Structure of the Atom

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1. What are canal rays?

Answer

Canal rays are positively charged radiations that can pass through perforated cathode plate. These rays consist of positively charged particles known as protons.

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

Answer

An electron is a negatively charged particle, whereas a proton is a positively charged particle. The magnitude of their charges is equal. Therefore, an atom containing one electron and one proton will not carry any charge. Thus, it will be a neutral atom.

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

Answer

As per Thomson’s model of the atom, an atom consists both negative and positive charges which are equal in number and magnitude. So, they balance each other as a result of which atom as a whole is electrically neutral.

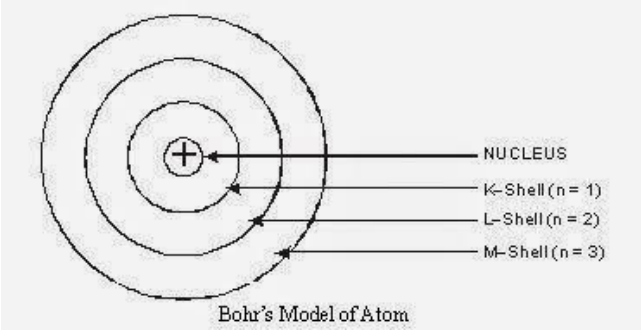
2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

Answer

On the basis of Rutherford's model of an atom, protons are present in the nucleus of an atom.

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

Answer



Bohr's Model of an atom with three shells

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

Answer

If α-particle scattering experiment is carried out using a foil of any metal as thin as gold foil used by Rutherford, there would be no change in observations. But since other metals are not so malleable so, such a thin foil is difficult to obtain. If we use a thick foil, then more α-particles would bounce back and no idea about the location of positive mass in the atom would be available with such a certainty.

1. Name the three sub-atomic particles of an atom.

Answer

The three sub-atomic particles of an atom are:
(i) Protons
(ii) Electrons, and
(iii) Neutrons

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

Answer

Number of neutrons = Atomic mass - Number of protons
Therefore, the number of neutrons in the atom = 4 - 2 = 2

1. Write the distribution of electrons in carbon and sodium atoms

Answer

► The total number of electrons in a carbon atom is 6. The distribution of electrons in carbon atom is given by:

First orbit or K-shell = 2 electrons
Second orbit or L-shell = 4 electrons

Or, we can write the distribution of electrons in a carbon atom as 2, 4.

► The total number of electrons in a sodium atom is 11. The distribution of electrons in sodium atom is given by:

First orbit or K-shell = 2 electrons
Second orbit or L-shell = 8 electrons
Third orbit or M-shell = 1 electron

Or, we can write distribution of electrons in a sodium atom as 2, 8, 1.

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

Answer

The maximum capacity of K shell is 2 electrons and L shell can accommodate maximum 8 electrons in it. Therefore, there will be ten electrons in the atom.

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

Answer

If the number of electrons in the outermost shell of the atom of an element is less than or equal to 4, then the valency of the element is equal to the number of electrons in the outermost shell. On the other hand, if the number of electrons in the outermost shell of the atom of an element is greater than
4, then the valency of that element is determined by subtracting the number of electrons in the outermost shell from 8.
The distribution of electrons in chlorine, sulphur, and magnesium atoms are 2, 8, 7; 2, 8, 6 and 2, 8, 2 respectively.

Therefore, the number of electrons in the outer most shell of chlorine, sulphur, and magnesium atoms are 7, 6, and 2 respectively.

► Thus, the valency of chlorine = 8 -7 = 1

► The valency of sulphur = 8 - 6 = 2

► The valency of magnesium = 2

1. If number of electrons in an atom is 8 and number of protons is also 8, then (i) what is the atomic number of the atom and (ii) what is the charge on the atom?

Answer

(i) The atomic number is equal to the number of protons. Therefore, the atomic number of the atom is 8.

(ii) Since the number of both electrons and protons is equal, therefore, the charge on the atom is 0.

2. With the help of Table 4.1, find out the mass number of oxygen and sulphur atom.

Answer

Mass number of oxygen = Number of protons + Number of neutrons
= 8 + 8
= 16

Mass number of sulphur = Number of protons + Number of neutrons
= 16 +16
= 32

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

Answer

Symbol	Proton	Neutron	Electron
H	1	0	1
D	1	1	1
T	1	2	1

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

Answer

$^{12}C_6$ and $^{14}C_6$ are isotopes, have the same electronic configuration as (2, 4)$^{22}Ne_{10}$and $^{22}Ne_{11}$ are isobars. They have different electronic configuration as given below:
$^{22}Ne_{10}$ – 2, 8
$^{22}Ne_{11}$ – 2, 8, 1

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Excercise

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

Answer

Particle	Nature of Charge	Mass	Location
Electron	Electrons are negatively charged.	9×10^{-31} kg	Extra nuclear part distributed in different shell or orbits.
Proton	Protons are positively charged.	1.672×10^{-27} kg (1 μ) (approx. 2000 times that of the electron)	Nucleus
Neutron	Neutrons are neutral.	Equal to mass of proton	Nucleus

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

Answer

The limitations of J.J. Thomson's model of the atom are:
→ It could not explain the result of scattering experiment performed by rutherford.
→ It did not have any experiment support.

