boiling.	No bubbles are formed during evaporation.
It is a bulk phenomenon.	It is a surface phenomenon.
It occurs at a definite temperature, i.e. boiling point.	It can occur at any temperature.
Source of energy is needed.	Energy is supplied by surroundings.

(d) Care for others, scientific temperament, etc.

2. While organising the bottles containing various chemicals in the reagent racks, a student accidentally spilled a bottle of ammonia on the floor of the laboratory. The whole laboratory was soon filled with pungent irritating odour of ammonia and white fumes were formed in the laboratory. A fellow student immediately opened the doors and windows and switched on the exhaust fans. The teacher asked all the students to move out of the laboratory in a line and then to wash their eyes with water.

(a) Name the phenomenon which led the spreading of pungent odour of ammonia in the whole laboratory.

(b) Write the composition of the white fumes.

(c) Suggest any precaution which is needed in the laboratory.

(d) State the values demonstrated by the fellow student and teacher.

Ans. (a) Diffusion

(b) NH_3

(c) Always be alert, handle all the chemicals carefully, etc.

(d) Alertness, scientific temperament, care for others, etc.

3. Deepti went to her village located in mountains during the summer vacation. She observed her aunt was cooking in open vessels, which took longer time. So, she advised her to use pressure cooker for cooking.

(a) Why does cooking in open vessels take longer time in mountains?

(b) What is the advantage of cooking in pressure cooker as compared to open vessels?

(c) State the values displayed by Deepti.

Ans. (a) On mountains, the atmospheric pressure is less and hence water boils at below 100 °C. So, less heat is provided to the vessels in a given time and hence, open vessels take longer time for cooking.

(b) The pressure within the pressure cooker is higher than atmospheric pressure and hence water boils at much higher temperature than 100 °C. So, more heat is provided in a given time and hence, it takes less time for cooking.

(c) Care for others, sharing knowledge, scientific temperament, etc.

2

Is Matter Around Us Pure?

Checkpoint (Page 24)

1. Are most of the substances around us pure substances or mixtures?

Ans. Mixtures.

2. Which method will you use to separate water and sugar?

Ans. Evaporation.

3. Name two substances that are soluble and two that are insoluble in water.

Ans. Sugar and salt are soluble while wood and sand are insoluble in water.

4. A saturated solution of sugar in water is heated. Is it possible to dissolve more sugar in it?

Ans. Yes

5. Can all physical changes be reversed?

Ans. No

6. Is changing of milk into curd a reversible change?

Ans. No

7. Which method is used to convert water vapour into its liquid form?

Ans. Condensation

8. Is burning of wood an irreversible change?

Ans. Yes

9. Can we consider air as a pure substance?

Ans. No, it is a mixture of many substances.

10. Which method will you use to separate stones from grains?

Ans. Hand-picking

Milestone 1

(Page 29)

Multiple-Choice Questions

1. Which of the following is not a homogeneous mixture?

(a) Solution of salt in water

(b) Smoke

(c) Brass

(d) Solution of sugar in water

Ans. (b) Smoke

2. The most 'abundant' element in earth's crust is

(a) carbon. (b) phosphorus.

(c) oxygen. (d) nitrogen.

Ans. (c) oxygen.

3. Which of the following is a mixture?

(a) Sugar (b) Water

(c) Blood (d) Glucose

Ans. (c) Blood

4. Which of the following is not a metalloid?

(a) Silicon (b) Arsenic

(c) Gallium (d) Germanium

Ans. (c) Gallium

5. Which of the following is not a heterogeneous mixture?

(a) Smoke (b) Rock

(c) Cement (d) Vinegar

Ans. (d) Vinegar

6. Which of the following is not a metal?

(a) Copper (b) Silver

(c) Lead (d) Iodine

Ans. (d) Iodine

7. A pure substance can be

(a) an element only.

(b) a compound only.

(c) either an element or a compound.

(d) any substance.

Ans. (c) either an element or a compound.

8. Which of the following is not a compound?

(a) Sugar

(b) Washing soda

(c) Quick lime

(d) Brass

Ans. (d) Brass

Very Short Answer Type Questions

9. Pick the odd one out from the following:
sugar, coal, milk, honey, bronze.

Ans. Sugar

10. Air is an example of which type of mixture?

Ans. Heterogeneous mixture

11. Give the names of the most abundant and the rarest elements in the earth's crust.

Ans. The most abundant element in the earth's crust is oxygen and the rarest element in the earth's crust is astatine.

12. What are the substances made up of only one type of particles called?

Ans. Elements

13. Name a metal which is liquid at room temperature.

Ans. Mercury

14. Blood is an example of which type of mixture?

Ans. Heterogeneous mixture

15. Pick the odd one out from the following:
steam, diamond, silver, nitrogen.

Ans. Steam

Short Answer Type-I Questions

16. Classify the following as elements, mixtures or compounds:

(a) steel (b) butter

(c) ice (d) curry powder

(e) seawater (f) sugar cane juice

Ans. (a) mixture (b) mixture

(c) compound (d) mixture

(e) mixture (f) mixture

17. Identify the elements from the following:

(a) sugar (b) steam

(c) neon (d) chromium

(e) molybdenum (f) coal

Ans. neon, chromium, molybdenum

18. What are metalloids? Give any two examples.

Ans. The elements which exhibit the properties of both metals and non-metals are called metalloids. They are also known as semi-metals. Silicon and germanium are the examples of metalloids.

Short Answer Type-II Questions

19. Classify the following as homogeneous and heterogeneous mixtures:

(a) aqueous solution of salt

(b) blood

(c) milk

(d) sand-sugar mixture

(e) sulphur-ammonium chloride mixture

(f) iodised salt

Ans. (a) aqueous solution of salt – homogeneous mixture

(b) blood – heterogeneous mixture

(c) milk – heterogeneous mixture

(d) sand-sugar mixture – heterogeneous mixture

(e) sulphur-ammonium chloride mixture – heterogeneous mixture

(f) iodised salt – heterogeneous mixture

20. State three differences between homogeneous and heterogeneous substances.

Ans.

Homogeneous substances	Heterogeneous substances
A substance which has a uniform composition throughout its mass is called a homogeneous substance.	A substance which does not have a uniform composition throughout its mass is called a heterogeneous substance.
The components of a homogeneous substance cannot be seen distinctly in the substance.	The components of a heterogeneous substance can be seen distinctly in the substance.
For example, a mixture of sugar in water, salt in water, etc.	For example, muddy water, dusty air, etc.

21. Differentiate between elements and mixtures.

Ans.

Element	Mixture
An element is homogeneous as it is made up of only one kind of atoms.	A mixture can be homogeneous or heterogeneous.
An element has a fixed chemical composition.	Mixtures do not have a fixed chemical composition.
An element has definite physical properties such as melting point, boiling point, etc.	A mixture does not have definite physical properties.

Long Answer Type Questions

22. Write any five properties of metals and non-metals.

Ans. Five properties of metals and non-metals are as follows:

i. Metals are malleable and ductile, i.e. they can be hammered into thin sheets and drawn into wires while non-metals are not malleable and ductile.

ii. Metals are generally silver-grey or golden-yellow in appearance while non-metals have different colours.

iii. Metals are sonorous as they produce a ringing sound when beaten while non-metals are not sonorous.

iv. Metals are good conductors of heat and electricity while except graphite, non-metals are poor conductors of heat and electricity.

v. Metals are lustrous, i.e. they have shining surfaces while non-metals are not lustrous.

23. Explain and give one example of each of the following mixtures.

(a) Solid in solid
(b) Solid in liquid
(c) Solid in gas
(d) Liquid in solid
(e) Gas in gas

Ans. (a) Mixture of sand and ammonium chloride
(b) A mixture of chalk powder in water
(c) Camphor in nitrogen gas
(d) Mixture of mercury in amalgamated zinc
(e) Air is a mixture of gases such as nitrogen, oxygen, argon and carbon dioxide.

Milestone 2

(Page 34)

Multiple-Choice Questions

1. Which of the following is not a colloidal solution?

(a) Milk (b) Ink
(c) Soda water (d) Blood

Ans. (c) Soda water

2. The colloidal particles can be seen through

(a) a simple microscope.
(b) a powerful microscope.
(c) the naked eye.
(d) a magnifying glass.

Ans. (b) a powerful microscope.

3. Which of the following is a colloid?

(a) Sugar solution (b) Saline water
(c) Smoke (d) Coloured glass

Ans. (c) Smoke

4. What is a liquid in liquid colloid known as?

(a) Aerosol (b) Foam
(c) Emulsion (d) Gel

Ans. (c) Emulsion

5. When a beam of light is passed through a colloidal solution, the light is

(a) absorbed. (b) scattered.
(c) refracted. (d) reflected.

Ans. (b) scattered.

6. Which of the following will show Tyndall effect?

(a) Salt solution
(b) Milk
(c) Tap water
(d) Copper sulphate solution

Ans. (b) Milk

Very Short Answer Type Questions

7. What is the formula for calculating mass by mass percentage of a solution?

Ans. The formula for calculating mass by mass percentage of a solution is $\frac{\text{mass of solute}}{\text{mass of solution}} \times 100$.

8. What is the nature of the solution formed by mixing mustard oil and water?

Ans. It is a colloidal solution known as emulsion.

9. Which type of colloid is foam?

Ans. Foam is a colloid in which gas particles are trapped in a liquid.

10. What is the colloid of a liquid in a gas called?

Ans. Aerosol

11. What is the zig-zag random movement of particles of colloidal solution called?

Ans. Brownian movement

12. Does a true solution exhibit Tyndall effect?

Ans. No

13. Give an example of solid aerosol.

Ans. Dust-storm

Short Answer Type-I Questions

14. A solution is prepared by dissolving 18.0 g of sugar in 520 g of water. What is the mass percentage of solute in the solution?

Ans. Mass of solution = mass of solute + mass of solvent

= 18 + 520 = 538 g

Mass by mass percentage of sugar in the solution

$$= \frac{18.0\ g}{538\ g} \times 100$$

= 3.35% (*m*/*m*)

15. 18-carat gold contains 18 parts of gold and 6 parts of copper by mass. Calculate the concentration of gold and copper in it in % (*m*/*m*).

Ans. Mass percentage of gold

$$= \frac{18 \text{ parts of gold}}{18 \text{ parts of gold} + 6 \text{ parts of copper}} \times 100$$

$$= \frac{18}{24} \times 100 = 75\ \%$$

Similarly, mass percentage of copper $= \frac{6}{24} \times 100$

= 25 %

So, the concentration of gold is 75 % (*m*/*m*) and copper is 25 % (*m*/*m*).

16. What is meant by aerosol? Give an example of aerosol.

Ans. The colloidal solution of a solid or liquid in gas is called aerosol. Fog is an example of aerosol.

Short Answer Type-II Questions

17. A solution of potassium chloride in water is 35 % (*m*/*v*). The density of the solution is 1.2 g mL^{-1}. Calculate the concentration of the solution in % (*m*/*m*).

Ans. Mass by volume percentage of KCl = 35%

This means that 35 g of KCl is dissolved in 100 mL of solution.

So, mass of KCl (solute) = 35g, and

Volume of solution = 100 mL

Now, $\text{density} = \frac{\text{mass}}{\text{volume}}$

$$1.2 = \frac{\text{mass of solution}}{100}$$

Mass of solution = 120 g

Concentration of solution in % (*m*/*m*)

$$= \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

$$= \frac{35\ g}{120\ g} \times 100 = 29.16\%\ (m/m)$$

18. How are solution and suspension different from each other? Explain with the comparison of different features.

Ans. Comparison of different features of a solution and a suspension:

Property	Solution	Suspension
Nature	Homogeneous	Heterogeneous
Particle size	< 10^{-9} m	> 10^{-6} m
Appearance	Transparent	Translucent to opaque
Visibility	Particles are not visible with naked eyes.	Particles are visible with naked eyes.
Filterability	Particles can pass through filter paper and parchment paper.	Particles do not pass through parchment or filter paper.
Tyndall effect	Tyndall effect is not observed.	Tyndall effect may be observed.

19. Give examples of colloids having

(a) dispersed phase gas and dispersion medium solid.

(b) dispersed phase solid and dispersion medium also solid.

(c) dispersed phase liquid and dispersion medium gas.

Ans. (a) Colloids having dispersed phase gas and dispersion medium solid are solid foam. Rubber, sponge and marshmallow are the examples of solid foam.

(b) Colloids having dispersed phase solid and dispersion medium also solid are solid sol. pearls, opals and ruby are the examples of solid sol.

(c) Colloids having dispersed phase liquid and dispersion medium gas are aerosol. Sprays, clouds and fog are the examples of aerosol.

20. Write the solute and solvent for the following mixtures.

(a) Tincture of iodine

(b) Soda water

(c) Sugar solution

Ans. (a) Solute = iodine, solvent = alcohol

(b) Solute = carbon dioxide gas, solvent = water

(c) Solute = sugar, solvent = water

Long Answer Type Questions

21. Describe the properties of a colloidal solution.

Ans. The properties of colloids are:

i. Colloids are heterogeneous mixtures.

ii. The size of particles of a colloid is too small to be individually seen by naked eyes.

iii. Colloids are big enough to scatter a beam of light passing through it and make its path visible.

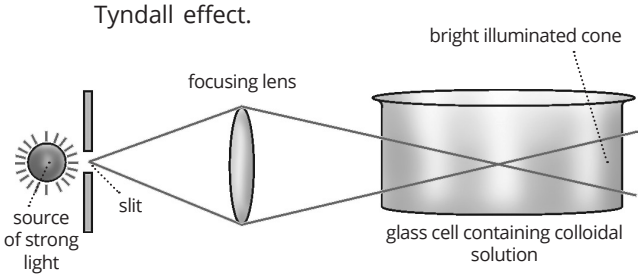
iv. Colloidal particles are stable and do not settle down when left undisturbed.

v. The colloidal particles cannot pass through animal membrane or parchment paper.

22. (a) What is Tyndall Effect? Explain with the help of a diagram.

(b) Which type of mixtures can show this effect? Do solutions also show Tyndall effect?

Ans. (a) The phenomenon of scattering of light by colloidal particles as a result of which the path of the beam of light becomes visible is called Tyndall effect.



Tyndall effect

(b) Colloidal solution and suspension show Tyndall effect. Solutions do not show Tyndall effect.

Milestone 3

(Page 41)

Multiple-Choice Questions

1. What is the order of the method applied to separate the components of a mixture of salt, sand and ammonium chloride?

(a) Dissolving in water, filtration, evaporation and sublimation

(b) Dissolving in water, evaporation and sublimation

(c) Sublimation, dissolving in water, filtration and evaporation

(d) Moving a magnet, dissolving in water and sublimation

Ans. (c) Sublimation, dissolving in water, filtration and evaporation

2. Rusting of an article made up of iron is called

(a) dissolution and it is a chemical change.

(b) dissolution and it is a physical change.

(c) corrosion and it is a chemical change.

(d) corrosion and it is a physical change.

Ans. (c) corrosion and it is a chemical change.

3. A mixture of milk and vegetable oil can be separated by

(a) using a separating funnel.

(b) condensation.

(c) filtration.

(d) sublimation.

Ans. (a) using a separating funnel.

4. Which of the following is not a chemical change?

(a) Digestion of food

(b) Photosynthesis

(c) Dyeing of a cloth

(d) Breaking a glass beaker

Ans. (d) Breaking a glass beaker

5. Which of the following is not a physical change?

(a) Drying of milk to get milk powder

(b) Sublimation of iodine

(c) Dissolution of sugar in tea

(d) Burning of wood

Ans. (d) Burning of wood

6. To a mixture of sulphur, iron filings, carbon and potassium chloride taken in a test tube, water was added. The mixture was shaken thoroughly and filtered. The filtrate would contain

(a) iron filings. (b) carbon.

(c) sulphur. (d) potassium chloride.

Ans. (d) potassium chloride.

7. The best method to separate the components of an ink is

(a) chromatography. (b) evaporation.

(c) sublimation. (d) filtration.

Ans. (a) chromatography.

Very Short Answer Type Questions

8. Which type of change is sublimation – physical or chemical?

Ans. Physical

9. A mixture of magnetic and non-magnetic substances is separated by which process?

Ans. Magnetic separation

10. How is a pure solid obtained in the form of crystals from its saturated solution?

Ans. Crystallization

11. The insoluble solid in a solvent is separated by which method?

Ans. Filtration

12. Is burning of wax a physical change or a chemical change?

Ans. Chemical change

13. What will happen if the colloidal solution of sulphur is centrifuged in a centrifugal machine for some time?

Ans. If the colloidal solution of sulphur is centrifuged in a centrifugal machine for some time, a yellow precipitate of sulphur will settle down at the bottom of the tube and the solution will become colourless.

14. Which separation technique can be used to separate a mixture of oil and water?

Ans. Separating funnel

Short Answer Type-I Questions

15. Which method can be used to separate heavy insoluble solids form a liquid?

Ans. The heavy insoluble solid constituent of a mixture can be separated from its liquid constituent by leaving the mixture undisturbed for some time. This allows the solid to settle down and this process is known as sedimentation. The clear liquid that remains above is separated by simply pouring it out. This process is called as decantation.

16. Write any two applications of centrifugation.

Ans. i. In diagnostic laboratories during blood and urine tests.

ii. In separating water from wet clothes in washing machines.

17. Define simple distillation.

Ans. The conversion of a liquid into vapours by heating followed by condensation of the vapours to obtain the pure liquid is called simple distillation.

Short Answer Type-II Questions

18. Burning of a candle involves both physical and chemical changes. How?

Ans. When a candle is burnt, the following two changes occur simultaneously :

i. melting of wax

ii. burning of thread and wax.

The melting of wax is a physical change whereas the burning of thread and wax is a chemical change.

19. Cutting and burning of wood involve two different types of changes. Identify the changes and justify your answer.

Ans. Cutting of wood is a physical change and it is reversible. In this change, no new substance is formed. On the other hand, burning of wood is a chemical change as it produces carbon dioxide gas, water vapour and ash. Also, this change cannot be reversed.

20. When naphthalene balls are kept inside cotton and woollen clothes in an almirah, the naphthalene balls disappear slowly. Is it a physical change or a chemical change? Give reasons.

Ans. Naphthalene balls undergo sublimation under normal conditions of temperature and pressure and are slowly converted into vapour. Since the disappearance of naphthalene balls involves a change of state from solid to vapour, it is a physical change.

Long Answer Type Questions

21. Tabulate the differences between physical and chemical changes.

Ans.