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

Answer

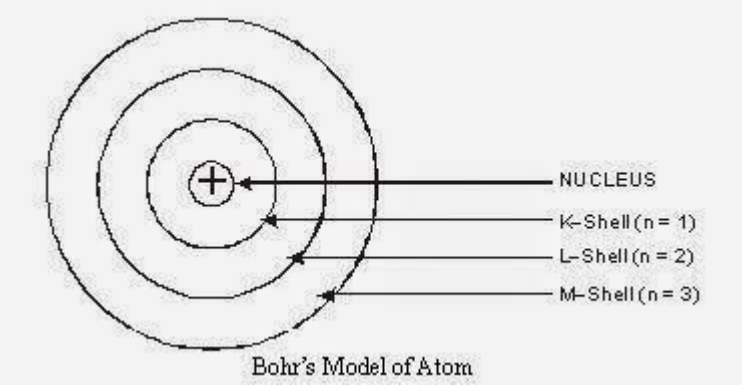
The limitations of Rutherford's model of the atom are
→ It failed to explain the stability of an atom.
→ It doesn't explain the spectrum of hydrogen and other atoms.

4. Describe Bohr's model of the atom.

Answer

→ The atom consists of a small positively charged nucleus at its center.
→ The whole mass of the atom is concentrated at the nucleus and the volume of the nucleus is much smaller than the volume of the atom.
→ All the protons and neutrons of the atom are contained in the nucleus.
→ Only certain orbits known as discrete orbits of electrons are allowed inside the atom.
→ While revolving in these discrete orbits electrons do not radiate

energy. These orbits or cells are represented by the letters K, L, M, N etc. or the numbers, n = 1, 2, 3, 4, . . as shown in below figure.



Bohr's Model of Atom

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

Answer

Thomson's model	Rutherford's model	Bohr's model
An atom consists of a positively charged sphere and the electrons are embedded in it.	An atom consists of a positively charged center in the atom called the nucleus. The mass of the atom is contributed mainly by the nucleus.	Bohr agreed with almost all points as said by Rutherford except regarding the revolution of electrons for which he added that there are only certain orbits known as discrete orbits inside the atom in which electrons revolve around the nucleus.
The negative and positive charges are equal in magnitude. As a result the atom is electrically neutral.	The size of the nucleus is very small as compared to the size of the atom.	While revolving in its discrete orbits the electrons do not radiate energy.

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

Answer

The rules for writing of the distribution of electrons in various shells for the first eighteen elements are given below.
→ If n gives the number of orbit or energy level, then $2n^2$ gives the maximum number of electrons possible in a given orbit or energy level.
Thus,
First orbit or K-shell will have 2 electrons,
Second orbit or L-shell will have 8 electrons,
Third orbit or M-shell will have 18 electrons.
→ If it is the outermost orbit, then it should have not more than 8 electrons.
→ There should be step-wise filling of electrons in different orbits, i.e., electrons are not accompanied in a given orbit if the earlier orbits or shells are incompletely filled.

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

Answer

The valency of an element is the combining capacity of that element. The valency of an element is determined by the number of valence electrons present in the atom of that element.→ Valency of Silicon: It has electronic configuration: 2,8,4
Thus, the valency of silicon is 4 as these electrons can be shared with others to complete octet.
→ Valency of Oxygen: It has electronic configuration: 2,6
Thus, the valency of oxygen is 2 as it will gain 2 electrons to complete its octet.

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8. Explain with examples (i) Atomic number, (ii) Mass number, (iii) Isotopes and (iv) Isobars. Give any two uses of isotopes.

Answer

(i) Atomic number: The atomic number of an element is the total number of protons present in the atom of that element. For example, nitrogen has 7 protons in its atom. Thus, the atomic number of nitrogen is 7.

(ii) Mass number: The mass number of an element is the sum of the number of protons and neutrons present in the atom of that element. For example, the atom of boron has 5 protons and 6 neutrons. So, the mass number of boron is 5 + 6 = 11.

(iii) Isotopes: These are atoms of the same element having the same atomic number, but different mass numbers. For example, chlorine has two isotopes with atomic number 17 but mass numbers 35 and 37 represented by

$$\frac{35}{17}Cl, \frac{37}{17}Cl$$

(iv) Isobars: These are atoms having the same mass number, but different atomic numbers i.e., isobars are atoms of different elements having the same mass number. For example, Ne has atomic number 10 and sodium has atomic number 11 but both of them have mass numbers as 22 represented by -

$$\frac{22}{10}Ne, \frac{22}{11}Ne$$

Two uses of isotopes:
→ One isotope of uranium is used as a fuel in nuclear reactors.
→ One isotope of cobalt is used in the treatment of cancer.

9. Na^+ has completely filled K and L shells. Explain.

Answer

The atomic number of sodium is 11. So, neutral sodium atom has 11 electrons and its electronic configuration is 2, 8, 1. But Na^+ has 10 electrons. Out of 10, K-shell contains 2 and L-shell 8 electrons respectively. Thus, Na^+ has completely filled K and L shells.

10. If bromine atom is available in the form of, say, two isotopes 79 / 35Br (49.7%) and 81 / 35Br (50.3%), calculate the average atomic mass of bromine atom.

Answer

It is given that two isotopes of bromine are 79 / 35Br (49.7%) and 81 / 35Br (50.3%). Then, the average atomic mass of bromine atom is given by:

$$79 \times \frac{49.7}{100} + 81 \times \frac{50.3}{100}$$

$$= \frac{3926.3}{100} + \frac{4074.3}{100}$$

$$= \frac{8000.6}{100}$$

$$= 80.006\ u$$

11. The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes 16 / 8 X and 18 / 8 X in the sample?

Answer

It is given that the average atomic mass of the sample of element X is 16.2 u.
Let the percentage of isotope 18 / 8 X be y%. Thus, the percentage of isotope 16 / 8 X will be (100 - y) %.

Therefore,

$$18 \times \frac{y}{100} + 16 \times \frac{(100-y)}{100} = 16.2$$

$$\frac{18y}{100} + \frac{16\,(100-y)}{100} = 16.2$$

$$\frac{18y+1600-16y}{100} = 16.2$$

18y + 1600 - 16y = 1620
2y + 1600 = 1620
2y = 1620 - 1600
y= 10
Therefore, the percentage of isotope 18 / 8 X is 10%.
And, the percentage of isotope 16 / 8 X is (100 - 10) % = 90%.