Physical change	Chemical change
Physical changes are generally temporary.	Chemical changes are generally permanent.
Physical changes are generally reversible.	Chemical changes are irreversible.
In physical changes, no new substance is formed.	In chemical changes, one or more new substances are formed.
In physical changes, no change occurs in the mass of a substance undergoing the change.	The chemical composition, mass and the chemical properties of the substance undergoing a chemical change get completely changed.
Energy change does not occur in physical changes.	Energy change occurs in chemical changes.

22. Name the process used for the separation of

(a) benzene (Boiling point = 80 °C) and toluene (Boiling point = 110 °C).

(b) common salt from a solution of common salt and water.

(c) a mixture of water and alcohol.

(d) powdered sulphur and carbon particles.

(e) iodine from a mixture of iodine and ammonium chloride.

Ans. (a) Fractional distillation

(b) Evaporation

(c) Distillation

(d) Dissolution of sulphur in CS_2 followed by filtration and evaporation.

(e) Dissolution of iodine in ethyl alcohol, filtration and evaporation.

Higher Order Thinking Skills (HOTS) Questions

(Page 43)

1. Is the separation by chromatography restricted to only coloured compounds? Give reasons.

Ans. No, chromatography is not restricted to only coloured compounds but it has a wide range of uses. It is used in separation of organic mixtures, determination of impurities in drugs and drug products, to test the purity of compounds, forensic analysis, etc.

2. How will you separate the components of gunpowder which is a mixture of charcoal, sulphur and nitre (potassium nitrate)?

Ans. Nitre is soluble in water and sulphur is soluble in CS_2 while charcoal is insoluble in both the two solvents. This information can be used for separating the components of gunpowder.

3. During an experiment the students were asked to prepare a 10 % (mass/mass) solution of sugar in water. Lokesh dissolved 10 g of sugar in 100 g of water while Shabnam prepared it by dissolving 10 g of sugar in water to make 100 g of the solution.

(a) Are the two solutions of the same concentration?

(b) Compare the mass % of the two solutions.

Ans. (a) No, the two solutions do not have the same concentration.

(b) Mass percentage of solution prepared by Lokesh

$$= \frac{\text{mass of solute}}{\text{mass of solute + mass of solvent}} \times 100$$

$$= \frac{10\ \text{g}}{10\ \text{g} + 100\ \text{g}} \times 100$$

$$= 9.09\ \text{g}$$

$$= 9.09\ \%\ (m/m)$$

Mass percentage of solution prepared by Shabnam

$$= \frac{10\ \text{g}}{100\ \text{g}} \times 100$$

$$= 10\ \text{g} = 10\ \%\ (m/m)$$

The solution prepared by Shabnam has more percentage by mass than that of Lokesh.

4. A housewife churned full cream milk with a churner.

(a) What will she observe after churning the milk?

(b) What could be the possible reason for the observation?

Ans. (a) After churning the milk, lighter particles of cream will move upwards and collect at the top. Heavier residual particles will remain at the bottom.

(b) This is a very common process used to separate cream from milk. This process is known as centrifugation.

Self-Assessment

(Page 43)

Multiple-Choice Questions

1. Which one of the following is not a pure substance?

(a) Milk (b) Sodium chloride

(c) Hydrogen (d) Helium

Ans. (a) Milk

2. Which of the following statements about mixtures is true?

(a) A mixture has a definite composition.

(b) Components of mixtures can be separated by physical processes.

(c) Mixtures are only homogeneous in nature.

(d) Mixtures are pure substances.

Ans. (b) Components of mixtures can be separated by physical processes.

3. Which of the following is an emulsion?

(a) Mist (b) Sponge

(c) Face cream (d) Mud

Ans. (c) Face cream

4. Which of the following is not an element?

(a) Sulphur (b) Potassium

(c) Boron (d) Glucose

Ans. (d) Glucose

5. Which of the following exist as liquid at room temperature?

(a) Lead (b) Mercury

(c) Copper (d) Silver

Ans. (b) Mercury

Assertion–Reason Type Questions

For question numbers 6 to 15, two statements are given – one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of the assertion.

(b) Both A and R are true but R is not the correct explanation of the assertion.

(c) A is true but R is false.

(d) A is false but R is true.

6. **Assertion:** A solution does not scatter a beam of light passing through it.

Reason: Size of particles is very small in a solution.

Ans. (a) Particles of colloids and fine suspensions are big enough to scatter light. However, particles of a solution are very small in size (smaller than 1 nm in diameter). Hence, when a beam of light passes through a solution, its path is not visible.

7. **Assertion:** When common salt is added to its saturated solution in water, the salt accumulate at the bottom of the solution.

Reason: A saturated solution cannot dissolve more solute at a particular temperature.

Ans. (a) At a given temperature, a saturated solution cannot dissolve more quantity of the solute. When excess salt is added to a saturated solution, the salt is accumulated at the bottom of the beaker.

8. **Assertion:** When a suspension of chalk powder in water is left undisturbed for some time, it does not scatter light.

Reason: Suspension is a homogeneous mixture.

Ans. (c) A suspension is a heterogeneous mixture. Particles of a suspension are big enough to scatter light. When a suspension of chalk powder in water is left undisturbed for some time, its particles settle at the bottom of the mixture. This breaks the suspension and it does not scatter light.

9. **Assertion:** Cranes fitted with electromagnets are used to separate scrap iron from waste material.

Reason: Iron is a magnetic material.

Ans. (a) Iron is a magnetic material and iron objects are attracted by a magnet, while the non-magnetic materials are left behind. Hence, in scrapyards, cranes are fitted with electromagnets to separate scrap iron from waste material.

10. **Assertion:** Particles of a colloid cannot be separated by filtration.

Reason: Size of the particles of a colloid is bigger than the particles of a suspension.

Ans. (c) Particles of a colloid are bigger than the particles of a solution but smaller than the particles of a suspension. Thus, particles of a colloid cannot be separated by filtration. However, they can be separated by centrifugation.

11. **Assertion:** When a mixture of kerosene oil and water is allowed to stand in a separating funnel, water forms the lower layer while kerosene oil forms the upper layer.

Reason: Kerosene oil is denser than water.

Ans. (c) Kerosene oil and water are immiscible liquids. When they are mixed, two separate layers are formed. So, when a mixture of kerosene oil and water is allowed to stand in a separating funnel, water forms the lower layer while kerosene oil forms the upper layer. Water being denser than kerosene oil, forms the lower layer, while kerosene oil forms the upper layer.

12. **Assertion:** Gases can be separated from liquefied air by simple distillation.

Reason: The difference between the boiling points of different gases present in the air is lesser than 25 K.

Ans. (d) Gases present in the air are separated by fractional distillation of the liquefied air. Boiling points of the gases present in the air are very close. Hence, simple distillation is not suitable for separating these gases.

13. **Assertion:** Melting of ice is a physical change.

Reason: Interconversion among different states of matter is a chemical change.

Ans. (c) Interconversion among different states of matter is a physical change because it does not change the chemical composition of a substance. In melting, a substance changes

from the solid state to the liquid state. Thus, melting of ice is a physical change.

14. **Assertion:** Electric wires are made of copper and aluminium.

Reason: Metals are malleable materials.

Ans. (b) Copper and aluminium (metals) are good conductors of heat and electricity, because of which they are used in making electric wires and cables. Malleability is the ability of a material to be beaten into thin sheets. Since metals are malleable, they can be beaten into foils and sheets.

15. **Assertion:** 24 carat gold is not suitable for making jewellery.

Reason: Pure gold is very soft.

Ans. (a) Pure gold is 24 carat gold. It is very soft and therefore not suitable for making jewellery. Hence, gold is first alloyed with copper or silver and then it is used for making jewellery.

Source-based/Case-based/Passage-based/ Integrated assessment questions

Answer the questions on the basis of your understanding of the following passages and the related studied concepts. (any four)

16. Anything that occupies space and has mass is called matter. Matter can be classified on the basis of physical properties and chemical nature. On the basis of physical properties, matter is classified as solids, liquids and gases. These three are the most commonly found states of matter. On the basis of chemical nature, matter is classified as pure substances and mixtures. Mixtures can either be homogeneous or heterogeneous. Pure substances, on the other hand, are classified as elements and compounds.

I. (a) What are homogeneous and heterogeneous mixtures? Give examples.

(b) State the difference between mixtures and compounds.

(c) How are elements different from compounds?

(d) Would you classify caustic soda as an element or a compound? Give reasons to support your answer.

Ans. (a) A mixture which has a uniform composition and properties throughout its mass is known as a homogeneous mixture. A mixture of common salt in water is an example of a homogeneous mixture. On the other hand, a mixture which does not have a uniform composition throughout its mass is a heterogeneous mixture. A mixture of sand in water is an example of a heterogeneous mixture.

(b) The differences between a compound and mixture are as follows:

Compound	Mixture
A compound is formed when two or more elements (or compounds) combine together in a fixed proportion by mass.	A mixture is formed when two or more elements or compounds combine together in any proportion.
A compound has a fixed chemical composition.	A mixture does not have a fixed chemical composition.
A compound has its own distinct properties.	A mixture exhibits the properties of its components.

(c) An element is the basic form of matter which cannot be broken down into simpler substances by chemical reactions. On the other hand, a compound is a pure substance formed when two or more elements combine in a fixed proportion by mass. Silver, gold and carbon are examples of elements while carbon dioxide and water are examples of compounds.

(d) Caustic soda is sodium hydroxide. It is formed when sodium, oxygen and hydrogen combine in a fixed proportion by mass. Thus, it has a fixed chemical composition. Also, its properties are different from that of its constituent elements. Hence, caustic soda is a compound.

II. (a) Which of the following is not a characteristic of pure substances?

(i) Pure substances are made up of only one type of particles.

(ii) Pure substances have variable compositions.

(iii) Pure substances are perfectly homogeneous.

(iv) Pure substances have definite melting and boiling points.

Ans. (ii) Pure substances have variable compositions.

(b) The simplest form of matter that cannot be broken down further into simpler substances by chemical methods is a/an

(i) mixture.

(ii) compound.

(iii) element.

(iv) alloy.

Ans. (iii) element.

(c) Which of the following is a heterogeneous mixture?
(i) Mixture of acetic acid and water
(ii) Mixture of ethanol and water
(iii) Mixture of acetone and water
(iv) Mixture of kerosene oil and water

Ans. (iv) Mixture of kerosene oil and water

(d) Which of the following statements is incorrect?
(i) The constituents of a compound cannot be separated by simple physical methods.
(ii) A mixture does not have a fixed chemical composition.
(iii) A mixture exhibits the properties of its components.
(iv) A compound does not have a fixed chemical composition.

Ans. (iv) A compound does not have a fixed chemical composition.

(e) Which of the following is not a homogeneous mixture?
(i) Mixture of sodium chloride and water
(ii) Mixture of sugar and water
(iii) Mixture of glucose and water
(iv) Mixture of clay and water

Ans. (iv) Mixture of clay and water

17. Brass is an alloy of copper and zinc. It is one of the principal alloys of copper, the other being bronze. The composition of brass is not fixed and depends upon the purpose for which it is to be used. It has a wide range of uses and it possesses many desirable properties such as high malleability, strength and good resistance to corrosion. It is used for making musical instruments, locks, gears, doorknobs, marine hardware and has many other applications. Because it has gold-like appearance, it is also used in making decorative material.

I. (a) What is an alloy?

(b) Would you classify brass as a pure substance? Give reasons to support your answer.

(c) What are the constituents of the other principal alloy of copper mentioned in the given paragraph?

(d) It is mentioned in the given paragraph that brass has high malleability. What is meant by malleability?

Ans. (a) An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal.

(b) Since brass is an alloy of copper and zinc, it is a mixture and not a pure substance. A pure substance is composed of only one type of particles. Brass, on the other hand, is composed of particles of copper and zinc.

(c) The other alloy of copper mentioned in the paragraph is bronze. Bronze is an alloy of copper and tin.

(d) Malleability is the ability of material to be beaten into thin sheets. Metals are malleable in nature.

II. (a) Brass is an alloy of copper and zinc. It can be classified as
(i) a pure substance.
(ii) a mixture.
(iii) a compound.
(iv) none of these.

Ans. (ii) a mixture.

(b) Which of the following is not a correct statement?
(i) Alloys are the mixtures of two or more metals or a metal and a non-metal.
(ii) The components of an alloy cannot be separated by any physical method.
(iii) Alloys can have variable compositions.
(iv) The components of an alloy can be separated by any physical method.

Ans. (iv) The components of an alloy can be separated by any physical method.

(c) The ability of a material to be beaten into thin sheets is
(i) corrosion.
(ii) ductility.
(iii) malleability.
(iv) resistivity.

Ans. (iii) malleability.

(d) Bronze is an alloy of
(i) copper and zinc.
(ii) copper and tin.
(iii) iron and aluminium.
(iv) iron and chromium.

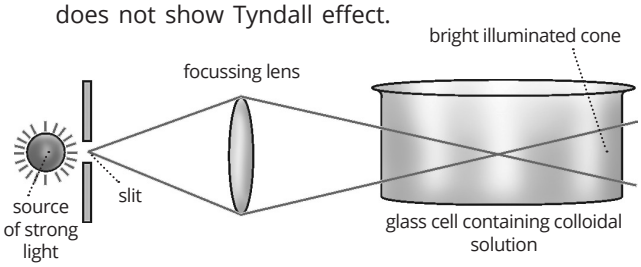
Ans. (ii) copper and tin.

(e) A substance which is made up of two or more elements chemically combined together in a definite proportion by mass is known as a/an
(i) alloy.
(ii) compound.
(iii) homogeneous mixture.
(iv) heterogeneous mixture.

Ans. (ii) compound.

18. When a beam of light is allowed to pass through a mixture of water and milk, the path of light becomes visible. This is due to the scattering of light by the particles of milk. This phenomenon

is known as Tyndall effect (named after an Irish physicist, John Tyndall). Tyndall effect is shown by colloids and fine suspensions. Solution, however, does not show Tyndall effect.



I. (a) List any two characteristics of a colloid.

(b) Compare the particle size in colloids with particle size in solutions.

(c) Why solutions do not show Tyndall effect?

(d) A suspension of chalk powder is left undisturbed for some time. When a beam of light is allowed to pass through it, will it show Tyndall effect?

Ans. (a) Two properties of a colloid are:

(i) A colloid is a heterogeneous mixture.

(ii) They do not settle down when left undisturbed.

(b) In solutions, the particles are very small in size. Their size is lesser than 1 nm in diameter. Particles of a colloid are bigger than the particles of a solution. Their size ranges from 1 nm to 1000 nm.

(c) Tyndall effect is the scattering of light by the particles of a colloid or fine suspension. Since particles of a solution are very small in size (< 1 nm in diameter), they do not scatter light.

(d) A mixture of chalk powder in water is a suspension. When left undisturbed for some time, the particles of chalk powder, being heavier, settle down at the bottom of the mixture. This breaks the suspension and it will not show Tyndall effect.

II. (a) Which of the following statements is incorrect regarding the characteristics of colloids?

(i) The size of colloidal particles is smaller than the size of pores of a filter paper.

(ii) The particles in a colloidal solution are not visible to the naked eye.

(iii) Colloidal solution is homogeneous in nature.

(iv) The colloidal solutions in water are called hydrosols.

Ans. (iii) Colloidal solution is homogeneous in nature.

(b) Solutions do not show Tyndall effect because

(i) the particles of a solution are very small in size.

(ii) the particles of a solution are very large in size.

(iii) the particles of a solution can easily scatter light.

(iv) they are heterogeneous in nature.

Ans. (i) the particles of a solution are very small in size.

(c) Colloidal solutions exhibit Tyndall effect. Their particle size ranges from

(i) 10^{9} to 10^{6} m. (ii) 10^{-9} to 10^{-6} m.

(iii) 10^{-2} to 10^{-4} m. (iv) 10^{2} to 10^{4} m.

Ans. (ii) 10^{-9} to 10^{-6} m.

(d) What is the random zig-zag motion of colloidal particles called?

(i) Tyndall effect

(ii) Rayleigh's scattering

(iii) Brownian movement

(iv) Adsorption

Ans. (iii) Brownian movement

(e) In emulsions, the dispersed phase and the dispersion medium are in

(i) liquid state.

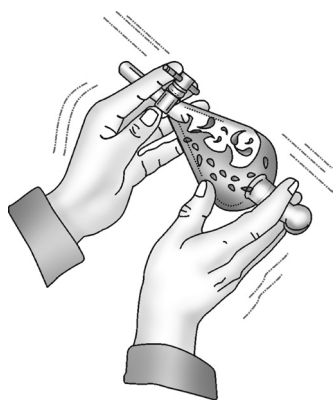
(ii) solid state.

(iii) liquid state and solid state, respectively.

(iv) solid state and liquid state, respectively.

Ans. (i) liquid state.

19. A separating funnel is a cone-shaped laboratory equipment, usually made up of glass. It is used for separating a mixture of two immiscible liquids. It is a very useful piece of equipment used in analytical labs for separating the components of a mixture and for extraction purposes. Sometimes, pressure may build up inside the funnel while using some volatile organic solvents. This pressure can be released by simply opening the stopper from time to time.



I. (a) What are immiscible liquids?

(b) What is the principle on which a separating funnel works?

(c) A mixture of two immiscible liquids, A and B, is taken in a separating funnel. The density of liquid A is 1 g/mL, while that of liquid B is 0.822 g/mL. When this mixture is allowed to stand for some time, which liquid will pour out first?

(d) Can a mixture of acetone and water be separated with the help of a separating funnel? Give reasons to support your answer.

Ans. (a) Liquids which do not mix with each other well are known as immiscible liquids. Two immiscible liquids do not form a homogeneous mixture.

(b) Separating funnel is used for separating a mixture of immiscible liquids. The principle of separating funnel is that immiscible liquids separate out in layers depending upon their densities.

(c) When two immiscible liquids are mixed, they form separate layers. The heavier liquid forms the lower layer and the lighter liquid forms the upper layer. So, in a separating funnel, the heavier liquid will pour out first. We are given that the density of liquid A is 1g/mL, while that of liquid B is 0.822 g/mL. This means liquid A is denser than liquid B. So, liquid A will pour out first.

(d) A mixture of acetone and water cannot be separated by a separating funnel. This is because they are miscible liquids and will form a homogeneous mixture instead of separate layers.

II. (a) Two liquids which do not mix with each other and form separate layers are known as

(i) miscible liquids.
(ii) immiscible liquids.
(iii) saturated liquids.
(iv) super saturated liquids.

Ans. (ii) immiscible liquids.

(b) Which of the following statements is correct about separating a mixture of two immiscible liquids by using a separating funnel?