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

Answer

By Z = 3, we mean that the atomic number of the element is 3. Its electronic configuration is 2, 1. Hence, the valency of the element is 1 (since the outermost shell has only one electron).
Therefore, the element with Z = 3 is lithium.

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

	X	Y
Protons =	6	6
Neutrons =	6	8

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

Answer

Mass number of X = Number of protons + Number of neutrons = 6 + 6 = 12

Mass number of Y = Number of protons + Number of neutrons
= 6 + 8
= 14

These two atomic species X and Y have the same atomic number, but different mass numbers. Hence, they are isotopes.

14. For the following statements, write T for 'True' and F for 'False'.

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

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

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

► True

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

► False

15. Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) Atomic nucleus
(b) Electron
(c) Proton
(d) Neutron
► (a) Atomic nucleus

16. Isotopes of an element have
(a) the same physical properties
(b) different chemical properties
(c) different number of neutrons
(d) different atomic numbers
► (c) different number of neutrons

17. Number of valence electrons in Cl^- ion are:
(a) 16
(b) 8
(c) 17
(d) 18
► (b) 8

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18. Which one of the following is a correct electronic configuration of sodium?
(a) 2, 8
(b) 8, 2, 1

(c) 2, 1, 8
(d) 2, 8, 1
► (d) 2, 8, 1

19. Complete the following table.

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

Answer

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

Chapter 3
Atoms and Molecules
Intext Questions

On Page 32

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

Sodium carbonate + ethanoic acid →sodium ethanoate + carbon + dioxide + water

Solution:

Law of conservation of mass states that mass is neither created nor destroyed during a chemical reaction.
It means the mass remains the same. So, we add the mass of the reactants on LHS and add the mass of all products on RHS

LHS = 5.3 g + 6 g = 11.3 g
RHS = 8.2g + 2.2g + 0.9g = 11.3g
LHS = RHS

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

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

Solution:'Law of constant proportions' states that composition of a compound is always fixed.
Applying this
∵1 g of hydrogen gas combines with oxygen = 8 g
∴3 g of hydrogen gas will combine with oxygen = 8 x 3 = 24 g

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

Solution:Following postulate of Dalton's atomic theory is the result of the law of conservation of mass. 'Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.'

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

Solution:Following postulate of Dalton's atomic theory can explain the 'law of definite proportions'.
'The relative number and kinds of atoms are constant in a given compound.'

On Page 35

Question 1:Define the atomic mass unit.

Solution:One atomic mass unit (amu) is a mass unit equal to exactly one-twelfth (1/12th) the mass of one atom of carbon-12.' The relative atomic masses of all the elements have been found with respect to an atom of carbon-12.

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

Solution:As an atom is extremely small in size, it is not possible to see it with naked eyes.
Generally radius of an atom is of the order of nanometres. For example, atomic radius of hydrogen atom is 10-10m (or 10-1nm).

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Question 1:Write down the formulae of

(i) sodium oxide
(ii) aluminium chloride
(iii) sodium sulphide
(iv) magnesium hydroxide

Solution:

(i)Na2O

(ii)NH4Cl

(iii)Na2SO4

(iv)Mg(OH)2

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

(i) AL2(SO4)3 (ii) CaCL2 (iii) K2SO4 (iv) KNO3(v) CaCO3

Solution:

(i) Aluminium sulphate

(ii) Calcium chloride

(iii) Potassium sulphate

(iv) Potassium nitrate

(v) Calcium carbonate.

Question 3:What is meant by the term chemical formula?

Solution:

Chemical formula of a compound (or element) is the symbolic representation of its composition. It represents
(i) The number and kind of atoms present per molecule of the compound,
(ii) One mole of the compound,
(iii) Molar mass of the compound.

Question 4:How many atoms are present in a
(i) H_2S molecule and (ii) PO_4^{3-} ion?

Solution:

(i) 2 atom of hydrogen + 1 atom of sulphur

= three (3) atoms (in a H_2S molecule).

(ii) 1 atom of phosphorus + 4 atoms of oxygen

= five (5) atoms (in a PO_4^{3-} ion).

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Question 1:Calculate the molecular masses of
H_2, O_2, CL_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.

Solution:
(i) Molecular mass of H_2(hydrogen)

= Atomic mass of hydrogen × 2
= 1 × 2 = 2 u

(ii) Molecular mass of O_2 (oxygen)
=Atomic mass of oxygen × 2

= 16 × 2 = 32 u

(iii) Molecular mass of CI_2(chlorine)
= Atomic mass of chlorine × 2
= 35.5 × 2 = 71 u
(iv) Molecular mass of CO_2(carbon dioxide)
= (Atomic mass of carbon × 1)+ (Atomic mass of oxygen × 2)
= 12 + (16 × 2) = 12 + 32 = 44 u

(v) Molecular mass of CH_4(methane)
= (Atomic mass of carbon × 1) + (Atomic mass of hydrogen × 4)

= 12 + (1 × 4) = 12 + 4 = 16 u

(vi) Molecular mass of C2H6(ethane)
= (Atomic mass of carbon × 2) + (Atomic mass of hydrogen × 6)
= (12 × 2) + (1 × 6) = 24 + 6 = 30 u

(vii) Molecular mass of C2H4(ethene)
= (Atomic mass of carbon × 2) + (Atomic mass of hydrogen × 4)
= (12 × 2) + (1 × 4) = 24 + 4 = 28 u

(viii) Molecular mass of NH3(ammonia)
= (Atomic mass of nitrogen × 1) + (Atomic mass of hydrogen × 3)
= (14 × 1) + (1 × 3) = 14 + 3 = 17 u

(ix) Molecular mass of CH3OH (methanol or methyl alcohol)
= (Atomic mass of carbon × 1) + (Atomic mass of hydrogen × 3)+ (Atomic mass of oxygen × 1) + (Atomic mass of hydrogen × 1)

= 12 + 3 + 16 + 1 = 32 u

Question 2:Calculate the formula unit masses of Zn0, Na20, K2C03.
Given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u

C = 12 u and 0 = 16 u.

Solution:

(i) Formula unit mass of ZnO (zinc oxide) =
65 + 16 = 81 u
(ii) Formula unit mass of Na2O (sodium oxide) =
(23 × 2) + (16 × 1) = 46 + 16 = 62 u
(iii) Formula unit mass of K2CO3(potassium carbonate) =
(39 × 2) + (12 × 1) + (16 × 3) = 78 + 12 + 48 = 138 u

On Page 42

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

Solution:

1 mole carbon atom = 6.022×10^{23} atoms
Molar atomic mass = 12 g
6.022×10^{23} carbon atoms weigh = 12 g

$$1 \text{ carbon atom weighs } \frac{12}{6.022 \times 10^{23}} = 1.99 \times 10^{-23} \text{g}$$

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

Solution:

Molar mass of sodium = 23 g
1 mole atom = 6.022×10^{23} atoms

23 g sodium contains = 6.022×10^{23} atoms

1 g sodium contains = $\frac{6.022 \times 10^{23}}{23}$ atoms

100 g sodium contains = 6.022×10^{23} atoms

= 2.618×10^{24} atoms

By the above method or by formula we find number of atoms in 100 g Fe;

Number of atoms of an element in a given mass

$$= \frac{\text{Given mass}}{\text{Gram atomic mass } 100g} \times \text{Avogadro's number}$$

$$= \frac{100g}{56g} \times 6.022 \times 10^{23}$$

= 1.075×10^{24} atoms

Hence, 100 g of sodium has more number of atoms as compared to 100 g of iron.

Exercises

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

Solution:

Mass of the compound = 0.24 g
Mass of boron = 0.096 g
Mass of oxygen = 0.144 g

$$\text{Percentage of boron} = \frac{\text{Mass of boron}}{\text{Mass of compound}} \times 100 = \frac{0.096\ g}{0.240\ g} \times 100 = 40\%$$

$$\text{Percentage of oxygen} = \frac{\text{Mass of oxygen}}{\text{Mass of compound}} \times 100$$

$$= \frac{0.144g}{0.240g} \times 100$$

Alternative method

Percentage of oxygen =100 percentage of boron
=100 - 40 = 60%

Question 2:When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of

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

Solution:

First we find the proportion of mass of carbon and oxygen in carbon dioxide.
In CO_2 , C : O = 12 : 32 or 3 : 8
In other words, we can say that
12.00 g carbon reacts with oxygen = 32.00 g
3.00 g carbon will react with oxygen = 32 x 3 = 8g

12

Therefore, 3.00 g of carbon will always react with 8.00 g of oxygen to form CO_2 (11g), even if large amount (50.00 g) of oxygen is present. This answer will be governed by 'the law of constant proportions'.

Question 3:What are polyatomic ions? Give examples.

Solution:The group of atoms which carry a fixed charge (either positive or negative) on them and behave as ions are called polyatomic ions.

Example
(i) Carbonate ion (ii) Sulphate ion
(iii) Ammonium ion (iv) Phosphate ion

Question 4:Write the chemical formulae of the following.
(i) Magnesium chloride (ii) Calcium oxide

(iii) Copper nitrate (iv) Aluminium chloride
(v) Calcium carbonate

Solution:

(i)
Formula = $MgCl_2$ (Magnesium chloride)
(ii)
Formula = CaO (Calcium oxide)
(iii)
Formula = $Cu(NO_3)_2$ (Copper nitrate)
(iv)
Formula = $AlCl_3$ (Aluminium Chloride)
(v)
Formula = $CaCO_3$ (Calcium carbonate)

Question 5:Give the names of the elements present in the following compounds.
(a) Quick lime (b) Hydrogen bromide
(c) Baking powder (d) Potassium sulphate

Solution:
(a) Quick lime- Calcium oxide - CaO
Elements–Calcium, oxygen.

(b)Hydrogen bromide- HBr
Elements- Hydrogen, bromine.

(c) Baking powder- Sodium hydrogen carbonate -$NaHCO_3$
Elements- Sodium, hydrogen, carbon, oxygen.

(d)Potassium sulphate- K_2SO_4
Elements- Potassium, sulphur, oxygen.

Question 6:Calculate the molar mass of the following substances.
(a) Ethyne, C_2H_2
(b) Sulphur molecule, S_8
(c) Phosphorus molecule, P_4(Atomic mass of phosphorus = 31)
(d) Hydrochloric acid, HCl
(e) Nitric acid, HNO_3

Solution:

(a) Molar mass of C_2H_2

= (2 × Atomic mass of C) + (2 × Atomic mass of H)
= (2 × 12) + (2 × 1)
= 26 u

(b) Molar mass of S_8

= (8 × Atomic mass of S)
= 8 × 32 = 256 u

(c) Molar mass of P_4

= 4 × Atomic mass of P
= 4 × 31 = 124u

(d) Molar mass of HCl

= Atomic mass of hydrogen + Atomic mass of CI
= 1 + 35.5 = 36.5 u

(e) Molar mass of HN03

= Atomic mass of H + Atomic mass of N + (3 × Atomic mass of 0)
= 1 + 14 + (3 × 16) = 15 + 48 = 63 u

Question 7:What is the mass of
(a) 1 mole of nitrogen atoms?
(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?
(c) 10 moles of sodium sulphite (Na2SO3)?