(i) Denser particles of a mixture are forced to the bottom while lighter particles stay at the top when the mixture is spun rapidly.
(ii) Immiscible liquids separate out in layers depending on their densities.
(iii) Different liquids boil at different temperatures.
(iv) A substance has different solubilities in different solvents.

Ans. (ii) Immiscible liquids separate out in layers depending on their densities.

(c) Which of the following statements is correct?

(i) In immiscible liquids, the heavier liquid forms the lower layer and the lighter liquid forms the upper layer.
(ii) In immiscible liquids, the heavier liquid forms the upper layer and the lighter liquid forms the lower layer.
(iii) Two immiscible liquids form a homogeneous mixture.
(iv) In a separating funnel, the lighter liquid will pour out first.

Ans. (i) In immiscible liquids, the heavier liquid forms the lower layer and the lighter liquid forms the upper layer.

(d) The density of liquid A is 1g/mL, while that of liquid B is 0.822 g/mL. Which of the following statements is correct regarding the given liquids A and B?

(i) Liquid A and liquid B will form a homogeneous mixture.
(ii) Liquid A is denser than liquid B.
(iii) Liquid B is denser than liquid A.
(iv) In a separating funnel, liquid B will pour out first.

Ans. (iii) Liquid B is denser than liquid A.

(e) The principle of separating funnel is that immiscible liquids separate out in layers depending upon their

(i) fluidity. (ii) volume.
(iii) density. (iv) compressibility.

Ans. (iii) density.

20. Sodium chloride is one of the most commonly used salts. Apart from its use in the manufacture of table salt (or common salt), it is used in de-icing of roads, softening of hard water, in the textile and paper industry and in the manufacture of important chemicals such as caustic soda. Seawater is a major source of this salt. Commercially, it is a very important compound.

I. (a) In the paragraph, it is given that sodium chloride is a compound. List any two characteristics of a compound.

(b) How is sodium chloride obtained from seawater?

(c) Sodium chloride and ammonium chloride are both white coloured salts. How will you separate a mixture of these two compounds?

(d) Calculate the mass by mass percentage of an aqueous solution of sodium chloride prepared by dissolving 24 g of the salt in 96 g of water.

Ans. (a) The characteristics of a compound are:

(i) A compound has a fixed chemical composition.

(ii) The properties of a compound are different from its constituent elements.

(b) Sodium chloride is obtained from seawater by the process of evaporation. Seawater is allowed to stand in shallows pits. The water gets evaporated by the heat of the sun, while the salt is left behind.

(c) A mixture of sodium chloride and ammonium chloride can be separated with the help of sublimation. Ammonium chloride is a sublimable substance, that is, on heating, it changes from the solid state directly to the gaseous state. So, when a mixture of the two salts is heated in a china dish, ammonium chloride sublimes while sodium chloride is left behind. Ammonium chloride can be obtained back by cooling its vapours.

(d) Mass by mass percentage of solution = (Mass of the solute / Total mass of the solution) × 100

Mass of solute = 24 g

Mass of solvent = 96 g

Mass of solution = Mass of solute + Mass of solvent = (24 + 96) g = 120 g

So, mass by mass percentage of the given solution = (24/120) × 100 = 20%

II. (a) Sodium chloride is a compound. Which of the following properties does not describe a compound?

(i) It is composed of two or more elements.

(ii) It is a pure substance.

(iii) It cannot be separated into constituents by physical means.

(iv) It is mixed in any proportion by mass.

Ans. (iv) It is mixed in any proportion by mass.

(b) Which of the following is considered to be a pure substance?

(i) Smoke

(ii) Sodium chloride

(iii) Muddy water

(iv) Milk of magnesia

Ans. (ii) Sodium chloride

(c) Salt obtained from seawater is purified by

(i) evaporation.

(ii) crystallization.

(iii) distillation.

(iv) centrifugation.

Ans. (ii) crystallization.

(d) The components of a mixture of ammonium chloride and sodium chloride can be separated by

(i) filtration. (ii) evaporation.

(iii) sublimation. (iv) crystallization.

Ans. (iii) sublimation.

(e) A solution is prepared by dissolving 10 g of sodium chloride in 40 g of water. What is the mass by mass percentage of this solution?

(i) 25% (ii) 20%

(iii) 50% (iv) 80%

Ans. (ii) 20%

Very Short Answer Type Questions

21. Is rainwater a pure substance?

Ans. No

22. What is a saturated solution?

Ans. A solution in which no more solute can be dissolved at a particular temperature and pressure is called a saturated solution.

Short Answer Type-I Questions

23. Which pure substance is used for cutting glass?

Ans. Diamond. A knife made from a special type of diamond is used for cutting glass.

24. Define alloys. Give any two examples of alloys.

Ans. Alloys are homogeneous mixtures of two or more metals or a metal and a non-metal. They cannot be separated into their components by physical methods. For example, brass, bronze, etc.

25. What do you understand by decantation and sedimentation?

Ans. The heavy insoluble solid constituent (sediment) of a mixture can be separated from its liquid constituent by leaving the mixture undisturbed for some time. This allows the solid to settle down and this process is known as sedimentation. The clear liquid that remains above is separated by simply pouring it out in another vessel without disturbing the sediment. This process is known as decantation.

26. Which of the following will scatter light and why?

(i) sugar solution

(ii) soap solution

Ans. (i) Sugar solution will not scatter light as it is a true solution.

(ii) Soap solution will scatter light as it is a colloidal solution.

Short Answer Type-II Questions

27. A given solution contains 50 g of sugar dissolved in 200 g of water. Calculate the concentration in terms of mass by mass percentage of the solution.

Ans. Mass by mass percentage of the solution

$$= \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

We are given that 50 g of sugar has been dissolved in 200 g of water. So, mass of solute = 50 g

Mass of solution = Mass of solute + Mass of solvent

= (50 + 200) g

= 250 g

Therefore, mass by mass percentage of the solution = $\frac{50}{250} \times 100 = 20\%$ (*m*/*m*)

28. Write any three important characteristics of pure substances.

Ans. i. A pure substance has a definite composition.

ii. A pure substance is perfectly homogeneous in nature.

iii. A pure substance consists of only one type of particles.

Long Answer Type Questions

29. Describe the properties of solutions and colloids.

Ans. **Properties of a Solution**

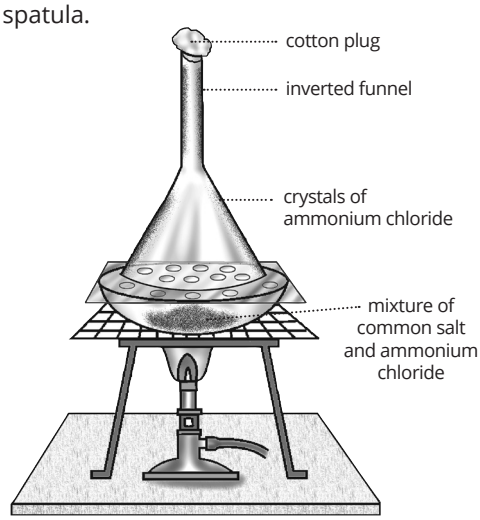
- A solution is homogeneous in nature. The diameter of particles in a solution (true solution) is less than 10^{-9} m. Thus, they are not visible even through a high power microscope.
- Due to very small particle size, a solution does not scatter light. Thus, path of light is not visible in it.
- The particles of the solute cannot be separated from the solution by a filter paper.
- Solutions are stable as the solute particles in a solution do not settle down when left undisturbed.
- The properties of a solute are retained in a solution. For example, a solution of sugar in water is sweet in taste.

Properties of Colloids

- The colloidal particles can easily pass through a filter paper as the size of the colloidal particles is smaller than the size of pores of a filter paper. Also, the dispersed phase cannot be separated from the dispersion medium through ordinary filtration.
- Colloidal solution is heterogeneous in nature and the particles of a colloidal solution are not visible to the naked eye but are visible under powerful microscope.
- Generally, the colloidal particles are stable and do not settle down when left undisturbed, but settle down slowly under gravity after a long period of time.
- The colloidal particles cannot pass through animal membrane or parchment paper.
- The colloidal particles diffuse from a region of higher concentration to a region of lower concentration.

30. How will you separate a mixture of common salt and ammonium chloride?

Ans. Ammonium chloride is a sublimable substance. So, to separate a mixture of common salt and ammonium chloride we can use the technique of sublimation. Take the mixture of common salt and ammonium chloride in a china dish and cover it by a perforated filter paper. Place an inverted glass funnel on the filter paper and plug the opening of its stem with some cotton. Place the china dish on a wire gauze and tripod stand and heat on a Bunsen burner. Ammonium chloride will undergo sublimation. Its vapours will condense on the cooler parts of the funnel while salt remains unaffected. When all of the ammonium chloride has condensed on the funnel, collect it by scrapping the funnel with a spatula.



Let's Compete

(Page 47)

Multiple-Choice Questions

1. About 0.5 g of soil was taken in a test tube and to this, 10 mL of water was added. The mixture was

shaken thoroughly and allowed to stand in a test tube stand. The mixture was then filtered. Which of the following is correct regarding the filtrate?

(a) The filtrate is a suspension.

(b) The filtrate is a colloidal solution.

(c) The filtrate is a true solution.

(d) The filtrate is neither a true solution nor a colloidal solution.

Ans. (b) The filtrate is a colloidal solution.

2. To a solution of copper(II) sulphate pentahydrate in a test tube, a small piece of silver metal is added. Which of the following is incorrect?

(a) A chemical change will occur.

(b) A physical change will occur.

(c) Brownish-red particles of copper settle at the bottom of the test tube.

(d) The blue colour of copper(II) sulphate solution will disappear.

Ans. (b) A physical change will occur.

3. Scattering of light occurs when a beam of light is passed through

(a) blood.

(b) water.

(c) copper sulphate solution.

(d) brine solution.

Ans. (a) blood.

4. Which of the following statements is correct?

(a) Vinegar is a colloidal solution of acetic acid in water.

(b) A suspension is transparent to light.

(c) A colloidal solution can be translucent.

(d) A colloidal solution is homogeneous in nature.

Ans. (c) A colloidal solution can be translucent.

5. In order to separate two liquids using a separating funnel,

(a) the liquids must have appreciably different boiling points.

(b) the liquids must be immiscible with each other.

(c) the liquids must be miscible with each other.

(d) one of the liquids must be water.

Ans. (b) the liquids must be immiscible with each other.

6. Which of the following statements is correct about a chemical change?

(a) No new substance is formed

(b) It is a permanent change

(c) There is no change in the mass of the substance undergoing change

(d) None of these

Ans. (b) It is a permanent change

7. Which of the following are chemical changes?

(i) Burning of wood

(ii) Hammering of a nail into a piece of wood

(iii) Sawing of wood

(iv Decaying of wood

(a) (i) and (ii) (b) (ii) and (iii)

(c) (iii) and (iv) (d) (i) and (iv)

Ans. (d) (i) and (iv)

8. About 5 mL of dilute hydrochloric acid is taken in a test tube. To this, a few pieces of granulated zinc are added. Which of the following is true?

(a) Hydrogen gas is evolved and it is a physical change.

(b) Zinc dissolves and it is a chemical change.

(c) Zinc dissolves and it is a physical change.

(d) Zinc dissolves and hydrogen gas is liberated, and it is a chemical change.

Ans. (d)

9. Which of the following are physical changes?

(i) Drawing a wire of iron metal

(ii) Rusting of iron

(iii) Melting of iron metal

(iv) Bending of an iron rod

(a) (i), (ii) and (iii) (b) (i), (ii) and (iv)

(c) (i), (iii) and (iv) (d) (ii), (iii) and (iv)

Ans. (c) (i), (iii) and (iv)

10. A mixture of sulphur and carbon disulphide is

(a) homogeneous and does not show Tyndall effect.

(b) heterogeneous and does not show Tyndall effect.

(c) homogeneous and shows Tyndall effect.

(d heterogeneous and shows Tyndall effect.

Ans. (d) heterogeneous and shows Tyndall effect.

Value-based Questions

(Optional) (Page 48)

1. Mixing of any other material with a pure compound is known as adulteration. Food adulteration is expanding its roots in all corners of our life. Being a responsible person, a student took help of his fellow students, some NGOs and some responsible persons of the society to create

awareness among people for the prevention of food adulteration.

(a) Give two examples of food adulteration.

(b) Mention the techniques that can be used to separate the components of adulterated foods.

(c) State the values shown by the student.

Ans. (a) Argemone oil is mixed with mustard oil and dried papaya seeds are mixed with black pepper.

(b) Starch is used as an adulterant in milk. To test the presence of starch in milk, add a few drops of iodine to the milk sample. Appearance of blue colour indicates the presence of starch.

(c) The student displayed qualities such as honesty, showing responsible behaviour, etc.

2. In order to demonstrate filtration process in the class, a teacher asked two students to go to the laboratory to collect the apparatus and materials required for filtration and to bring them to the class carefully. The students then helped the teacher in setting up of the apparatus for the filtration of a mixture of sand and water.

(a) Define filtration.

(b) Describe the filtration process for the separation of sand and water.

(c) State the values displayed by the students.

Ans. (a) The method of separating insoluble solid particles from a liquid by passing it through a filter paper is called filtration.

(b) The process of filtration is as follows:

A filter paper is folded into a semi-circle and then again folded to obtain a quarter circle. The filter paper is opened to form a cone and is then placed in a glass funnel which is supported on a funnel stand. A few drops of water are added to the filter paper so that the filter paper stays in place on the glass funnel and also to prevent the formation of any air bubble in between the filter paper and glass funnel. The mixture containing sand and water is stirred with the help of a glass rod and is then poured into the glass funnel, a little at a time, using the glass rod. The clear liquid is collected in a beaker kept below the funnel and the solid particles remain on the filter paper.

(c) Kindness, caring nature, respect for elders, helpful nature, etc.

3. Sushmita is a housewife. Once she got a cut on her finger while working in her kitchen. She tried to stop the bleeding by applying antiseptic solution on it but it was not effective. Her friend, Farzana was also there. She asked her to rub alum on the cut and the bleeding immediately stopped.

(a) Why antiseptic solution was not effective in stopping bleeding?

(b) Why was alum effective?

(c) State the values displayed by Farzana.

Ans. (a) Blood is a colloidal solution and the colloidal particle of RBCs carry charge. An antiseptic solution is an organic compound. It could not neutralize the charge on the colloidal particles. Therefore, bleeding did not stop.

(b) Alum is a salt. It has charged ions. When alum was applied on the cut, the charged ions of the colloidal particles get neutralized. In the absence of charge, blood became thick and bleeding stopped.

(c) Farzana has a proper knowledge of colloidal solutions. She must be a student of chemistry. Timely help by her stopped the bleeding. Otherwise, there would have been a further loss of blood.

3

Atoms and Molecules

Checkpoint (Page 51)

1. What is the difference between an element and a compound?

Ans. An element is a pure chemical substance made of same type of atom while a compound contains atoms of different elements chemically combined together in a fixed ratio.

2. Which is the smallest amongst all the atoms?

Ans. Hydrogen atom

3. How are elements classified?

Ans. Elements are classified as metals, non-metals and metalloids.

4. Name an element which exists in the free state in nature.

Ans. Gold

5. Name the most reactive element among non-metals.

Ans. Fluorine

6. If two compounds that do not react chemically are mixed, what do we get?

Ans. A mixture.

7. To which country the famous scientist John Dalton belongs?

Ans. Britain

8. Why elements are called homogeneous in nature?

Ans. Elements are homogeneous as they have a uniform composition throughout.

9. Does a mixture have definite composition?

Ans. No, a mixture does not have a definite composition.

10. Name the most abundant element among metals.

Ans. Aluminium

Milestone 1

(Page 56)

Multiple-Choice Questions

1. The law of constant proportions is applicable for

(a) any element. (b) any mixture.

(c) chemical compounds. (d) none of these.

Ans. (c) chemical compounds.

2. Which of the following is not correct according to Dalton's atomic theory?

(a) Atoms of any substance are indivisible.

(b) All atoms of an element may not have same mass.

(c) Atoms always combine in a simple whole number ratio.

(d) Atoms of different elements have different masses.

Ans. (b)

3. In a chemical reaction, mass of reactants is always equal to the mass of products. This is in accordance with

(a) Dalton's atomic theory.

(b) law of constant proportions.

(c) law of multiple proportions.

(d) law of conservation of mass.

Ans. (d) law of conservation of mass.

4. It is the correct symbol for bromine.

(a) BR (b) bR

(c) br (d) Br

Ans. (d) Br

5. Which of the following statements is not true about an atom?

(a) Atoms can never exist independently.

(b) Atoms are the building blocks of matter.

(c) Each element is made up of atoms.

(d) Atoms combine to form molecules.

Ans. (a)

6. What is the standard reference used for defining atomic mass unit?

(a) H-1 (b) C-12

(c) C-13 (d) H-2

Ans. (b) C-12

7. In water, the proportion of hydrogen and oxygen by mass is:

(a) 1 : 4 (b) 4 : 1

(c) 1 : 8 (d) 8 : 1

Ans. (c) 1 : 8

Very Short Answer Type Questions

8. What is the radius of a hydrogen atom?

Ans. The radius of a hydrogen atom is of the order of 10^{-10} m.

9. What does the symbol 'u' represent?

Ans. The symbol 'u' represents unified mass.

10. Express the mass of one atom of ^{12}C in atomic mass unit.

Ans. 12 u

11. State the law of multiple proportions.

Ans. When two elements combine to form two or more compounds, the different masses of one element which combine with a fixed mass of the other, bear a simple whole number ratio to one another.

12. What is the meaning of the statement "The relative atomic mass of sodium is 23 u"?

Ans. It means that the average mass of a sodium atom as compared to $1/12^{th}$ the mass of one C-12 atom is 23.

13. Write the chemical symbols of the following.

(i) Gold

(ii) Mercury

Ans. (i) Au

(ii) Hg

14. What is the mass of one hydrogen atom?

Ans. 1.67×10^{-24} g

Short Answer Type-I Questions

15. Given below are the symbols of some elements. Identify the incorrect symbols and correct them.

(a) Cobalt (CO)

(b) Sodium (So)

Ans. The correct symbols are given as follows:

(a) Cobalt : Co

(b) Sodium : Na

16. How is the atomic mass of an element different from the actual mass of an atom?

Ans. The atomic mass of an element is the weighted average of the actual masses of all the isotopes of an element.

Short Answer Type-II Questions

17. What is the mass of carbon that will combine with 8 g of oxygen to form carbon dioxide?

Ans. 12 g of carbon combines with 32 g of oxygen to form CO_2.