Solution:

(a) Molar mass of N atom = Atomic mass of N.
Mass of 1 mol of N atoms = 14 g

(b) Mass of 1 mole AI atoms = 27 g
Mass of 4 moles of AI atoms = 27 × 4 = 108 g

(c) Mass of 1 mole of Na2SO3 = (23 ×2) + 32 + (16 × 3)
= 46 + 32 + 48 = 126 g
Mass of 10 moles of Na2SO3 = 126 × 10 = 1260 g

Question 8:Convert into mole.
(a) 12 g of oxygen gas
(b) 20 g of water
(c) 22 g of carbon dioxide.

Solution:

(a) (O2)
Molar mass of oxygen (O2) = 16 x 2 = 32 g
32 g oxygen gas = 1 mol

12 g oxygen gas = 1 x 12 g = 0.375 mol

32g

(b) (H2O)
Molar mass of water (H2O) = 2 + 16 = 18g
18 g water = 1 mol
20 g water = 1 x 20 g = 1.11 mol

18g

(c) 22g of Carbon Dioxide(CO2)
Molar mass of carbon dioxide (CO2)=12 + 32 = 44g
44 g CO2 = 1 mol
22 g CO2 =1x 22 g = 0.5 mol

44g

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

Solution:

(a) Mass of 1 mole O-atoms = 16 g
Mass of 0.2 mole O-atoms = 16 × 0.2 = 3.2 g
(b) Mass of 1 mole of H2O molecules = 18 g

Mass of 0.5 mole of H_2O molecules = 18 × 0.5 = 9.0 g

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

Solution:

Molar mass of sulphur (S_8) = 32 x 8 = 256 g
Number of S_8 molecules in 256 g of solid sulphur = 6.022×10^{23}

Number of S_8 molecules in 16 g of solid sulphur $= \frac{6.022 \times 10^{23} \times 16g}{256g}$

$= 3.76 \times 10^{23}$ molecules

Question 11:Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.
[HintThe mass of an ion is the same as that of an atom of the same element. Atomic mass of AI= 27 u.]

Solution:

Molar mass of $AL_2O_3 = (27 \times 2) + (16 \times 3) = 54 + 48 = 102$ g

$$\underset{(102\text{ g})}{\underset{1\text{ mol}}{AL_2O_3}} \rightleftharpoons \underset{2\text{ mol}}{2\overset{3+}{AL}} + 3\overset{2-}{O}$$

$\because$ 102 g AL_2O_3 contains AL^3 + ions $= 2 \times 6.022 \times 10^{23}$

$\therefore$ 0.051 g AL_2O_3 will contain AL^3 + ions $= \dfrac{2 \times 6.022 \times 10^{23}}{102} \times 0.05$

$= 6.022 \times 10^{20}$ AL^{3+} ions

Chapter 2
Is Matter around Us Pure
Intext Questions

On Page 15

Question 1:What is meant by a pure substance?

Solution:Substance having single type of particles is known as pure substance.
For example:Hydrogen, Water etc., are pure.
Note:All elements and compounds are considered to be pure.

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

Solution:

Homogeneous mixture

Its constituent's particles cannot be seen easily.

There are no visible boundaries of separation in a homogeneous mixture.

Its constituents cannot be easily separated.

Examples: Alloys, solution of salt in water etc.

Heterogeneous mixture

Its constituent particles can be seen easily.

Have visible boundaries of separation between the constituents.

Its constituents can be separated by simple methods.

Examples: Mixture of sand and common salt, mixture of sand and water etc.

On Page 18

Question 1:Differentiate between homogeneous and heterogeneous mixture with example.

Solution:Same as above answer.

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

Solution:

Solution :

Solution or true solution is homogeneous.

NO Tyndall effect.

Solute particles cannot be filtered by using a filter paper

True solution is transparent.

Examples: Sea water, alloys, solution of lemon juice in water etc.

Sol (colloidal solution) :

Sol or colloidal solution is heterogeneous.

Tyndall effect.

Cannot be separated by ordinary filter paper.

It may be transparent or translucent.

Examples: Milk of magnesia, cough syrup, mist, fog, clouds, smoke, mud etc.

Suspension :

Suspension is also heterogeneous.

Tyndall effect.

It may be transparent or translucent.

Separated easily by filter paper.(because of large particles)

Examples: Mixture of sand in water, mixture of chalk in water.

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

Solution:
Mass of sodium chloride (solute) = 36 g
Mass of water (solvent) = 100 g
We know that, mass of solution = mass of solute + mass of solvent
= 36 g+ 100 g= 136 g

Concentration (mass percentage) of the solution

$$= \frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 100$$

$$= \frac{36\text{g}}{136\text{ g}} \times 100 = 26.47\%$$

On Page 24

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

Solution:Simple distillation is the method which can separate the mixture of kerosene and petrol (b.p. differ by more than 25°C).

Method:In a distillation flask, a mixture of kerosene and petrol is taken

as shown in figure. The mixture is heated slowly and the temperature is recorded with the help of thermometer. Petrol
(b.p. = 70° C to 1200 ° C) vaporizes first and the temperature becomes constant for some time (till all petrol evaporates from the mixture). Vapours of petrol are condensed and collected in
another container while the kerosene remains in the distillation flask. As soon as the temperature starts' rising again, the heating is stopped and both the components are collected separately.

Question 2:Name the technique to separate
(i) Butter from curd
(ii) Salt from sea water
(iii) Camphor from salt

Solution:(i) By using centrifugation method, butter can be separated from curd.
(ii) By using evaporation method, salt from sea water can be separated . Water vaporises on evaporation leaving behind the salt.
(iii) Camphor from salt can be separated by sublimation method. On subliming camphor will be converted into vapour leaving behind the salt.

Question 3:What types of mixtures are separated by the technique of crystallisation?

Solution:Crystallisation method can be used for the purification of those mixtures which

Contain insoluble and/or soluble impurities.

Have crystalline nature.

Cannot be separated by filtration as some impurities are soluble.

Question 4:Classify the following as chemical or physical changes

(a) Cutting of trees,
(b) Melting of butter in a pan,
(c) Rusting of almirah,
(d) Boiling of water to form steam,
(e) Passing of electric current, through water and the water breaking down into hydrogen and oxygen gases,
(f) Dissolving common salt in water,
(g) Making a fruit salad with raw fruits, and
(h) Burning of paper and wood

Solution :

Physical Change :

Cutting of trees

Melting of butter in a pan

Boiling of water to form steam

Dissolving common salt in water

Making a fruit salad with raw fruits

Chemical Change :

Rusting of almirah.

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

Burning of paper and wood.

Question 5:Try segregating the things around you as pure substances or mixtures.
(a) Wood
(b) Coal
(c) Milk
(d) Sugar
(e) Common salt
(f) Soap
(g) Soil
(h) Rubber

Solution:

(a) Mixture
(b) Mixture
(c) Mixture
(d) Pure substance
(e) Pure substance
(f) Compound/mixture
(g) Mixture
(h) Pure substance

Exercises

Question 1:Which separation techniques will you apply for the separation of the following?
(a) Sodium chloride from its solution in water.
(b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride.
(c) Small pieces of metal in the engine oil of a car.

(d) Different pigments from an extract of flower petals.
(e) Butter from curd.
(f) Oil from water.
(g) Tea leaves from tea.
(h) Iron pins from sand.
(i) Wheat grains from husk.
(j) Fine mud particles suspended in water.

Solution:

(a) Evaporation
(b) Sublimation
(c) Filtration
(d) Chromatography.
(e) centrifugal machine or churning the curd by hand.
(f) Decantation
(g) Filtration.
(h) Magnetic Separation.
(i) Winnowing.
(j) Coagulation and decantation:

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

Solution:Method of preparation of tea

(i) Take some water (solvent) in a pan and heat it.
(ii) Add some sugar (solute) and boil to dissolve the sugar completely the obtained homogeneous mixture is called solution.
(iii) Add tea leaves (or tea) in the solution and boil the mixture.

(iv) Now add milk and boil again.
(v) Filter the mixture through the tea stainer and collect the filtrate or soluble substances, i.e., tea in a cup. The insoluble tea leaves left behind as residue in the 8 trainer.

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

(a) What mass of potassium nitrate would be needed to produce a saturated solution of potassium nitrate in 50 grams of water at 313 K?

(b) Pragya makes a saturated solution of potassium chloride in water at 353 K and leaves the solution to cool at room temperature. What would she observe as the solution cools?

Explain.

(c) Find the solubility of each salt at 293 K. Which salt has the highest solubility at this temperature?
(d) What is the effect of change of temperature on the solubility of a salt?

Solution:

(a) Mass of potassium nitrate needed to produce its saturated solution in 100 g of water at 313 K = 62 g

Mass of potassium nitrate needed to produce its saturated solution in

50 g of water at 313

$$K = \frac{62}{100} \times 50g = 31g$$

(b) Crystals of potassium chloride are formed. This happens as solubility of solid decreases with decreasing the temperature.

(c) Solubility of each salt at 293 K

Potassium nitrate	32 g per 100 g water
Sodium chloride	36 g per 100 g water
Potassium chloride	35 g per 100 g water
Ammonium chloride	37 g per 100 g water

Note:Solubility of a solid is that amount in gram which can be dissolved in 100 g of water (solvent) to make saturated solution at a particular temperature.

Ammonium chloride has the maximum solubility (37 g per 100 g of water) at 293 K.

(d) Solubility of a (solid) salt decreases with decrease in temperature while it increases with rise in temperature.

Question 4:Explain the following giving examples.
(a) Saturated solution
(b) Pure substance
(c) Colloid
(d) Suspension

Solution:

(a) Saturated solution:A solution in which no more amount of solute can be dissolved at a particular temperature is called saturated solution.
Example: when sugar is dissolved repeatedly in a given amount of water, a condition is reached at which further dissolution of sugar is not possible in that amount of water at room temperature.
(b) Pure substance: A substance made up of single type of particles (atoms and/or molecules) is called pure substance. All elements and compounds are said to be pure,
Example: water, sugar etc.

(c) Colloid:A heterogeneous mixture in which the solute particle size is too small to be seen with the naked eye, but is big enough to scatter light is known as Colloid. There are two phases in colloidal solution
Dispersed phase: solute particles are said to be dispersed phase
Dispersion medium: the medium in which solute particles are spread is called the dispersion medium.

Example: Milk, clouds etc., are the example of colloid.

(d) Suspension: A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. Particles of suspension are visible to the naked eye.
Example: Mixture of sand, Water and Muddy water etc.

Question 5:Classify each of the following as a homogeneous or heterogeneous mixture. Soda water, wood, air, soil, vinegar, filtered tea.

Solution:Homogeneous mixtures: Air, soda water, vinegar, filtered tea.

Heterogeneous mixtures: Wood, soil,

Question 6:How would you confirm that a colorless liquid given to you is pure water?

Solution:If the given colorless liquid boils at 100°C sharp, it is pure water, otherwise not.

Question 7:Which of the following materials fall in the category of a "pure substance"?

(a) Ice	(b) Milk	(c) Iron
(d) Hydrochloric acid	(e) Calcium oxide	(f) Mercury
(g) Brick	(h)Wood	(i) Air

Solution:Ice, iron, calcium oxide, mercury are pure substance as they have definite composition.