Mass of carbon that will combine with 8 g of oxygen

$= 12 \times 8/32$

$= 3.0$ g

18. What is the mass of sulphur that will combine with 2 g of hydrogen to form hydrogen sulphide?

Ans. Atomic mass of hydrogen is 1 u and atomic mass of sulphur is 32 u. So, 32 g of sulphur will combine with 2 g of hydrogen to form hydrogen sulphide (H_2S).

19. (a) Write the full form of IUPAC.

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

Ans. (a) International Union of Pure and Applied Chemistry

(b) 1 g of hydrogen combines with 8 g of oxygen to form water.

So, 3 g of H_2 will completely react with $8 \times 3 = 24$ g of oxygen.

20. The following data is obtained when nitrogen and oxygen react together to form different oxides:

	Mass of Nitrogen	**Mass of Oxygen**
(a)	14 g	16 g
(b)	14 g	32 g
(c)	28 g	80 g

Which law of chemical combination is obeyed by the above experimental data? Write the statement of the law.

Ans. The law of multiple proportions is obeyed by the given experimental data. According to this law, when two elements combine to form two or more compounds, then the different masses of one

element which combine with a fixed mass of the other, bear a simple ratio to one another.

Long Answer Type Questions

21. What are the drawbacks of Dalton's atomic theory?

Ans. The drawbacks of Dalton's atomic theory are as follows:

i. Atom is no longer considered as the smallest indivisible particle. Towards the end of nineteenth century, it was found that an atom was composed of smaller subatomic particles such as electrons, protons and neutrons.

ii. Atoms of the same element have different masses. For example, chlorine has two types of atoms with masses 35 u and 37 u. Such atoms of an element with different masses are called isotopes.

iii. Atoms of some different elements have same masses. The atoms of different elements with same mass numbers are called isobars. For example, the atoms of potassium and calcium have the same atomic mass (40).

iv. Substances made up of same kind of elements have different properties. For example, diamond, graphite and charcoal are made up of carbon atoms but they possess different physical properties.

v. The ratio in which different atoms combine to form a compound is fixed and integral but may not be simple. For example, a molecule of sugar having the formula $C_{12}H_{22}O_{11}$ contains C, H and O in the ratio 12 : 22 : 11. The ratio is fixed and integral but not simple.

22. How do atoms exist in millions of substances we see around us?

Ans. Each element is made up of atoms only. The atoms of each element are different from the atoms of other elements. An atom is the smallest unit of an element which can take part in a chemical reaction. At present, 118 elements are known to us and the atoms of these elements combine in so many different ways that form the substances we see around us. Except the noble gases such as helium, neon, argon, krypton and xenon, atoms of most of the elements do not exist independently. Atoms combine together to form molecules and ions. Molecules and ions differ in terms of the charge they are carrying. Molecules are neutral compounds while ions possess either positive or negative charge. These molecules or ions aggregate in large numbers to form various types of matter.

Milestone 2

(Page 64)

Multiple-Choice Questions

1. The mass of one Avogadro's number of nitrogen atoms is equal to

(a) 14 u. (b) 14 g.
(c) 28 g. (d) 14 kg.

Ans. (b) 14 g.

2. Which of the following has the largest number of molecules?

(a) 54 g of N_2O_5 (b) 28 g of CO_2
(c) 36 g of H_2O (d) 46 g of C_2H_5OH

Ans. (c) 36 g of H_2O

3. Which of the following has the maximum number of atoms?

(a) 108 g of Ag (b) 56 g of Fe
(c) 27 g of Al (d) 24 g of Carbon-12

Ans. (d) 24 g of Carbon-12

4. 8 g of O_2 has the same number of molecules as

(a) 22 g of CO_2. (b) 7 g of CO.
(c) 14 g of CO. (d) 28 g of CO.

Ans. (b) 7 g of CO.

5. The molecular formula of zinc phosphate is

(a) $Zn(PO_4)_3$. (b) Zn_2PO_4.
(c) $Zn_3(PO_4)_2$. (d) $ZnPO_4$.

Ans. (c) $Zn_3(PO_4)_2$.

6. What is the valency of a noble gas?

(a) 1 (b) 0
(c) 2 (d) None of these

Ans. (b) 0

7. Which of the following molecules is tetratomic?

(a) H_2 (b) O_3
(c) P_4 (d) S_8

Ans. (c) P_4

8. The atomic mass of potassium is 39. The number of moles in 78 g of potassium is

(a) 78. (b) 39.
(c) 2. (d) 1.

Ans. (c) 2.

9. Which of the following elements has four atoms in its molecule?

(a) Magnesium (b) Phosphorus
(c) Carbon (d) Calcium

Ans. (b) Phosphorus

Very Short Answer Type Questions

10. In a certain mass of a gas, the number of atoms and number of molecules are equal. What conclusion can you draw from this observation?

Ans. The gas is monoatomic.

11. How many molecules are there in one mole of a compound?

Ans. 6.022×10^{23} molecules

12. How many atoms are there in one mole of sodium?

Ans. 6.022×10^{23} atoms

13. What is the gram atomic mass of sulphur?

Ans. 32 g

14. Calculate the formula unit mass of $CaCl_2$.

Ans. The atomic mass of calcium and chlorine is 40 u and 35.5 u respectively. So, the formula unit mass of $CaCl_2$ = (40 + 2 × 35.5) u = 111 u

Short Answer Type-I Questions

15. Define the term mole. Write the notation of the mole unit.

Ans. The amount of a substance which contains Avogadro's number of chemical units (atoms, molecules or ions) of the substance is called mole. The SI unit of mole is written as 'mol'.

16. How many moles of carbon and oxygen atoms are present in one mole of carbon dioxide?

Ans. 1 mole of carbon atoms and 2 moles of oxygen atoms are present in one mole of carbon dioxide.

17. Write the relationship between the number of moles (n), mass (m) and the molar mass (M) of a compound.

Ans. Number of moles of a compound (n)

$$= \frac{\text{Mass of the compound in grams } (m)}{\text{Molar mass of the compound } (M)}$$

So, $n = \frac{m}{M}$

18. What is the molecule C_{60} called? What type of shape does it have?

Ans. The molecule with the formula C_{60} is called buckminsterfullerene. It has a similar structure to that of a football.

Short Answer Type-II Questions

19. Write down the formulae of the following:

(a) Aluminium oxide

(b) Calcium hydroxide

(c) Potassium sulphide

(d) Phosphorus pentachloride

(e) Boron trifluoride

(f) Copper sulphate pentahydrate

Ans. (a) Al_2O_3

(b) $Ca(OH)_2$

(c) K_2S

(d) PCl_5

(e) BF_3

(f) $CuSO_4 \cdot 5H_2O$

20. What is meant by the term molecular formula? What is its significance?

Ans. A chemical formula representing the actual number of different atoms present in a molecule of a compound is known as its molecular formula.

The significance of molecular formula is as follows:

i. It indicates the names of various elements present in the compound.

ii. It indicates the number of various atoms present in one molecule of the compound.

iii. Relative molecular mass of the compound can be calculated from the molecular formula.

iv. Molecular formula gives the number of gram-atoms of each element present in one mole of the compound.

21. How is the molecular mass different from formula unit mass? Explain.

Ans. The molecular mass of a compound is the average mass of its one molecule as compared to 1/12th the mass of one carbon-12 atom. It is denoted in atomic mass units (u). On the other hand, formula unit mass of a compound is the sum of the atomic masses of all the atoms present in a formula unit of the compound.

Long Answer Type Questions

22. Using the valencies of the elements, write down the chemical formulae of the following compounds:

(a) Sodium nitrate (b) Lead acetate

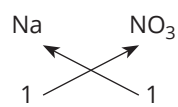
(c) Barium chloride (d) Silicon dioxide

(e) Nitric acid (f) Sodium bicarbonate

(g) Sodium hydroxide (h) Carbon tetrachloride

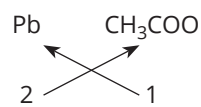
(i) Potassium sulphate (j) Ammonium sulphate

Ans. (a) Sodium nitrate



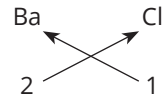
Formula: $NaNO_3$

(b) Lead acetate



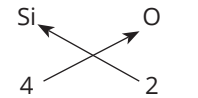
Formula: $(CH_3COO)_2Pb$

(c) Barium chloride



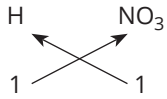
Formula: $BaCl_2$

(d) Silicon dioxide



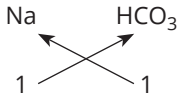
Formula: Si_2O_4 or SiO_2

(e) Nitric acid



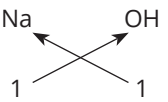
Formula: HNO_3

(f) Sodium bicarbonate



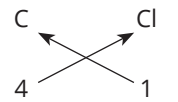
Formula: $NaHCO_3$

(g) Sodium hydroxide



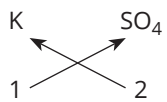
Formula: NaOH

(h) Carbon tetrachloride



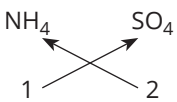
Formula: CCl_4

(i) Potassium sulphate



Formula: K_2SO_4

(j) Ammonium sulphate



Formula: $(NH_4)_2SO_4$

23. (a) A sample of phosphorus weighs 200 g. Calculate the following:

(i) number of phosphorus molecules (P_4) in the sample.

(ii) number of phosphorus atoms in the sample.

(b) Calculate the molecular mass of the following:

(i) H_2O (ii) CO_2 (iii) CH_4

Ans. (a) (i) Molar mass of $P_4 = 4 \times 31 = 124$ g/mol

124 g phosphorus contain 6.022×10^{23} molecules

200 g phosphorus will contain

$$\frac{200 \times 6.022 \times 10^{23}}{124} = 9.71 \times 10^{23} \text{ molecules}$$

(ii) Each phosphorus molecule contains 4 atoms.

Number of atoms in 9.71×10^{23} molecules

$= 9.71 \times 10^{23} \times 4$

$= 38.8 \times 10^{23}$

$= 3.88 \times 10^{24}$ atoms

(b) (i) H_2O

Atomic mass of oxygen = 16 u

Atomic mass of hydrogen = 1 u

So, molecular mass of $H_2O = 2 \times 1 + 16$

= 18 u

(ii) CO_2

Molecular mass of CO_2

= atomic mass of carbon + 2 × atomic mass of oxygen

$= 12 + 2 \times 16$

$= 12 + 32 = 44$ u

(iii) CH_4

Molecular mass of CH_4

= atomic mass of carbon + 4 × atomic mass of hydrogen

$= 12 + 4 \times 1 = 16$ u

Higher Order Thinking Skills (HOTS) Questions

(Page 65)

1. A gold sample contains 90% of gold and the rest is copper. How many atoms of gold are present in one gram of this sample of gold?

Ans. Amount of gold in 1 g of gold sample

$$= 1 \times \frac{90}{100}$$

$= 0.9$ g

As we know,

Mass of 1 mole of gold = 197g

Also, 1 mole of gold = 6.022×10^{23} atoms

This means, 197 g of gold contains 6.022×10^{23} atoms.

So, 0.9 g of gold contains $\frac{6.022 \times 10^{23} \times 0.9}{197}$

$= 2.75 \times 10^{21}$ atoms.

2. Buckminsterfullerene is an allotrope of carbon. Atoms of carbon form pentagonal and hexagonal rings in it, which are joined together to form a football-like structure. Its molecular formula is C_{60}. What is the molar mass of buckminsterfullerene? Also, find out the number of atoms in 300 grams of it.

Ans. We are given that the molecular formula of buckminsterfullerene is C_{60}. So, its molar mass will be mass of one mole of buckminsterfullerene

= 60 × molar mass of one carbon atom

$= 60 \times 12$

$= 720$ g mol^{-1}

The number of atoms in 300 g of it will be

$$= \frac{6.022 \times 10^{23} \times 300 \times 60}{720}$$

$= 1.505 \times 10^{25}$

3. The molecular formula of DDT (Dichlorodiphenyltrichloroethane) is $C_{14}H_9Cl_5$. It is used as an insecticide and its life period is 10 years. In 0.1 g of DDT, calculate

(a) the number of chlorine atoms,

(b) the number of molecules of DDT, and

(c) the number of moles of DDT.

Ans. (a) Molar mass of DDT

$= 14 \times 12 + 9 \times 1 + 5 \times 35.5$

= 354.5 g/mol

354.5 g of DDT contain 6.022×10^{23} molecules

0.1 g of DDT contains

$$= \frac{6.022 \times 10^{23} \times 0.1}{354.5}$$

$= 1.7 \times 10^{20}$ molecules

One molecule of DDT has 5 chlorine atoms

1.7×10^{20} molecules of DDT will have

$= 1.7 \times 10^{20} \times 5$

$= 8.5 \times 10^{20}$ Cl atoms

(b) 0.1 g of DDT contains 1.7×10^{20} molecules

(c) 354.5 g of DDT contain 1 mole

0.1 g of DDT contains

$$= \frac{1 \times 0.1}{354.5} = 0.000282 \text{ moles}$$

Self-Assessment

(Page 66)

Multiple-Choice Questions

1. The mass of sulphur dioxide (SO_2) that will contain 6.022×10^{22} molecules of SO_2 is

(a) 0.064 g. (b) 0.64 g.

(c) 6.4 g. (d) 64 g.

Ans. (c) 6.4 g.

6.022×10^{23} molecules of SO_2 = 64 g of SO_2

So, 1 molecule of SO_2 = $64/6.022 \times 10^{23}$ g

$\therefore$ 6.022×10^{22} molecules of SO_2

$$= \frac{64}{6.022 \times 10^{23}} \times 6.022 \times 10^{22} = 6.4 \text{ g.}$$

2. What is the symbol of silicon?

(a) SI (b) sI

(c) Si (d) si

Ans. (c) Si

3. Which of the following is taken as the standard reference for measuring atomic masses?

(a) Carbon-14 (b) Oxygen-16

(c) Oxygen-18 (d) Carbon-12

Ans. (d) Carbon-12

4. What is the ratio by mass of carbon and hydrogen atoms in a molecule of methane?

(a) 6 : 1 (b) 3 : 1

(c) 3 : 2 (d) 4 : 1

Ans. (b) 3 : 1

5. Which of the following is not an ionic compound?

(a) $MgCl_2$ (b) KBr

(c) $CaSO_4$ (d) CO_2

Ans. (d) CO_2

Assertion–Reason Type Questions

For question numbers 6 to 15, two statements are given – one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of the assertion.

(b) Both A and R are true but R is not the correct explanation of the assertion.

(c) A is true but R is false.

(d) A is false but R is true.

6. **Assertion:** A corked conical flask containing a solution of sodium sulphate and an ignition tube of barium chloride solution would weigh the same after the two solutions are allowed to mix.

Reason: Mass can neither be created nor destroyed in a chemical reaction.

Ans. (a) When aqueous solutions of sodium sulphate and barium chloride are allowed to mix in a conical flask whose mouth is corked, a chemical reaction between the two will occur. We will get a mixture of sodium chloride and barium sulphate at the end of the reaction.

$$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$$

According to the law of conservation of mass, mass can neither be created nor destroyed in a chemical reaction. So, the mass of the conical flask containing the two solutions will remain the same before and after the solutions are allowed to mix.

7. **Assertion:** Ratio of mass of hydrogen to the mass of oxygen in water samples collected from a well and a pond is the same.

Reason: In a chemical substance, elements are always present in the same proportion by mass.

Ans. (a) According to the law of constant proportions, in a chemical substance the elements are always present in a definite proportion by mass. So, water from different sources, such as river, well, pond or from a tap will have the same ratio of mass of hydrogen and oxygen.

8. **Assertion:** Symbol of iron is fE.

Reason: The symbol of iron has been taken from its Latin name.

Ans. (d) The symbol of iron is Fe. While writing the symbols of elements, the first letter is written as a capital letter and the second is written as a small letter. The symbol of iron is derived from its Latin name *ferrum*.

9. **Assertion:** Molecules of elements are different from molecules of compounds.

Reason: Molecules are formed when two or more atoms combine together.

Ans. (b) Molecules of an element contain atoms of that particular element only. For example, a molecule of oxygen contains two atoms of oxygen and is represented as O_2. However, molecules of compounds contain atoms of different elements. For example, a molecule of carbon dioxide contains one atom of carbon and two atoms of oxygen. Also, a molecule will only be formed when two or more atoms combine together.

10. **Assertion:** In calcium oxide, the ratio by mass of calcium and oxygen is 5 : 2.

Reason: One mole of calcium oxide consists of 16 g of calcium and 40 g of oxygen.

Ans. (c) The chemical formula of calcium oxide is CaO. The gram atomic mass of calcium is 40 g while that of oxygen is 16 g. Thus, one mole of CaO will contain 40 g of calcium and 16 g of oxygen. So, the ratio of masses of calcium and oxygen in CaO will be 40 : 16 or 5 : 2.

11. **Assertion:** The chemical formula of aluminium sulphate is $Al_2(SO_4)_3$.

Reason: The symbols of aluminium ion and sulphate ion are Al^{3+} and SO_4^{2-}, respectively.

Ans. (a) To write the chemical formulae of compounds, we write the symbols of the cation and the anion and criss-cross their respective charges. The symbol of aluminium ion is Al^{3+} and that of sulphate ion is SO_4^{2-}. They carry charges of +3 and –2, respectively. So, on using the criss-cross method, we will get the formula of aluminium sulphate as $Al_2(SO_4)_3$.

12. **Assertion:** The phosphate ion is a monoatomic ion.

Reason: The phosphate ion consists of atoms of phosphorus and oxygen.

Ans. (d) The symbol of the phosphate ion is PO_4^{3-}. It consists of one atom of phosphorus and four atoms of oxygen. Hence, it is a polyatomic ion. A monoatomic ion consists of one atom only.

13. **Assertion:** To denote the mass of potassium chloride, the term 'formula unit mass' is used instead of molecular mass.

Reason: Potassium chloride is an ionic compound.

Ans. (a) Ionic compounds are made up of ions and not molecules. The term 'molecular mass' is used in reference to the compounds which contain molecules. To denote the mass of ionic compounds, we use the term 'formula unit mass'. It is calculated in the same manner as molecular mass.

14. **Assertion:** Mass of one mole of a substance always contains the same number of particles.

Reason: Dividing the given mass of a substance by its molar mass gives the number of moles of that substance.

Ans. (b) One mole of a substance is defined as the amount of substance which contains as many particles as there are atoms in exactly 12 g of carbon-12 isotope. There are 6.022×10^{23} atoms in 12 g of carbon-12 isotope. This quantity (6.022×10^{23}) is a fixed quantity and is known as Avogadro's constant. So, mass of one mole of any substance will always contain 6.022×10^{23} particles.