Milk is a colloid, so it is a heterogeneous mixture.

Hydrochloric acid is also a mixture of hydrogen chloride gas and water.

Question 8:Identify the solutions among the following mixtures.

(a) Soil
(b) Sea water
(c) Air
(d) Coal
(e) Soda water

Solution:

Sea water, air and soda water: Homogeneous mixture
Coal, Soil: Heterogeneous solution.

Question 9:Which of the following will show "Tyndall effect"?
(a) Salt solution
(b) Milk
(c) Copper sulphate solution
(d) Starch solution

Solution:Milk and starch solution will show "Tyndall effect" as both of these are colloids.

Question 10:Classify the following into elements, compounds and mixtures.

(a) Sodium	(b) Soil	(c) Sugar solution
(d) Silver	(e) Calcium carbonate	(f) Tin
(g) Silicon	(h) Coal	(i) Air
(j) Soap	(k) Methane	(l) Carbon dioxide
(m) Blood		

Solution:

Elements : Sodium, silver, tin and silicon
Compounds : Calcium carbonate, methane, and carbon dioxide
Mixtures : Soil, sugar solution, coal, air, soap and blood.

Question 11:Which of the following are chemical changes?
(a) Growth of a plant
(b) Rusting of iron

(c) Mixing of iron filings and sand
(d) Cooking of food
(e) Digestion of food
(f) Freezing of water
(g) Burning of a candle

Solution:Growth of a plant, rusting of iron, cooking of food, digestion of food, burning of a candle are chemical changes, because here the chemical composition of substance changes.

Chapter 1
Matter in Our Surroundings
Intext Questions
On Page 3

Question 1:Which of the following are matters?

Chair, air, love, smell, hate, almonds, thought, cold, cold-drink, smell of perfume.

Solution: Any things which have some weight and occupy space will come under category of matter.
Chair, air, smell, almonds, cold-drink and smell of perfume: Matter

Question 2:Give reasons for the following observation

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

Solution: Evaporation is directly proportional to temperature, means hot food evaporates easily.Diffusion of hot food vapor with air becomes very fast and can reach to a distant place within a very short time.

Question 3:A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?

Solution: The phenomena of cutting the water by the diver show that matter has space between its particles.

Question 4:What are the characteristics of the particles of matter?

Solution: Characteristics of particles of matter are given below:
1. Particles of matter have space between them.
2. Particles of matter are continuously moving.
3. Particles of matter have an attraction force between them.
4. Particles of matter are very small in size.

On Page 6

Question 1:The mass per unit volume of a substance is called density. (Density = mass/volume).
Arrange the following in order of increasing density–
Air, exhaust from chimneys, honey, water, chalk, cotton and iron.

Solution:We can solve this question by keeping this concept in mind. The correct order of density for gas, liquid and solid are:
Gas < Liquid < Solid. Thus,

Air, exhaust from chimneys — water, honey, — cotton , chalk ,iron
Gas — Liquid — Solid
---------->
Increasing order of Density

Question 2:

(a) Tabulate the differences in the characteristics of states of matter.
(b) Comment upon the following:
Rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy and
density.

Solution:
(a)Solid :

Solids have a definite volume.
Solids do not tend to flow.
Solids are rigid.
Generally solids have a definite shape with very few exceptions like sponge, rubber band etc.
Solids are generally incompressible with very few exceptions like sponge, rubber band etc.

Liquid :

Liquids also have a definite volume.
Liquids tend to flow.
Liquids are not rigid.
Liquids do not have a definite shape. They take the shape of the container.
Liquids are almost incompressible.

Gases :

Gases do not have a definite volume. Their volume varies with the container in which they are stored or kept.
Gases also tend to flow
Gases are not rigid.
Gases do not have a definite shape
Gases are compressible.

(b)

Rigidity:Property by which an object retains its shape and size is called as rigidity.
Solids are rigid whereas liquids and gases are not.

Compressibility: Compressibility is the property; due to which a substance can be
compressed, means its volume can be decreased. Gases are compressible whereas solids
and liquids are not.

Fluidity: Flowing tendency of a substance called fluidity. Gases and liquids are fluids,
solids are not.

Filling a gas container: a large volume of gas can be filled in a gas container by
compressing it under very high pressure. The property of compressibility (of gases) ivey sue full in this case

Shape:The property of having a definite geometry is called shape of a particular
substance. Solids have a definite shape whereas gases and liquids do not have.

Kinetic energy: The energy possessed by a moving object or by the moving molecules
of called kinetic energy.
On increasing the temperature, kinetic energy of a substance (or its molecules) also
increases. Molecules of gases posses highest kinetic energy.

Density : The mass per unit volume of a substance is called density.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Question 3:Give reasons:

(a) A gas fills completely the vessel in which it is kept.
(b) A gas exerts pressure on the walls of the container.
(c) A wooden table should be called a solid.
(d) We can easily move our hand in air but to do the same through a solid block of wood we need a karate expert.

Solution:
(a) Force of attraction between the molecules of gases is negligible. So, molecules of gases occupy the maximum space available to them. High kinetic energy possessed by their molecules also helps for the same.

(b)The motion of particles is random and having very high speed in the gaseous state.Due to this random movement, the particles hit each other and also the walls of the container. The pressure exerted by the gas is due to this force exerted by these particles per unit area on the walls of the container.

(c) There is a strong force of attraction between the molecules of wood and the intermolecular space is the least. So, a wooden table has a definite shape and volume and it should be called a solid.

(d) Air molecules are very-very far from each other due to negligible force of attraction working between them. So, our hand gets sufficient

space to move in air and we also displace some air molecules by applying force. But a solid block of wood has closely
packed molecules so there is no question of the movement of hand through it, in absence of suitable force in proper direction.

Question 4:Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why?

Solution:Liquids have lower density than that of solids. Water is also a liquid so it should also

have less density than that of solid that is ice.

But the case is not so and the reason for the same is the cage-like structure of ice. i.e.,
presence of vacant spaces between water (H2O) molecules when they linked in ice. The number of these spaces is comparatively less in water. Being more porous than water, ice
is lighter than water and floats over the surface of water.

On Page 9

Question 1:Convert the following temperature to Celsius scale
(a) 300 K (b) 573 K

Solution: By the use of given formula, we can convert the Kelvin temperature to Celsius.

T K –273 = t°C
(a) 300K–273 = 27°C
(b) 573K–273 = 300°C

Question 2:What is the physical state of water at
(a) 250°C (b) 100°C?

Solution:

As the boiling point of water is 100°C so
(a) at 250°C, the state of water will be steam or water vapour, i.e., gaseous state.
(b) at 100°C, there will be a transition of liquid state into the gaseous state. So, at this
temperature, the state is/may be liquid as well as gaseous.

Question 3:For any substance, why does the temperature remain constant during the change of state?

Solution:During the change of state of a substance, the temperature remains constant. This can be understood with the help of an example. When a solid is heated to its melting point, the

temperature first rises and becomes constant when reaches its melting point. Now, on further heating, the heat energy provided to the substance helps to break the attraction force between the solid molecules. This heat is called latent heat. That is why, the temperature does not rise.

Question 4:Suggest a method to liquefy atmospheric gases.

Solution:By applying pressure and reducing the temperature, atmospheric gases can be liquefied

On Page 10

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

Solution:A desert cooler functions on the basis of evaporation. The rate of evaporation increases with increase in temperature and decrease in humidity. As evaporation increases when the day is hot and dry. So, the desert cooler functions to a better extent.

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

Solution: Large number of tiny pores is present on the surface of the earthen pot (matka). The water stored in the earthen pot (matka) evaporates faster through these pores due to the increased exposed surface area. As the' process of evaporation causes cooling, the stored water inside the earthen pot (matka) becomes cool.

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

Solution:Acetone, petrol, perfume etc., being volatile, evaporate very fast when exposed to larger surfaces. During the process they absorb the required latent heat of vaporization from the palm (if kept on palm). So, the process causes Cooling and the palm feels cool.

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

Solution: A liquid has large surface area in a saucer than in a cup. Thus, it evaporates faster and cools faster in a saucer than in a cup. For this reason we able to sip hot tea or milk faster from a saucer rather than a cup.

Question 5:What type of clothes should we wear in summer?

Solution:We should wear light colored cotton clothes in summer because

1. Cotton is a good absorber of water/sweat. It provides more surface area for the sweat to evaporate.
2. Light colours absorb less heat.

So, wearing light coloured cotton clothes helps us feeling cool and comfortable.

Exercises

Question 1:Convert the following temperatures to the Celsius scale.
(a) 293 K (b) 470 K

Solution:

In order to covert temperature from Kelvin to Celsius scale, we have to subtract 273 from the given value because K - 273 = ° C
(a) 293 K - 273 = 20°C
(b) 470K - 273 = 197°C

Question 2:Convert the following temperatures to the kelvin scale.

(a) 25°C (b) 373°C

Solution: To convert temperature from Celsius to Kelvin scale, add 273 to the given values because

° C + 273 = K
(a) 25°C + 273 = 298 K
(b) 373°C + 273 = 646 K

Question 3:Give reason for the following observations.

(a) Naphthalene balls disappear with time without leaving any solid.
(b) We can get the smell of perfume sitting several meters away.

Solution:
(a) Naphthalene is a substance which directly changes from solid to gas on heating by the process of sublimation. So, the naphthalene balls disappear with time as they sublime due to heat of surroundings.

(b) The smell (aroma) of perfume reaches several meters away due to the fast diffusion of the gaseous perfume particles through the air.

Question 4:Arrange the following substances in increasing order of forces of attraction between the particles-water, sugar, oxygen.

Solution:The forces of attraction are strongest in solids and weakest (or negligible) in case of gases. Sugar is a solid, water is in liquid form and oxygen is a gas so, the order of forces of attraction is oxygen < water < sugar.

Question 5:What is the physical state of water at (a) 25°C (b) 0°C (c) 100°C?

Solution:At zero °C temperature water (liquid) get starts to convert into its solid form (ice) and at 100°C temperature water (liquid) starts to change into water vapours .Between 0° to 100°C it remains in liquid state.
Thus,
(a) Liquid state
(b) Solid or/and liquid state (Transition state)
(c) Liquid or/and gaseous state (Transition state)

Question 6:Give two reasons to justify

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

Solution:

(a) Water is a liquid at room temperature because

It has a tendency to flow.

It takes the shape of the container in which it is filled, but its volume remains the same.

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

Its shape and volume are definite.

It is hard and rigid.

Its density is high.

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

Solution:Ice at 273K has less energy than water (although both at the same temperature). Water is having additional latent heat of fusion, hence at 273 K ice is more effective cooling than water

Question 8:What produces more severe burns, boiling water or steam?

Solution:Steam causes more severe burns than boiling water. The reason is that it releases the extra amount of heat (latent heat) which it has already taken during vaporization

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

Solution :

A = Melting or fusion, where solid changes into liquid.
B = Evaporation or vaporization, where liquid changes into gas.
C = Condensation or liquification where gas changes into liquid.
D = Freezing or solidification, where liquid changes into solid.
E = Sublimation, where solid directly changes into gas without coming in liquid state.
F = Sublimation, where gas changes into solid without coming to liquid state.