15. **Assertion:** 24 g of hydrogen contains 24 moles of hydrogen molecules.

Reason: The molar mass of hydrogen molecule is 2 g.

Ans. (d) The molar mass of hydrogen molecule (H_2) is 2 g. The number of moles of a substance can be calculated by dividing the mass of the substance by its molar mass. So, the number of moles of H_2 molecules in 24 g of hydrogen will be $\frac{24}{2} = 12$.

Source-based/Case-based/Passage-based/ Integrated assessment questions

Answer the questions on the basis of your understanding of the following passages and the related studied concepts. (any four)

16. Limestone is a sedimentary rock which is composed of mainly calcium carbonate. The chemical formula of calcium carbonate is $CaCO_3$. It is one of the most important compounds of calcium. It is used in the extraction of iron, manufacture of high quality paper, neutralisation of acidic soil, refining of sugar and as a building material. At higher temperatures, it decomposes to form calcium oxide and carbon dioxide.

$$CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$$

I. (a) Calculate the formula unit mass of calcium carbonate.

(b) If 100 g of calcium carbonate decomposes to form 56 g of calcium oxide, what will be the mass of carbon dioxide liberated?

(c) What is the ratio of masses of elements in the products formed by the decomposition of calcium carbonate?

(d) How many moles of calcium oxide will be produced by the thermal decomposition of 200 g of calcium carbonate?

Ans. (a) Formula unit mass of $CaCO_3$ = Atomic mass of Ca + Atomic mass of carbon + 3 x (Atomic mass of oxygen)

= 40 u + 12 u + 3(16 u)

= 100 u

(b) On heating, calcium carbonate decomposes to form calcium oxide and carbon dioxide. According to the law of conservation of mass,

Total mass of reactants = Total mass of products

Here, mass of reactant = 100 g

So, mass of carbon dioxide liberated = 100 g – mass of calcium oxide = (100 – 56) g = 44 g

(c) Decomposition of calcium carbonate gives calcium oxide and carbon dioxide. The atomic masses of calcium, oxygen and carbon are 40 u, 16 u and 12 u, respectively.

So, the ratio of masses of calcium and oxygen in CaO = 40 : 16 = 5 : 2

Ratio of masses of carbon and oxygen in carbon dioxide = 12 : 32 = 3 : 8

(d) The equation for the decomposition of calcium carbonate is as follows:

$$CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$$

Thus, 100 g of calcium carbonate gives 56 g of calcium oxide.

So, 1 g of calcium carbonate will give $\left(\frac{56}{100}\right)$ g of calcium oxide.

Hence, 200 g of calcium carbonate will give $\left(\frac{56}{100}\right)$ × 200 g of calcium oxide = 112 g

II. (a) The formula unit mass of $CaCO_3$ is

(i) 50 u. (ii) 100 u.

(iii) 40 u. (iv) 90 u.

Ans. (ii) 100 u.

(b) What mass of calcium contains the same number of atoms as present in 2.3 g of sodium?

(i) 40 g (ii) 13.8 g

(iii) 9.2 g (iv) 4 g

Ans. (iv) 4 g

(c) If 100 g of calcium carbonate decomposes to form 56 g of calcium oxide, the mass of carbon dioxide liberated will be

(i) 14 g (ii) 24 g

(iii) 34 g (iv) 44 g

Ans. (iv) 44 g

(d) The ratio of masses of calcium and oxygen in CaO is

(i) 3 : 8 (ii) 8 : 3

(iii) 5 : 2 (iv) 2 : 5

Ans. (iii) 5 : 2

(e) How many moles of calcium oxide will be produced by the thermal decomposition of 200 g of calcium carbonate?

(i) 112 g (ii) 111 g

(iii) 110 g (iv) 107 g

Ans. (i) 112 g

17. In 1961, carbon-12 isotope was adopted as the standard reference for determining the atomic masses of elements. Till 1961, oxygen was used as the standard reference for determining the atomic masses of elements. The unit of atomic mass was therefore taken as 1/16 of the mass of an atom of oxygen. The standard reference was changed from oxygen to carbon because it was found that natural oxygen had two more isotopes. The chemists used the atomic mass of 16 as the mass of natural oxygen (which was a mixture of three isotopes of oxygen), while the physicists used the value of 16 as the atomic mass of the principal isotope of oxygen. This led to two different scales for determining the atomic mass. So, to avoid this confusion, carbon-12 was chosen as the standard reference.

I. (a) What is meant by relative atomic mass?

(b) What is the standard unit for expressing atomic mass?

(c) How is the molecular mass of a substance can be calculated with the help of atomic mass?

(d) What is the difference between molecular mass and molar mass of an element?

Ans. (a) The average mass of an atom of an element as compared to 1/12th the mass of one carbon-12 atom is known as the relative atomic mass of the atom.

(b) The standard unit for expressing atomic mass is unified mass. It is denoted by 'u'.

(c) The molecular mass of a substance can be obtained by simply adding the atomic masses of all the atoms present in one molecule of the substance. For example, the molecular formula of hydrogen peroxide is H_2O_2. So, the molecular mass of this compound will be

= 2 (Atomic mass of hydrogen) + 2 (Atomic mass of oxygen)

= 2 (1 u) + 2 (16 u) = 34 u

(d) Molecular mass of an element is the mass of one molecule of an element. On the other hand, molar mass of an element is the mass of one mole of molecules (or 6.022×10^{23} molecules) of that element. For example, the molecular mass of oxygen molecule (O_2) is 32 u but the molar mass of oxygen molecule is 32 g.

II. (a) The relative atomic mass of the atom is the average mass of an atom of an element as compared to

(i) 1/12th the mass of one carbon-12 atom.

(ii) 1/13th the mass of one carbon-12 atom.

(iii) 1/14th the mass of one carbon-12 atom.

(iv) 1/15th the mass of one carbon-12 atom.

Ans. (i) 1/12th the mass of one carbon-12 atom.

(b) The standard unit for expressing atomic mass is

(i) kilogram (ii) unified mass

(iii) gram (iv) miligram

Ans. (ii) unified mass

(c) Which of the following statements is correct?

(i) Molecular mass of a substance can be obtained by simply adding the atomic numbers of all the atoms present in one molecule of the substance.

(ii) Molecular mass of an element is the mass of one mole of molecules of that element.

(iii) Molar mass of an element is the mass of one mole of molecules of that element.

(iv) Molar mass of an element is the mass of one molecule of an element.

Ans. (iii) Molar mass of an element is the mass of one mole of molecules of that element.

(d) The molecular mass of hydrogen peroxide is

(i) 14 u (ii) 24 u

(iii) 44 u (iv) 34 u

Ans. (iv) 34 u

(e) One atomic mass unit is equal to

(i) 1/16th of the mass of an O-16 atom.

(ii) 1/17th of the mass of an O-17 atom.

(iii) 1/12th of the mass of a C-12 atom.

(iv) 1/13th of the mass of a C-13 atom.

Ans. (iii) 1/12th of the mass of a C-12 atom.

18. Not all the atoms combine with each other to form molecules. Some atoms exist individually as well. These are the atoms of elements such as helium, argon and neon. These elements are known as noble gases or inert gases. They are unreactive in nature and so exist as monoatomic gases. Thus, the atomicity of these elements is one. However, other elements may exist as diatomic, triatomic or polyatomic molecules.

I. (a) What is a molecule?

(b) Can we call a molecule as the building block of matter? Give reasons to support your answer.

(c) Give an example of a diatomic, triatomic and tetra-atomic element.

(d) How is the molecule of an element different from the molecule of a compound?

Ans. (a) A molecule is a group of atoms formed when two or more atoms chemically combine together. It is the smallest particle of a substance which can exist independently and shows all the properties of that substance.

(b) A molecule cannot be called the building block of matter because it is not the basic unit of matter. Molecules are formed when atoms combine together. Thus, the basic unit or building block of matter is atom.

(c) The example of diatomic, triatomic and tetra-atomic element is hydrogen (H_2), ozone (O_3) and phosphorus (P_4) respectively.

(d) Molecules of an element contain atoms of that particular element only. For example, a molecule of nitrogen contains two atoms of nitrogen and is represented as N_2. On the other hand, molecules of compounds contain atoms of different elements. For example, a molecule of water contains one atom of oxygen and two atoms of hydrogen. It is represented as H_2O.

II. (a) Name the smallest particle of an element or a compound which can exist independently and shows the properties of that substance.

(i) Atom

(ii) Molecule

(iii) Anion

(iv) Cation

Ans. (ii) Molecule

(b) Which of the following is a monoatomic element?

(i) Fluorine

(ii) Sulphur

(iii) Argon

(iv) Ozone

Ans. (iii) Argon

(c) What is the atomicity of a phosphorus molecule?

(i) Two

(ii) Three

(iii) Four

(iv) Eight

Ans. (iii) Four

(d) Which of the following is an incorrect statement?

(i) Molecules of compounds contain atoms of similar elements.

(ii) A molecule of nitrogen contains two atoms of nitrogen.

(iii) Molecules of an element contain atoms of that particular element only.

(iv) Hydrogen is an example of diatomic element.

Ans. (i) Molecules of compounds contain atoms of similar elements.

(e) Which of the following is a polyatomic ion?

(i) Sulphide (ii) Chloride

(iii) Nitride (iv) Nitrate

Ans. (iv) Nitrate

19. The standard unit of the amount of substance is mole. One mole is defined as the amount of substance which contains as many particles present in exactly 12 g of the ^{12}C isotope. 12 g of ^{12}C contains 6.022×10^{23} atoms of carbon. Thus, one mole of any substance will contain 6.022×10^{23} particles of that substance. The mass of one mole of a substance is known as its molar mass.

I. (a) What is the number of particles present in one mole of a substance known as?

(b) How can we determine the gram atomic mass of an element from its atomic mass?

(c) A given packaged bottle of water contains one litre of water. Calculate the number of moles of water present in this quantity of water. (Given: Density of water is 1 g/mL)

(d) The molar mass of a given element X is 32 g. Calculate the number of atoms of X present in 256 g of the sample.

Ans. (a) The number of particles present in one mole of a substance is known as Avogadro's number or Avogadro's constant. It is a fixed quantity and denoted by N_o.

(b) The gram atomic mass of an element is represented in grams and is numerically equal to the atomic mass of the element.
For example, the atomic mass of carbon is 12 u and its gram atomic mass is 12 g.

(c) One litre of water is equal to 1000 mL. We are given that the density of water is 1 g/mL. Hence, the mass of water in the bottle will be 1000 g.

Number of moles of water present in 1000 g of water = $\frac{\text{Mass of water}}{\text{Molar mass of water}}$

Molar mass of water = 18 g

So, number of moles

$= \frac{1000}{18} = 55.56$

(d) Given mass of substance (X) = 256 g

Molar mass = 32 g

So, number of atoms of X present in the given mass of the substance = $\left(\frac{256}{32}\right) \times 6.022 \times 10^{23}$

$= 4.8177 \times 10^{23}$ atoms

II. (a) What is the number of atoms of oxygen present in 0.5 moles of O_2?

(i) 6.022×10^{23}

(ii) 3.011×10^{23}

(iii) 6.022×10^{20}

(iv) 3.011×10^{20}

Ans. (i) 6.022×10^{23}

(b) What is the mass of 3.011×10^{23} atoms of hydrogen?

(i) 2 g

(ii) 1 g

(iii) 0.5 g

(iv) 0.25 g

Ans. (iii) 0.5 g

(c) Calculate the mass of 0.25 moles of Cl_2 gas.

(i) 284 g

(ii) 71 g

(iii) 35.5 g

(iv) 17.75 g

Ans. (iv) 17.75 g

(d) The molar mass of a given element X is 32 g. The number of atoms of X present in 256 g of the sample will be

(i) 6.0222×10^{23}.

(ii) 2.4177×10^{23}.

(iii) 4.8177×10^{23}.

(iv) 5.8177×10^{23}.

Ans. (iii) 4.8177×10^{23}.

(e) What is the number of moles present in 62 g of P_4 molecules?

(i) 0.25 moles

(ii) 0.5 moles

(iii) 1.5 moles

(iv) 2 moles

Ans. (ii) 0.5 moles

20. The compounds which are made up of charged species (ions) are known as ionic compounds. Positively-charged ions are known as cations while negatively-charged ions are known as anions. The symbols of cations and anions and their valencies

can be used in determining the chemical formulae of ionic compounds. Each ion has a specific symbol and a particular valency. For example, potassium iodide is an ionic compound made up potassium and iodide ions. Hence, its chemical formula is KCl.

I. (a) What is meant by chemical formula?

(b) State any two rules which are followed while writing the chemical formulae of compounds.

(c) What will be the chemical formula of the compound formed by sodium and carbonate ions? Also write the chemical name of this compound.

(d) What will be the symbols of the cations and anions in aluminium phosphate?

Ans. (a) A symbolic representation of the chemical composition of a substance is known as its chemical formula.

(b) Two rules which are followed for writing the chemical formulae of substances are as follows:

(i) The valencies or charges on the ion should balance each other.

(ii) For compounds consisting of metals and non-metals, the symbol of the metal is written first followed by the symbol of the non-metal.

(c) The symbol of sodium ion is Na^+ while that of carbonate ion is CO_3^{2-}. So, chemical formula of the compound formed by sodium and carbonate ions will be Na_2CO_3. The chemical name of this compound is sodium carbonate.

(d) The chemical formula of aluminium phosphate is $AlPO_4$. The symbol of the cation is Al^{3+} while that of anion is PO_4^{3-}.

II. (a) Which of the following is an ionic compound?

(i) CCl_4 (ii) H_2S

(iii) N_2O_5 (iv) K_2SO_4

Ans. (iv) K_2SO_4

(b) What is the chemical formula of magnesium phosphate?

(i) $Mg_2(PO_4)_3$ (ii) $Mg_3(PO_4)_2$

(iii) $Mg_3(PO_4)$ (iv) $Mg(PO_4)_2$

Ans. (ii) $Mg_3(PO_4)_2$

(c) What will be the chemical formula of the compound formed by sodium and carbonate ions?

(i) Na_2CO_3 (ii) Na_2HCO_3

(iii) $NaCO_3$ (iv) $NaHCO_3$

Ans. (i) Na_2CO_3

(d) Which of the following compounds has the chemical formula $ZnSO_3$?

(i) Zinc sulphite

(ii) Zinc sulphide

(iii) Zinc sulphate

(iv) Zinc hydrogen sulphate

Ans. (i) Zinc sulphite

(e) The symbols of the cation and anion in aluminium phosphate are

(i) Al^+ and PO_4^-, respectively.

(ii) Al^{2+} and PO_4^{2-}, respectively.

(iii) Al^{3+} and PO_4^{3-}, respectively.

(iv) Al^{4+} and PO_4^{4-}, respectively.

Ans. (iii) Al^{3+} and PO_4^{3-}, respectively.

Very Short Answer Type Questions

21. Define formula unit mass.

Ans. Formula unit mass of a compound is the sum of the atomic masses of all the atoms in a formula unit of the compound.

22. Write the chemical formula of the following:

(a) Hydrogen bromide (b) Calcium nitrate

Ans. (a) HBr (b) $Ca(NO_3)_2$

23. What do you mean by gram atomic mass?

Ans. The mass of one mole of an atom is known as its gram atomic mass.

24. What is the chemical formula of magnesium phosphate?

Ans. $Mg_3(PO_4)_2$

Short Answer Type-I Questions

25. If the molar mass of oxygen gas is 32 g, calculate the mass of one molecule of oxygen.

Ans. The molar mass of oxygen molecule is 32 g. This means that the mass of 6.022×10^{23} molecules of oxygen is 32 g.

So, mass of one molecule of oxygen

$$= 32/6.022 \times 10^{23} \text{ g} = 5.314 \times 10^{-23} \text{ g}$$

26. What mass of sulphur dioxide contains the same number of molecules as there are atoms in 2.7 g of aluminium?

Ans. Number of atoms present in 27 g of aluminium

$$= 6.022 \times 10^{23}$$

Number of atoms present in 1 g of aluminium

$$= \frac{6.022 \times 10^{23}}{27}$$

Number of atoms present in 2.7 g of aluminium

$$= \frac{6.022 \times 10^{23} \times 2.7}{27}$$

$$= 6.022 \times 10^{22}$$

Now, we have to find the mass of sulphur dioxide which contains 6.022×10^{22} molecules.

Mass of 6.022×10^{23} molecules of sulphur dioxide = 64 g

Mass of 1 molecule of sulphur dioxide

$$= \frac{64}{6.022 \times 10^{23}} \text{ g}$$

Mass of 6.022×10^{22} molecules of sulphur dioxide

$$= \frac{64 \times 6.022 \times 10^{22}}{6.022 \times 10^{23}} \text{ g}$$

$$= 6.4 \text{ g}$$

Short Answer Type-II Questions

27. What is the difference between gram atomic mass and gram molecular mass? Explain with the help of an example.

Ans.

Gram atomic mass	Gram molecular mass
i. The mass of one mole of an atom is known as its gram atomic mass.	i. The molar mass or the mass of one mole of molecules of a substance is known as its gram molecular mass.
ii. The gram atomic mass of an element is numerically equal to its atomic mass and expressed in grams.	ii. The gram molecular mass of a compound is numerically equal to its molecular mass and expressed in grams.
iii. For example, the atomic mass of nitrogen is 14 u. Hence, its gram atomic mass will be 14 g. It should be noted that 14 u nitrogen has only 1 nitrogen atom and 14 g of nitrogen has 1 mole of nitrogen atoms, i.e. 6.022×10^{23} atoms of nitrogen. Hence, the gram atomic mass of an element is equal to the mass of the Avogadro's number of atoms of that element.	iii. For example, the molecular mass of water is 18 u. Hence, its gram molecular mass will be 18 g. Here, 18 u water has only 1 water molecule, whereas 18 g of water has 1 mole of water molecules, i.e. 6.022×10^{23} molecules of water. Hence, the gram molecular mass of a compound is equal to the mass of the Avogadro's number of molecules of that compound.

28. Calculate the formula unit mass of

(a) KCl

(b) $MgBr_2$

(c) ZnO

Ans. (a) KCl

The atomic mass of potassium is 39 u while that of chlorine is 35.5 u.

So, formula unit mass of KCl = atomic mass of potassium + atomic mass of chlorine

= 39 u + 35.5 u

= 74.5 u

(b) $MgBr_2$

The atomic mass of magnesium is 24 u while that of bromine is 80 u.

So, formula unit mass of $MgBr_2$ = atomic mass of magnesium + 2 × atomic mass of bromine

= 24 u + (2 × 80) u

= 184 u

(c) ZnO

Formula unit mass of ZnO = atomic mass of zinc + atomic mass of oxygen

= 65 u + 16 u

= 81 u

Long Answer Type Questions

29. 2.8 g of sodium sulphate reacts with 5.2 g of barium chloride to form barium sulphate and sodium chloride. If the mass of barium sulphate formed is 6.1 g, what will be the mass of sodium chloride formed?

Ans. The chemical reaction between sodium sulphate and barium chloride is given by the following equation:

$$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$$

2.8 g of sodium sulphate reacts with 5.2 g of barium chloride to form barium sulphate and sodium chloride.

According to the law of conservation of mass:

Total mass of reactants = Total mass of products

So, mass of sodium sulphate + mass of barium chloride = mass of barium sulphate + mass of sodium chloride

2.8 g + 5.2 g = 6.1 g + mass of sodium chloride

So, mass of sodium chloride formed = 1.9 g

30. Which of the following weighs the most:

(a) 56 g of iron

(b) 1×10^{23} atoms of carbon

(c) 0.1 gram–atom of silver

(d) 5 gram–atom of nitrogen

(e) 16 g of oxygen

Ans. We should convert all the given substances in grams.

(a) 56 g of iron

(b) 1×10^{23} atoms of carbon = $12 / 6.022 \times 10^{23} \times 1 \times 10^{23} = 1.99$ g

(c) 0.1 gram–atom of silver means 0.1 mole of silver = $0.1 \times 107.9 = 10.79$ g

(d) 5 gram–atom of nitrogen means 5 moles of nitrogen = $5 \times 14 = 70$ g

(e) 16 g of oxygen

So, we can see that 5 gram–atom of nitrogen will weigh the most.

Let's Compete

(Page 69)

Multiple-Choice Questions

1. Calcium carbonate ($CaCO_3$) is also known as calcite. Apart from being an important component of seashells, it is actively used in agricultural lime. The number of moles present in 38 g of $CaCO_3$ is

(a) 0.19. (b) 0.57.

(c) 0.38. (d) 0.76.

Ans. (c) 0.38.

Molar mass of $CaCO_3 = (40 + 12 + 16 \times 3) = 100$ g

100 g of $CaCO_3$ = 1 mole of $CaCO_3$

1 g of $CaCO_3 = \frac{1}{100}$ mole

Thus, 38 g of $CaCO_3 = \frac{1}{100} \times 38 = 0.38$ mole

2. The element whose gram-atomic mass and gram-molecular mass are same is

(a) argon. (b) nitrogen.

(c) oxygen. (d) hydrogen.

Ans. (a) argon.

3. A solid has a mass of 35 g. On mixing it with a solution, a chemical reaction takes place. No gases were produced during the reaction. The total mass of the solution containing the product was found to be 85 g. What is the mass (in grams) of the solution to which the solid was added?

(a) 25 (b) 50

(c) 120 (d) 60

Ans. (b) 50

Mass of solid + Mass of Solution = Total mass of the solution after reaction

Mass of solution = 85 – 35 = 50 g

4. A compound has the chemical formula XCl_4. The molecular mass of the compound is 154 u. What is X?

(a) C (b) N

(c) Pb (d) Si

Ans. (a) C

5. How many moles are present in N_o number of Argon atoms?

(a) 1 (b) 2

(c) 18 (d) 40

Ans. (a) 1 (N_o is Avogadro number)

6. Which of the following represents 1 u?

(a) Mass of a C-12 atom

(b) Mass of a O-16 atom

(c) 1/12th mass of a C-12 atom

(d) Mass of hydrogen molecule

Ans. (c) 1/12th mass of a C-12 atom

7. The number of hydrogen atoms present in 1 mole of ethyne (C_2H_2) is

(a) $4 \times 6.022 \times 10^{23}$. (b) $2 \times 6.022 \times 10^{23}$.

(c) 6.022×10^{23}. (d) $8 \times 6.022 \times 10^{23}$.

Ans. (b) $2 \times 6.022 \times 10^{23}$.

8. 2 moles of H_2 burn to form 2 moles of H_2O. The mass of oxygen used up will be

(a) 16 g. (b) 32 g.

(c) 2 g. (d) 4 g.

Ans. (b) 32 g.

9. Which of the following will have maximum mass?

(a) 1 g iron

(b) 10^{20} molecules of CO_2

(c) 0.1 mole of NH_3

(d) 10^{22} atoms of carbon

Ans. (c) 0.1 mole of NH_3

10. Which of the following will weigh the most?

(a) 0.2 moles of sucrose ($C_{12}H_{22}O_{11}$)

(b) 2 moles of CO_2

(c) 2 moles of $CaCO_3$

(d) 10 moles of H_2O

Ans. (c) 2 moles of $CaCO_3$

0.2 moles of sucrose = $0.2 \times 342 = 68.4$ g

2 moles of $CO_2 = 2 \times 44 = 88$ g

2 moles of $CaCO_3 = 2 \times 100 = 200$ g

10 moles of $H_2O = 10 \times 18 = 180$ g

Value-based Questions

(Optional) (Page 70)

1. John Dalton's most outstanding contribution to chemistry was a scientifically grounded atomic theory. He even supplemented his atomic theory with theoretical values of atomic masses and atomic sizes which were found to be incorrect. These values revealed the discrepancies between

his enthusiasm in chemistry and his inadequate training. He even did not consider Aristotle's suggestion of divisibility of atom.

(a) How does modern atomic theory correlate with Dalton's atomic theory?

(b) What is the major contradiction between modern atomic theory and Dalton's atomic theory?

(c) What value can we learn from Dalton's non-consideration of Aristotle's view that an atom is sub-divisible, which was later found to be correct?

Ans. (a) Though there were some short comings in Dalton's atomic theory, some of its postulates are still applicable in modern atomic theory. These are:

i. All matter is made of very tiny particles called atoms.

ii. Atoms combine in the ratio of small whole numbers to form compounds.

iii. The relative number and kinds of atoms are constant in a given compound.

(b) Following are the points of contradiction between modern atomic theory and Dalton's theory:

i. According to Dalton's theory, atoms are indivisible particles. However, we know that atoms can be further divided into electrons, protons and neutrons.

ii. According to Dalton's theory, atoms of a given element are identical in terms of mass and chemical properties. However, isotopes are atoms of same element having different properties.

iii. According to Dalton's theory, atoms of different elements have different masses and properties. However, isobars are atoms of different elements having same atomic mass.

(c) Even though a few postulates of Dalton's theory were incorrect, it was the result of years and years of research and experimentation. Hence, we learn values like hardworking nature and dedication from Dalton.

2. Pratyush, a class 9 student, was asked by his teacher to verify the law of conservation of mass in the laboratory. He prepared 5% aqueous solutions of NaCl and Na_2SO_4. He mixed 10 mL of both these solutions in a conical flask. He weighed the flask on a balance and then stirred it with a rod. He weighed it again after sometime. There was no change in the mass.

(a) Was the student able to verify the law of conservation of mass?

(b) If not, what was the mistake made by him?

(c) What is the value based information associated with this experiment?

Ans. (a) No, he could not verify the law of conservation of mass inspite of the fact that there was no change in mass.

(b) No chemical reaction takes place between NaCl and Na_2SO_4. This means that no reaction actually took place in the flask.

(c) While working in the chemistry laboratory, a student must select those chemical substances which actually react with each other. Only then products will be formed.

4

Structure of the Atom

Checkpoint (Page 73)

1. What are the building blocks of matter?

Ans. Atoms

2. Define an atom.

Ans. An atom is the smallest particle of an element that takes part in a chemical reaction. It may or may not exist independently.

3. Which American scientist showed that clouds have electrical charges?

Ans. Benjamin Franklin (1706–1790)

4. Can atoms of different elements have same masses?

Ans. Yes, they are known as isobars.

5. Which atom has the smallest atomic mass?

Ans. Hydrogen

6. Atoms are indivisible particles. Yes or no?

Ans. Yes, it can be divided into electrons, protons and neutrons.

7. Give an example of a polyatomic molecule.

Ans. Sulphur (S_8)

8. Write the chemical symbol of aluminium.

Ans. Al

9. How are compounds formed?

Ans. When atoms of at least two different elements come together to form chemical bonds, the new substance formed is a compound.

10. Give an example of a monoatomic element.

Ans. Helium (He)

Milestone 1

(Page 79)

Multiple-Choice Questions

1. Cathode rays are produced when high voltage is applied across a gas under

(a) normal pressure.

(b) low pressure (0.1 mm).

(c) very low pressure (0.001 mm).

(d) high pressure.

Ans. (c) very low pressure (0.001 mm).

2. Which of the following statements is not correct regarding anode rays?

(a) Anode rays are also called canal rays.

(b) Anode rays are made up of positively charged particles.

(c) Anode rays affect photographic plates.

(d) The properties of anode rays produced by hydrogen gas in a discharge tube are the same as the properties of anode rays produced by helium gas.

Ans. (d) The properties of anode rays produced by hydrogen gas in a discharge tube are the same as the properties of anode rays produced by helium gas.

3. Which of the following statements is correct with respect to protons?

(a) They possess lower mass than electrons.

(b) They carry positive charge.

(c) They carry negative charge.

(d) None of these.

Ans. (b) They carry positive charge.

4. An atom consists of equal number of

(a) electrons, protons and neutrons.

(b) protons and neutrons.

(c) protons and electrons.

(d) neutrons and electrons.

Ans. (c) protons and electrons.

5. If hydrogen gas is used in a discharge tube, the particles of the positive rays will be

(a) protons. (b) neutrons.

(c) electrons. (d) none of these.

Ans. (a) protons.

6. How many times is a proton heavier than an electron?

(a) about 1837 times (b) about 1000 times

(c) about 100 times (d) about 10 times

Ans. (a) about 1837 times

Very Short Answer Type Questions

7. In what respect cathode rays differ from anode rays?

Ans. Charge

8. Production of which type of ray does not depend on the type of gas taken in the discharge tube?

Ans. Cathode rays

9. Which fundamental particle is not present in hydrogen atom?

Ans. Neutron

Short Answer Type-I Questions

10. Write any two properties of canal rays.

Ans. i. Canal rays consist of positively charged particles.

ii. Canal rays travel in straight lines.

11. What happens when an electric field is applied to anode rays?

Ans. Anode rays deflect and bend towards the negatively charged plates. This shows that they consist of positively charged particles.

12. Compare an electron, a proton and a neutron with respect to charge and mass.

Ans.

Fundamental particle	Charge	Mass
Electron	–1	9.109×10^{-28} g
Proton	+1	1.673×10^{-24} g
Neutron	0	1.676×10^{-24} g

Short Answer Type-II Questions

13. In a discharge tube, both cathode rays and anode rays are formed. What does the formation of cathode and anode rays indicate about the atom?

Ans. The formation of cathode and anode rays indicate that atoms consist of negatively and positively charged particles.

14. What is meant by *e/m* ratio? Give the value of *e/m* ratio of cathode rays.

Ans. *e/m* ratio is the charge to mass ratio. The value of *e/m* ratio of cathode rays is 1.759×10^{11} C/kg.

15. How will you prove that proton is a positively charged particle?

Ans. Proton is a positively charged particle because on subjecting to electric field, it moves towards the negatively charged plate. It also gets deflected by a magnetic field in a direction opposite to the cathode rays.

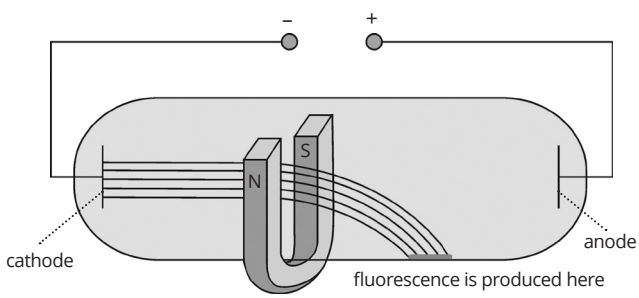
16. How was neutron discovered? Explain briefly.

Ans. In 1932, Chadwick showed that highly penetrating radiation produced by lighter metals was due to neutral particles of approximately unit mass but little heavier than proton. Chadwick named these particles neutrons.

Long Answer Type Questions

17. Draw a labelled diagram showing the deflection of cathode rays in a magnetic field.

Ans. When cathode rays are passed through a magnetic field, they are deflected in a direction which shows that they are negatively charged particles.

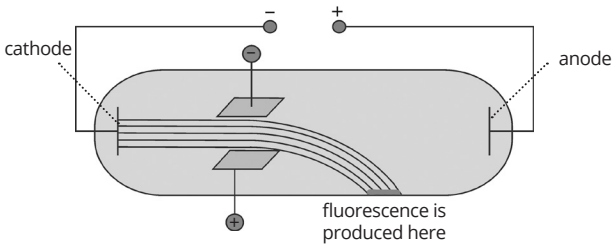


Deflection of cathode rays in a magnetic field

18. What happens when cathode rays are passed through an electric field between two parallel plates? Is it possible to determine the charge on the particles of cathode rays?

Ans. When cathode rays are passed through a strong electric field formed by placing positively and negatively charged plates in their path, they are deflected towards positively charged plate in their

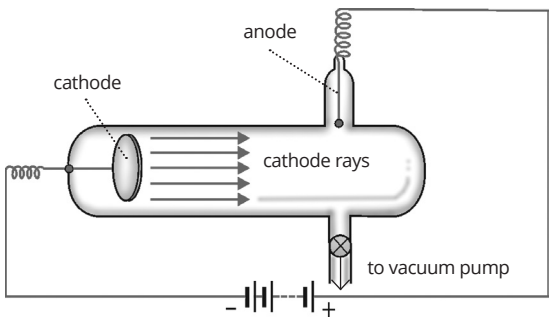
path and this shows that they consist of negatively charged particles. Yes, the charge on the particles of cathode rays can be determined.



Deflection of cathode rays in an electric field

19. Draw a labelled diagram showing the presence of charge on cathode rays in a discharge tube.

Ans.



Emission of cathode rays in a discharge tube

Milestone 2

(Page 89)

Multiple-Choice Questions

1. Number of valence electrons in a potassium atom is

(a) 2. (b) 3.

(c) 1. (d) 4.

Ans. (c) 1.

2. The symbol of arsenic is $^{75}_{33}As$. The number of protons, neutrons and electrons in an atom of arsenic is

(a) 33, 75, 33, respectively.

(b) 33, 42, 33, respectively.

(c) 33, 33, 24, respectively.

(d) 33, 75, 34, respectively.

Ans. (b) 33, 42, 33, respectively.

3. Boron has two isotopes with relative abundances as 80% of ^{11}B and 20% of ^{10}B. What is the average atomic mass of boron?

(a) 10.8 (b) 10.7

(c) 10.6 (d) 10.5

Ans. (a) 10.8

4. Which of the following shows the correct electronic configuration of sulphur?

(a) 2, 8, 6 (b) 8, 2, 6

(c) 2, 8 (d) 2, 6, 8

Ans. (a) 2, 8, 6

5. The number of electrons and neutrons in an element X is 17 and18 respectively. Which of the following is the correct representation of the element?

(a) $^{18}_{17}X$ (b) $^{35}_{18}X$

(c) $^{35}_{17}X$ (d) $^{17}_{18}X$

Ans. (c) $^{35}_{17}X$

6. Which of the following pairs of elements represent isobars?

(a) $^{40}_{20}Ca$ and $^{40}_{18}Ar$ (b) $^{14}_{6}C$ and $^{16}_{8}O$

(c) $^{14}_{6}C$ and $^{12}_{6}C$ (d) $^{2}_{1}H$ and $^{3}_{1}H$

Ans. (a) $^{40}_{20}Ca$ and $^{40}_{18}Ar$

7. Isotopes are the atoms of an element having

(a) same mass number but different number of neutrons.

(b) same atomic number but different number of neutrons.

(c) same atomic number and same number of neutrons.

(d) different atomic and mass numbers but same number of neutrons.

Ans. (b) same atomic number but different number of neutrons.

8. The sum of the number of protons and neutrons in tritium, an isotope of hydrogen is

(a) 6. (b) 5.

(c) 4. (d) 3.

Ans. (c) 4.

9. Rutherford's α-particle scattering experiment showed that

(i) most of the space in an atom is empty.

(ii) neutrons exist in the nucleus.

(iii) the positive charge and mass of an atom are concentrated in the nucleus.

(iv) electrons have negative charge.

(a) (ii) and (iv) (b) (i) and (iii)

(c) (i) and (iv) (d) (i) and (ii)

Ans. (b) (i) and (iii)

Very Short Answer Type Questions

10. Define the term isotope with a suitable example.

Ans. The atoms of an element which have the same atomic numbers but different mass numbers are

called isotopes. For example, ^{16}O and ^{17}O are isotopes of oxygen.

11. What is the name given to the atoms of an element which have the same number of protons and electrons but different number of neutrons?

Ans. Isotopes

12. Give a reason for the identical chemical properties of isotopes.

Ans. The chemical properties of an element depend on its number of electrons. Isotopes have same number of electrons due to the same atomic number. So, they have similar chemical properties.

13. Write one postulate of Bohr's model of atom.

Ans. In an atom, the electrons revolve around the nucleus in certain definite circular paths called orbits. Only certain discrete orbits of electrons are allowed inside the atom.

14. Give an example of isobars.

Ans. $^{40}_{18}Ar$, $^{40}_{20}Ca$

15. Write the distribution of electrons in various shells of the element whose atomic number is 13.

Ans. Distribution of electrons in various shells of the element whose atomic number is 13 is 2, 8, 3.

Short Answer Type-I Questions

16. An atom of iron is represented as $^{56}_{26}Fe$. Give the number of (i) electrons, (ii) neutrons present in the atom.

Ans. (i) 26 (ii) 30

17. Which of the following pairs represent isotopes?

(i) $^{74}_{33}X$, $^{75}_{33}X$ (ii) $^{55}_{25}X$, $^{55}_{26}X$

Ans. (i) $^{74}_{33}X$, $^{75}_{33}X$

18. What approximate term will you use for the three different atoms of hydrogen represented by $^{1}_{1}H$, $^{2}_{1}H$ and $^{3}_{1}H$?

Ans. $^{1}_{1}H$, $^{2}_{1}H$ and $^{3}_{1}H$ are the three isotopes of hydrogen.

19. Which type of electron distribution corresponds to chemical non-reactivity of elements?

Ans. The elements having the completely filled outermost shell do not exhibit chemical reactivity.

Short Answer Type-II Questions

20. The complete symbol of an atom X is written as $^{11}_{5}X$.

(i) What does the number 5 indicate?

(ii) What is the number of protons in X?

(iii) What is the number of neutrons in X?

Ans. (i) It indicates the atomic number of the atom X.

(ii) The number of protons in X is 5.

(iii) The number of neutrons in X is (11 – 5) = 6.

21. Explain why the isotopes $^{1}_{1}H$, $^{2}_{1}H$ and $^{3}_{1}H$ are electrically neutral and have similar chemical properties.

Ans. The isotopes $^{1}_{1}H$, $^{2}_{1}H$ and $^{3}_{1}H$ are electrically neutral because they have equal number of electrons and protons. It means the positive charge and negative charge of the atoms cancel out each other. Isotopes have the same number of electrons. Thus, they have similar chemical properties.

Long Answer Type Questions

22. Describe the observations in α-particle scattering experiment which led Rutherford to make the following conclusions:

(i) Nucleus is positively charged.

(ii) Almost entire mass of an atom is present in the nucleus of an atom.

(iii) Most of the space in an atom is empty.

Ans. Ernest Rutherford performed an experiment in which he bombarded very thin sheets of gold foil with alpha particles, which are helium ions (He^{2+}) containing two protons and two neutrons. These particles are emitted by radioactive elements like radium. The observations in the experiment which led Rutherford to make the given conclusions are:

(i) The alpha particles got deflected which means the centre of the atom was of the same charge as alpha particle which is positive charge.

(ii) As gold foil deflected some alpha particles and very few were returned back, it shows that the centre of an atom is dense, hard and positively charged.

(ii) Most of the space in an atom was empty. This was because the gold foil allowed most of the alpha particles to pass straight through without being deflected.

23. Describe Thomson's model of atom. Why was it rejected?

Ans. Thomson proposed a model for the structure of atom on the basis of his discovery of the composition of atom. This atomic model is called Thomson's plum-pudding model of atom. According to this model, an atom is considered to be a sphere of uniform positive charge into which the negatively charged electrons are embedded, just like raisins are embedded in a plum-pudding. An important feature of the plum-pudding model is that the mass of atom is considered to be evenly spread over the atom. This model could account for electrical neutrality of atom. This model was rejected because it could not explain the results of alpha-particle scattering experiment carried out by Rutherford.

24. What are the postulates of Bohr's model of atom?

Ans. The postulates of Bohr's atomic model are:

i. In an atom, the electrons revolve around the nucleus in certain definite circular paths called orbits. Only certain discrete orbits of electrons are allowed inside the atom.

ii. Each orbit has a definite energy. These orbits are known as energy levels or energy shells. The orbits or energy shells (n) are numbered as 1, 2, 3, 4 ... or K, L, M, N, ... shells starting from the nucleus. The energy shell nearest to the nucleus has minimum energy and the energy shell farthest from the nucleus has maximum energy.

iii. As long as an electron remains in a particular orbit, it does not radiate energy.

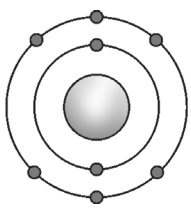
iv. An electron loses energy when it jumps from an orbit of higher energy (E_2) to an orbit of lower energy (E_1) and energy equal to $E_2 - E_1$ is given out in the form of electromagnetic radiation.

v. An electron gains energy when it jumps from an orbit of lower energy (E_1) to an orbit of higher energy (E_2). The change in energy, ΔE is given as $\Delta E = E_2 - E_1 = h\nu$, where h is the Planck's constant and ν is the frequency of radiation emitted or observed.

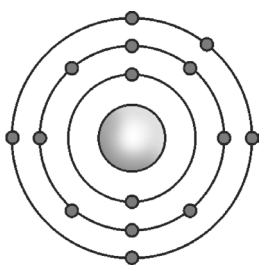
25. State $2n^2$ rule of Bohr and Bury. Draw diagrams indicating the distribution of the electrons in the atoms of the elements having atomic number 8, 15 and 17.

Give the names and symbols of these elements.

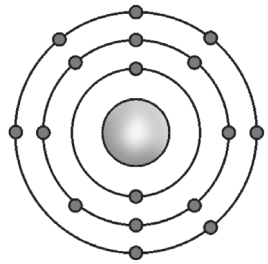
Ans. $2n^2$ rule of Bohr-Bury states that the maximum number of electrons which can be accommodated in an energy shell or orbit is given by $2n^2$, where n stands for the number of the orbit.



Atomic number 8
Oxygen atom (O) and its electrons



Atomic number 15
Phosphorus atom (P) and its electrons



Atomic number 17
Chlorine atom (Cl) and its electrons

Higher Order Thinking Skills (HOTS) Questions

(Page 90)

1. Which element will be more reactive – the element whose atomic number is 18 or the one whose atomic number is 19? Give reasons.

Ans. Element with atomic number 18 have 8 electrons in its outermost shell. Hence, it will be stable and unreactive whereas the element with atomic number 19 will be more reactive as it will have one electron in its outermost shell.

2. How can you explain that protons are the fundamental constituents of all atoms?

Ans. Protons are the fundamental subatomic particles that are found in all atoms. Unlike neutron, which is not found in hydrogen atom, protons are present in nuclei of all atoms. Since an atom has to be electrically neutral, it will always contain electrons and protons. Otherwise, an atom would not be a neutral entity.

3. Cathode rays originate from cathode in a discharge tube whereas anode rays do not. Explain and justify your answer.

Ans. Any gas taken in the discharge tube always produces cathode rays having electrons with same mass and charge. These electrons are produced due to their knock out from the atoms present inside the gas. This shows that the cathode rays must be originating from the cathode which are hitting the atoms of the gas to knock out electrons from them.

Anode rays consist of positively charged particles with mass nearly equal to the mass of the atoms of the gas. These are again produced due to knock out of electrons from the atoms of the gas by cathode rays converting the atoms into positive ions. Thus, these positive ions are produced in the space between cathode and anode and do not originate from the anode.

4. In the Gold foil experiment, that paved the way for Rutherford's model of an atom, 1.00% of the α-particles were found to get deflected at angles more than 50°. If one mole of α-particles were bombarded on the gold foil, compute the number of α-particles that would deflect at angles less than 50°.

Ans. Total number of α-particles used for bombardment = 1 mole

No. of α-particles deflected at angles more than 50°= 1%

No. of α-particles deflected at angles less than 50° = 100 – 1 = 99%

No. of α-particles bombarded = 6.022×10^{23}

No. of α-particles that deflected at an angle less than 50° will be

$= 99/100 \times 6.022 \times 10^{23}$

$= 596.178/100 \times 10^{23}$

$= 5.96 \times 10^{23}$

Self-Assessment

(Page 90)

Multiple-Choice Questions

1. Neutron, a neutral subatomic particle, was discovered by

(a) J J Thomson. (b) Eugen Goldstein.

(c) William Crookes. (d) J Chadwick.

Ans. (d) J Chadwick.

2. The number of electrons in the outermost shell of phosphorus atom is

(a) 3. (b) 6.

(c) 4. (d) 5.

Ans. (d) 5.

3. Which of the following is not the property of anode rays?

(a) Anode rays consist of positively charged particles.

(b) Anode rays travel in straight lines.

(c) Anode rays are deflected by electric field and they bend towards the positive plate.

(d) Anode rays can produce mechanical effects.

Ans. (c) Anode rays are deflected by electric field and they bend towards the positive plate.

4. Rutherford's α-particles scattering experiment was performed using foil of which of the following metals?

(a) Silver (b) Copper

(c) Gold (d) Aluminium

Ans. (c) Gold

5. The mass number of an element with 13 protons and 12 neutrons is

(a) 13. (b) 12.

(c) 26. (d) 25.

Ans. (d) 25.

Mass number = number of protons + number of neutrons

Assertion–Reason Type Questions

For question numbers 6 to 15, two statements are given – one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of the assertion.

(b) Both A and R are true but R is not the correct explanation of the assertion.

(c) A is true but R is false.

(d) A is false but R is true.

6. **Assertion:** Rutherford's model could not explain the stability of an atom.

Reason: Bohr suggested that only discrete orbits of electrons are allowed in an atom.

Ans. (b) According to Rutherford's model of an atom, the electrons revolve around the nucleus in circular paths. This revolution of the electron makes an atom unstable. This is because due to circular motion, the electron would undergo acceleration and any charged particle under acceleration radiates energy. Thus, the electron would lose energy and eventually fall into the nucleus. This would make the atom unstable.

7. **Assertion:** An atom is electrically neutral.

Reason: In an atom, the number of protons and electrons are equal.

Ans. (a) An atom is composed of electrons, protons and neutrons. Since the number of protons is equal to the number of electrons, the magnitude of positive and negative charge is equal. This makes an atom electrically neutral.

8. **Assertion:** Rutherford suggested that most of the space in an atom is occupied by the nucleus.

Reason: Most of the alpha particles in the α-particle scattering experiment passed straight through the gold foil.

Ans. (d) One of the observations of the alpha particle scattering experiment was that most of the alpha particles passed straight through the gold foil. This led Rutherford to conclude that most of the space inside an atom is empty.

9. **Assertion:** Rutherford used gold foil for his alpha particle scattering experiment.

Reason: Gold is a malleable element.

Ans. (a) Gold is a malleable metal, that is, it can be beaten into thin sheets. Rutherford wanted a very thin foil for his experiment. Since a very thin gold foil can be easily obtained, Rutherford conducted his experiment with gold.

10. **Assertion:** The electronic configuration of magnesium is 2, 8, 2 and not 2, 6, 4.

Reason: The shells in an atom are filled in a stepwise manner.

Ans. (a) A particular shell does not accommodate electrons unless the inner shells are completely filled with electrons. That is, electrons are filled in shells in a stepwise manner. This is why, the electronic configuration of magnesium is 2, 8, 2 and not 2, 6, 4.

11. **Assertion:** The maximum number of electrons which can be accommodated in the *N* shell is 32.

Reason: For the *N* shell, $n = 3$.

Ans. (c) The maximum number of electrons which can be accommodated in a given shell can be calculated by the formula $2n^2$, where n is the shell number. For the *N* shell, $n = 4$. So, $2n^2 = 2 \times (4)^2 = 2 \times 16 = 32$

12. **Assertion:** The combining capacity of neon is zero.

Reason: The outermost shell of neon is completely filled.

Ans. (a) Neon is an inert gas. Its electronic configuration is 2, 8. Since it has a complete octet of electrons, that is, its outermost shell is completely filled, it does not combine with other atoms. Hence its combining capacity or valency is zero.

13. **Assertion:** The number of neutrons in $^{14}_{6}C$ is six.

Reason: Atomic number and mass number of $^{14}_{6}C$ are 6 and 14, respectively.

Ans. (d) Atomic number is the number of protons present in an atom, while mass number is the total number of protons and neutrons present in an atom. The number of neutrons can be calculated by subtracting atomic number from mass number. Since the atomic number of $^{14}_{6}C$ is 6 and its mass number is 14, the number of neutrons in C-14 will be 14 – 6 = 8.

14. **Assertion:** Both $^{35}_{17}Cl$ and $^{37}_{17}Cl$ combine with hydrogen to form HCl.

Reason: Chlorine has a fractional atomic mass.

Ans. (b) Atoms of an element which have the same atomic number but different mass numbers are known as isotopes. Isotopes have the same chemical properties but show different physical properties. Since $^{35}_{17}Cl$ and $^{37}_{17}Cl$ are the isotopes of chlorine, they will show the same chemical properties. Both will combine with hydrogen to form HCl.

15. **Assertion:** $^{40}_{20}Ca$ and $^{40}_{18}Ar$ are regarded as isobars.

Reason: $_{20}Ca$ and $_{18}Ar$ contain the same number of nucleons.

Ans. (a) Atoms of different elements which possess the same mass number are known as isobars. These elements have different atomic numbers, but the number of nucleons is the same. Since the mass number of both $^{40}_{20}Ca$ and $^{40}_{18}Ar$ is 20, they are isobars.

Source-based/Case-based/Passage-based/ Integrated assessment questions

Answer the questions on the basis of your understanding of the following passages and the related studied concepts. (any four)

16. Age of fossils and ancient objects (such as remains of dead plants and animals) can be determined with the help of carbon dating, also known as radiocarbon dating. It was developed by Willard Libby, an American chemist, in the late 1940s. In this method, the amount of carbon-14 (a radioactive isotope of carbon) in a sample is determined. With the help of this information, its age is calculated. The lower is the amount of ^{14}C in the sample, the older it is.

I. (a) What are isotopes?

(b) How are ^{14}C and ^{14}N related?

(c) It is given that ^{14}C is a radioactive isotope of carbon. What is the atomic number and mass number of ^{14}C?

(d) Compare the molecular masses of carbon dioxide formed by ^{12}C and ^{14}C (atomic mass of oxygen is 16 u).

Ans. (a) Atoms of an element which have the same atomic number but different mass numbers are known as isotopes. For example, $^{14}_{6}C$ and $^{12}_{6}C$ are the isotopes of carbon.

(b) ^{14}C and ^{14}N are atoms of different elements possessing the same number of nucleons, which is 14. Hence, they are isobars.

(c) The atomic number of the ^{14}C isotope is 6, while its mass number is 14.

(d) The chemical formula of carbon dioxide is CO_2. So, the molecular mass of CO_2 formed by ^{12}C

= Atomic mass of carbon-12 + 2 (Atomic mass of oxygen)
= 12 u + 2 (16 u) = 44 u
Molecular mass of CO_2 formed by ^{14}C
= Atomic mass of carbon-14 + 2 (Atomic mass of oxygen)
= 14 u + 2 (16 u) = 46 u

II. (a) Which of the following statements about isotopes is incorrect?
(i) Isotopes are the atoms of the same element.
(ii) Isotopes have the same atomic number.
(iii) Isotopes have different mass numbers.
(iv) Isotopes have different chemical properties.

Ans. (iv) Isotopes have different chemical properties.

(b) ^{14}C and ^{14}N are atoms of different elements having
(i) same atomic number but different mass numbers.
(ii) different atomic numbers but same mass number.
(iii) same atomic number and same mass number.
(iv) different atomic numbers and different mass numbers.

Ans. (ii) different atomic numbers but same mass number.

(c) Isotope of the element used in the treatment of goitre is
(i) hydrogen (ii) cobalt
(iii) iodine (iv) phosphorus

Ans. (iii) iodine

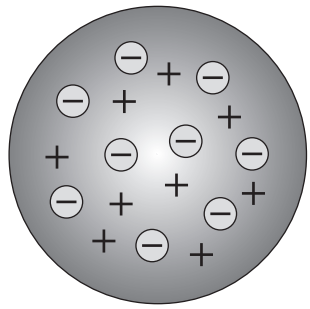
(d) The atomic number and mass number of ^{14}C isotope are
(i) 6 and 14, respectively.
(ii) 7 and 15, respectively.
(iii) 8 and 16, respectively.
(iv) 9 and 18, respectively.

Ans. (i) 6 and 14, respectively.

(e) The molecular mass of carbon dioxide formed by ^{14}C (atomic mass of oxygen is 16 u) is
(i) 43 u (ii) 44 u
(iii) 45 u (iv) 46 u

Ans. (iv) 46 u

17. J J Thomson was a British physicist. He is known for many significant contributions to science such as the discovery of electron, charge to mass ratio of an electron and Thomson scattering. He also proposed the model for an atom, known as the plum pudding, raisin pudding or watermelon model of an atom. In 1906, he was awarded the Nobel Prize in physics for his work on conduction of electricity by gases.



I. (a) Describe the Thomson's model of an atom.
(b) Why was Thomson's model of an atom not regarded as the correct model of atom?
(c) How is Thomson's model of an atom different from the present model of an atom?
(d) State the significance of the Thomson's model of an atom.

Ans. (a) According to Thomson's model of an atom, an atom consists of a sphere of uniformly-distributed positive charge with electrons embedded in it. This is similar to a raisin pudding which consists of raisins embedded in the pudding. The magnitude of positive charge is equal to the magnitude of negative charge.
(b) Thomson's model could not explain the results of the experiments carried out by other scientists, such as the results of the alpha particle scattering experiment performed by Rutherford.
(c) In Thomson's model of an atom, the electrons are embedded in a sphere of positive charge. In the present model of an atom, the electrons revolve around a small, dense, positively-charged body(nucleus) present in the centre of the atom in circular paths.
(d) Thomson's model of an atom could account for the electrical neutrality of an atom, since the magnitude of positive charge was considered equal to the magnitude of negative charge.

II. (a) The cathode ray experiment was done for the first time by
(i) J J Thomson
(ii) John Dalton
(iii) Goldstein
(iv) Rutherford

Ans. (i) J J Thomson

(b) The value of charge by mass (e/m) ratio of the cathode rays is
(i) 1.759×10^{11} C kg^{-1}
(ii) 2.212×10^{11} kg^{-1}

(iii) 2.212×10^{11} C kg^{-1}

(iv) 1.759×10^{11} kg^{-1}

Ans. (i) 1.759×10^{11} C kg^{-1}

(c) According to Thomson's model of an atom, the magnitude of positive charge in an atom is

(i) more than the magnitude of negative charge.

(ii) less than the magnitude of negative charge.

(iii) half of the magnitude of negative charge.

(iv) equal to the magnitude of negative charge.

Ans. (iv) equal to the magnitude of negative charge.

(d) Which of the following postulates of Thomson's model of an atom is not true?

(i) Thomson's model of an atom is similar to that of Christmas pudding.

(ii) An atom consists of a positively charged sphere with electrons embedded in it.

(iii) This model could account for electrical neutrality of atom.

(iv) An atom carries a net positive charge.

Ans. (iv) An atom carries a net positive charge.

(e) The magnitude of the charge of an electron in coulombs is

(i) 1.802×10^{-19} coulombs.

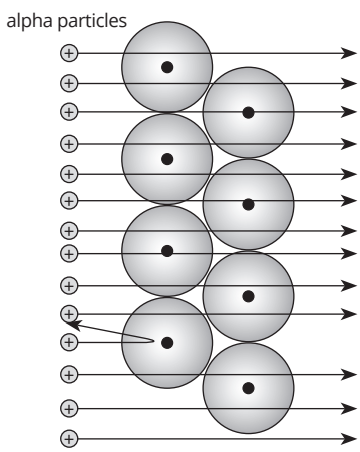
(ii) 1.602×10^{-19} coulombs.

(iii) 1.402×10^{-19} coulombs.

(iv) 1.202×10^{-19} coulombs.

Ans. (ii) 1.602×10^{-19} coulombs.

18. The alpha particle scattering experiment played a significant role in determining the structure of an atom. In this experiment, a very thin foil made of gold was bombarded with fast moving alpha particles (from a radioactive source). A circular zinc sulphide screen was placed around the gold foil. A tiny flash was produced wherever the alpha particle struck the screen.



I. (a) Why were the results of the scattering experiment regarded unexpected?

(b) What conclusions did Rutherford draw on the basis of this experiment?

(c) Write an important postulate of the Rutherford model of atom.

(d) State the major drawback of the Rutherford's model of atom.

Ans. (a) The results of the alpha particle scattering experiment were regarded unexpected because they were not in agreement with the Thomson's model of atom. According to Thomson's model, the positive charge is uniformly distributed in an atom and the electrons are embedded in it. So, it was expected that when the alpha particles pass through the gold foil, they would slow down and change their directions only by small angles. However, most of the alpha particles passed straight through the gold foil and a very few even bounced back.

(b) On the basis of the alpha particle scattering experiment, Rutherford drew the following conclusions:

(i) Since most of the alpha particles passed undeflected through the gold foil, most of the space in an atom is empty.

(ii) Since very few alpha particles were deflected by small angles, it indicates that the positive charge occupies very small space inside an atom.

(iii) As a very small fraction of alpha particles were deflected by 180°, it suggests that the positive charge and the mass of the atom are concentrated in a very small body in the centre of the atom.

(c) An atom consists of a small, positively-charged centre called nucleus. Nearly all the mass of the atom is present inside the nucleus. The size of the nucleus is very small as compared to the size of the atom.

(d) Rutherford's model could not explain the stability of an atom. When a particle moves in a circular path, it undergoes acceleration. When a charged particle undergoes acceleration, it radiates energy. Thus, an electron revolving around the nucleus in a circular path should fall into the nucleus. As a result, an atom should be highly unstable. However, atoms are known to be quite stable.

II. (a) In Rutherford's alpha-particle scattering experiment, a stream of fast moving alpha particles was allowed to strike a very thin

(i) iron foil.
(ii) aluminium foil.
(iii) gold foil.
(iv) silver foil.

Ans. (iii) gold foil.

(b) In the alpha-particle scattering experiment, most of the alpha particles
(i) passed undeflected through the foil.
(ii) were deflected by small angles.
(iii) were deflected by large angles.
(iv) were deflected by 180°.

Ans. (i) passed undeflected through the foil.

(c) Which of the following postulates of the Rutherford's model of an atom is incorrect?
(i) An atom contains a positively charged centre called the nucleus.
(ii) Nearly all the mass of the atom is concentrated in the nucleus.
(iii) The electrons revolve around the nucleus in circular paths.
(iv) The size of the nucleus is comparable to the size of the atom.

Ans. (iv) The size of the nucleus is comparable to the size of the atom.

(d) Which of the following conclusions of the Rutherford's model of an atom is incorrect?
(i) Since most of the alpha particles passed undeflected through the gold foil, most of the space in an atom is empty.
(ii) Since most of the alpha particles passed undeflected through the gold foil, most of the space in an atom is occupied.
(iii) Since very few alpha particles were deflected by small angles, it indicates that the positive charge occupies very small space inside an atom.
(iv) As a very small fraction of alpha particles were deflected by 180°, it suggests that the positive charge and the mass of the atom are concentrated in a very small body in the centre of the atom.

Ans. (ii) Since most of the alpha particles passed undeflected through the gold foil, most of the space in an atom is occupied.

(e) Rutherford's model of an atom could not explain the
(i) electrical neutrality of an atom.
(ii) distribution of electrons in an atom.
(iii) distribution of positive charge in an atom.
(iv) stability of an atom.

Ans. (iv) stability of an atom.

19. Gases which are inert in nature and show very little or no chemical reactivity are known as inert gases or noble gases. These include helium, neon, argon, krypton, etc. Due to their inert nature, the atoms of these elements do not combine with the atoms of other elements. The inertness arises due to their stable electronic configuration. Except helium, all the noble gases have a complete octet.

I. (a) Why are noble gases called chemically inert?

(b) Atoms generally have a tendency to combine with each other. If inert gases are chemically unreactive, how do they exist in nature?

(c) Why helium does not have an octet?

(d) What is meant by electronic configuration?

Ans. (a) Noble gases do not exhibit chemical reactivity, so they are called chemically inert.

(b) Inert gases are unreactive in nature. Atoms of inert gases do not have a tendency to combine with other atoms. Hence, they exist as monoatomic gases.

(c) Octet refers to a full set of eight electrons present in the valence shell of an atom. Helium has only two electrons. Hence, it has a duplet and not an octet.

(d) The arrangement of electrons of an atom in its different shells (or energy levels) is known as its electronic configuration.

II. (a) Noble gases are called chemically inert because they
(i) are not having the completely filled outermost shell.
(ii) exhibit little to no chemical reactivity.
(iii) exhibit high chemical reactivity.
(iv) have a tendency to combine with other atoms.

Ans. (ii) exhibit little to no chemical reactivity.

(b) Helium has a duplet and not an octet because
(i) it is unreactive in nature.
(ii) it is chemically inert.
(iii) it has only four electrons.
(iv) it has only two electrons.

Ans. (iv) it has only two electrons.

(c) Which of the following statements about electronic configuration is correct?
(i) Electronic configuration is the arrangement of electrons of an atom in its different shells.
(ii) Electronic configuration is the arrangement of protons of an atom in its different shells.

(iii) Electronic configuration is the arrangement of protons and neutrons of an atom in its different shells.

(iv) Electronic configuration is the arrangement of neutrons of an atom in its different shells.

Ans. (i) Electronic configuration is the arrangement of electrons of an atom in its different shells.

(d) Which of the following gases has a complete octet?

(i) Nitrogen (ii) Oxygen

(iii) Neon (iv) Hydrogen

Ans. (iii) Neon

(e) What is the valency of argon?

(i) 8 (ii) 6

(iii) 2 (iv) 0

Ans. (iv) 0

20. An atom is composed of three subatomic particles – the electron, proton and neutron. Neutron is a neutral particle whose mass is nearly equal to that of proton. It was discovered by James Chadwick in the year 1932. In his experiment, Chadwick bombarded a thin sheet of beryllium by fast moving alpha particles. When alpha particles from a radioactive source fell on beryllium, new radiations consisting of uncharged particles were produced. These particles were neutrons. James Chadwick was awarded the Nobel Prize in physics in 1935 for the discovery of neutrons.

I. (a) Where are neutrons present in an atom?

(b) How is a neutron represented?

(c) Name the element which does not contain any neutrons.

(d) The mass number and atomic number of an element X are 32 and 15, respectively. What is the number of neutrons in this element?

Ans. (a) The neutrons are present in the nucleus of an atom.

(b) A neutron does not carry any charge and its mass is almost the same as that of a proton. Hence, a neutron is represented as n or ${}^{1}_{0}n$.

(c) Hydrogen is the only element which does not contain neutrons.

(d) Mass number = number of protons + number of neutrons

We are given that the mass number of element X is 32 while its atomic number is 15. So, the number of neutrons in the element will be 32 – 15 = 17.

II. (a) Which of the following is the correct representation of a neutron?

(i) ${}^{0}_{0}n$ (ii) ${}^{1}_{0}n$

(iii) ${}^{0}_{1}n$ (iv) ${}^{1}_{1}n$

Ans. (ii) ${}^{1}_{0}n$

(b) Which of the following elements does not carry a proton?

(i) Lithium (ii) Boron

(iii) Hydrogen (iv) Oxygen

Ans. (iii) Hydrogen

(c) The total number of protons present in the nucleus of an atom is equal to its

(i) atomic number. (ii) atomic mass.

(iii) mass number. (iv) valency.

Ans. (i) atomic number.

(d) The mass number of an element X with the electronic configuration 2, 8, 1 is 25. The number of neutrons present in element X is

(i) 11. (ii) 14.

(iii) 25. (iv) 37.

Ans. (ii) 14.

(e) The atomic number of an element is 18 and its mass number is 40. Which of the following elements has the same number of neutrons as X?

(i) ${}^{40}_{20}Ca$ (ii) ${}^{40}_{19}K$

(iii) ${}^{41}_{20}Ca$ (iv) ${}^{41}_{19}K$

Ans. (iv) ${}^{41}_{19}K$

Very Short Answer Type Questions

21. What are canal rays?

Ans. Canal rays (anode rays) are positively charged radiations consist of positively charged particles.

22. Define mass number of an element.

Ans. The sum of the number of protons and neutrons in an atom of an element is called its mass number.

23. Atomic number of an element is 12. What is its valency?

Ans. Its valency is equal to 2 because its electronic configuration is 2,8,2. It can lose 2 electrons to complete its octet and become stable.

Short Answer Type-I Questions

24. What were the drawbacks of Rutherford's model of an atom?

Ans. Rutherford's model of atom has the following drawbacks:

i. This model has not explained about the distribution of electrons around the nucleus and the energy of the electrons.

ii. In a circular orbit, moving body undergoes acceleration even while moving at a constant speed due to change in direction. A charged particle on acceleration loses energy. Hence, an electron in an orbit is expected to radiate energy. Thus, it should follow a spiral path and ultimately fall into the nucleus. Hence, an atom should be very unstable. However, this does not happen. So, Rutherford's model could not explain the stability of an atom.

25. How are isotopes different from isobars? Give one example for each of them.

Ans. The atoms of an element which have the same atomic numbers but different mass numbers are called isotopes. For example, ^{12}C and ^{14}C are isotopes of carbon.

The atoms of different elements which have the same mass number but different atomic numbers are called isobars. For example, $^{14}_{6}C$ and $^{14}_{7}N$ are isobars.

26. The number of nucleons present in an atom of an element is 26. If the atomic number of the element is 12, find the number of neutrons present in the atom.

Ans. We are given that the mass number of the element is 26. Also, the atomic number of the element is 12. Thus, number of neutrons

= mass number – atomic number

= 26 – 12 = 14

Short Answer Type-II Questions

27. Why do helium, neon and argon have zero valency?

Ans. Helium has 2 electrons in its valence shell whereas neon and argon have 8 electrons in their valence shells. They have maximum possible number of electrons in their valence shells, so, they have no tendency to gain or lose or share electrons to form bonds. Thus, they have zero valency.

28. Write the features of Rutherford's nuclear model of an atom.

Ans. On the basis of the his experiment, Rutherford proposed the nuclear model of an atom and explained the following features:

i. An atom consists of a positively charged centre called nucleus surrounded by negatively charged electrons. Electrons revolve around the nucleus in fixed circular paths called orbits.

ii. The size of the nucleus is extremely small as compared to the total size of the atom.

iii. Most of the mass of an atom is concentrated in the nucleus. The mass of the nucleus is due to protons and neutral particles (neutrons) having mass almost equal to the mass of proton.

Long Answer Type Questions

29. In what way is the Rutherford's atomic model different from that of Thomson's atomic model?

Ans. According to Rutherford, atoms consist of positively charged centre called nucleus. Electrons revolve around the nucleus in fixed circular paths called orbits. The whole mass of atom is concentrated into the nucleus.

According to Thomson, the electrons are embedded in a positively charged sphere like seeds of the watermelon and the positive charge in the atom is spread all over like the red edible part of the watermelon. The mass of the atom was assumed to be uniformly distributed. The negative and positive charges are equal in magnitude and the atom as a whole is electrically neutral.

30. Explain how an isotope of phosphorus is useful in the manufacturing of steel from cast iron.

Ans. Isotope $^{33}_{15}P$ is used in the manufacture of steel from cast iron in order to find out the complete removal of phosphorus from steel. For this purpose, the cast iron containing a small quantity of $^{32}_{15}P$ isotope is used. The disappearance of radioactivity in the molten steel indicates the complete removal of phosphorus from the steel. Radioactive isotopes are used to detect minor cracks in the underground gas-pipelines, oil-pipelines and water-pipelines. A solution of a radioactive substance is introduced in the pipeline. If there is a minor crack in the pipeline, a high level of radiation will be detected at the place of the crack. The wear and tear of engines is found out by incorporating a radioactive isotope of a metal in the piston and measuring the radioactivity of the lubricating oil at various intervals of time. The appearance of radioactivity in the lubricating oil gives an indication that the wear and tear of the piston have started.

Let's Compete

(Page 94)

Multiple-Choice Questions

1. The given list shows some elements with their electron distributions (not necessarily in the correct order).

(i) Aluminium	(A) 2, 8, 8, 1
(ii) Potassium	(B) 2, 8, 1

(iii) Phosphorus (C) 2, 8, 5

(iv) Sodium (D) 2, 8, 3

The rows in the given list can be correctly matched as

(a) (i)→B, (ii)→A, (iii)→D, (iv)→C

(b) (i)→D, (ii)→A, (iii)→C, (iv)→B

(c) (i)→D, (ii)→B, (iii)→C, (iv)→A

(d) (i)→B, (ii)→C, (iii)→D, (iv)→A

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

2. The number of valence electrons in an atom of aluminium is

(a) 2. (b) 3.

(c) 1. (d) 4.

Ans. (b) 3.

3. Pooja studied about Rutherford's atomic model. She wrote the drawbacks of the model as follows.

(i) Presence of nucleus was not explained.

(ii) Stability of atoms could not be explained.

(iii) Position of electrons in the atom was not fixed.

(iv) Nothing could be said about the mass of the atom.

Among the drawbacks written by Pooja,

(a) (i) and (iii) are correct

(b) (ii) and (iii) are correct

(c) only (ii) is correct

(d) only (iv) is correct

Ans. (c) only (ii) is correct

4. Four statements regarding isotopes are given below.

(i) Isotopes have same melting and boiling points.

(ii) An isotope of cobalt is used in the treatment of goitre.

(iii) Isotopes have similar chemical reactivities.

(iv) An isotope of uranium is used as a fuel in nuclear reactors.

Which pair of the given statements is correct?

(a) (i) and (ii) (b) (ii) and (iii)

(c) (iii) and (iv) (d) (i) and (iv)

Ans. (c) (iii) and (iv)

5. Pratyush's teacher asked him to write four points about the structure of an atom. He wrote the following points about the same.

(i) Electrons are present inside the nucleus.

(ii) Mass of an atom is due to nucleons only.

(iii) The electrons revolve around the nucleus.

(iv) Atom is negatively charged.

However, his teacher points out two errors in the statements he has written.

Which pair of the given statements written by Pratyush is incorrect?

(a) (i) and (ii) (b) (ii) and (iii)

(c) (ii) and (iv) (d) (i) and (iv)

Ans. (d) (i) and (iv)

6. Which of the following statement(s) is correct?

(i) All atoms except hydrogen atom contain electron.

(ii) Cathode rays are deflected towards the positively charged plate in an electric field.

(iii) Anode rays cannot produce mechanical effect.

(iv) Electrons are not stable inside an atom.

(a) (i) and (ii) (b) Only (ii)

(c) (iii) and (iv) (d) Only (i)

Ans. (b) Only (ii)

7. Chromium, which is a lustrous, steel grey and hard metal, has a high melting point. It exists in nature in the form of four isotopes, chromium-50, chromium-52, chromium-53, and chromium-54. The respective relative abundances of these isotopes are 4.35 %, 83.79 %, 9.5 %, and 2.36 %.

The average atomic mass of chromium is

(a) 52.06. (b) 53.05.

(c) 55.02. (d) 55.20.

Ans. (a) 52.06.

Average atomic mass of chromium

$$= \frac{(50 \times 4.35) + (52 \times 83.79) + (53 \times 9.5) + 54 \times 2.36}{(4.35 + 83.79 + 9.5 + 2.36)}$$

$$= \frac{217.5 + 4357.08 + 503.5 + 127.44}{100}$$

$$= \frac{5206}{100} = 52.06$$

8. Consider the following statements regarding Rutherford's atomic model.

(i) Most of the mass of an atom resides in the nucleus.

(ii) The size of the nucleus is very small as compared to the size of an atom.

(iii) The electrons reside in the nucleus of an atom.

Among the given statements,

(a) (i) and (ii) are correct.

(b) (ii) and (iii) are correct.

(c) only (i) is correct.

(d) only (ii) is correct.

Ans. (a) (i) and (ii) are correct.

9. The symbol of selenium is $^{79}_{34}Se$. The number of protons, neutrons and electrons in a selenide ion (Se^{2-}) is

(a) 34, 79, 34, respectively.

(b) 34, 45, 36, respectively.

(c) 34, 45, 34, respectively.

(d) 34, 48, 36, respectively.

Ans. (b) 34, 45, 36, respectively.

10. The given table lists some elements along with distribution of their electrons.

Element	Distribution of electrons
Nitrogen	2, 5
Sulphur	2, 6, 8
Oxygen	2, 6
Magnesium	2, 8, 2

The electronic configuration of which element is listed incorrectly in the table?

(a) Magnesium (b) Oxygen

(c) Sulphur (d) Sodium

Ans. (c) Sulphur

Value-based Questions

(Optional) (Page 95)

1. Electrons are negatively charged but the nucleus is positively charged as it contains protons. Neils Bohr proved that electrons never fall into the nucleus. Atom is always stable.

(a) Why is it that electrons do not fall into the nucleus?

(b) What lesson do you learn from this example for your day-to-day life?

Ans. (a) According to Bohr's theory, as long as an electron moves in a particular orbit, it does not radiate energy. As a result, it does not fall into the nucleus.

(b) From this, we learn that as long as we are focused on a particular work, we cannot be distracted by other things.

2. The journey from Dalton's model of atom to Thomson's model of atom to Rutherford's model of atom to Bohr's model of atom is a long and strenuous one. Each model has its merits and drawbacks. Even Bohr's model of atom is not the final answer to the structure of atom.

(a) Give the distinguishing features between Thomson's model and Rutherford's model of atom.

(b) What value can you learn from the ongoing journey of development of atomic structure from Dalton's model of atom to the present model of atom? Is this value applicable to the improvement of standards of our life?

Ans. (a) In Thomson's plum pudding model, the atom was considered to be a sphere of uniform positive charge into which the negatively charged electrons are embedded just like raisins are embedded in a plum-pudding. In this model, mass of atom is considered to be evenly spread over the atom. However, in Rutherford's model of an atom, most of the space in an atom is considered to be empty. Also, the entire mass of the atom is concentrated in the nucleus (centre of the atom). The volume of the nucleus is extremely small as compared to the total volume of the atom.

(b) We learn that there is always a scope of improvement to make any theory more acceptable and better than its earlier form. This is indeed applicable to the improvement of standard of our life.