Atoms and Molecules

Multiple Choice Questions

1. Which of the following correctly represents 360 g of water?
(i) 2 moles of H_20
(ii) 20 moles of water
(iii) 6.022×10^{23} molecules of water
(iv) 1.2044×10^{25} molecules of water
(a) (i)
(b) (i) and (iv)
(c) (ii) and (iii)
(d) (ii) and (iv)
Ans. (d) (ii) and (iv)

2. Which of the following statements is not true about an atom?
(a) Atoms are not able to exist independently
(b) Atoms are the basic units from which molecules and ions are formed
(c) Atoms are always neutral in nature
(d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch
Ans. (a) Atoms are not able to exist independently.
Explanation: Atoms of inert gases exist independently, i.e. as single atom.

3. The chemical symbol for nitrogen gas is
(a) Ni
(b) N_2
(c) N^+
(d) N
Ans. (b) N_2

4. The chemical symbol for sodium is
(a) So
(b) Sd
(c) NA
(d) Na
Ans. (d) Na

5. Which of the following would weigh the highest?
(a) 0.2 mole 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 $CaCO_3$
Explanation: Weight of 1 mole of each compound can be calculated as follows:

(a) Sucrose $= 12\times12 + 22\times1 + 11\times16 = 144 + 22 + 176 = 342\ g$

Or 0.2 M Sucrose $= 342\times0.2 = 68.4\ g$

(b) 1 M carbon dioxide $= 1\times12 + 2\times16 = 44\ g$

Or 2 M $CO_2 = 44\times2 = 88\ g$

(c) 1 M $CaCO_3 = 1\times10 + 1\times12 + 3\times16 = 100\ g$

Or 2 M $CaCO_3 = 100\times2 = 200\ g$

(d) 1 M $H_2O = 2\times1 + 1\times16 = 18g$

Or 10 M water $= 18\times10 = 180g$

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

(a) 18 g of H_2O

(b) 18 g of O_2

(c) 18 g of CO_2

(d) 18 g of CH_4

Ans. (d) 18 g of CH_4

Explanation: Number of atoms

$$= \frac{\text{mass of substance} \times \text{no. of atoms in a molecule}}{\text{molar mass}} \times N_A$$

(a) for 18g of $H_2O = \frac{18g\times3}{18g}\times N_A = 3N_A$

(b) for 18g of $O_2 = \frac{18g\times2}{32g}\times N_A = 1.125N_A$

(c) for 18g of $CO_2 = \frac{18g\times3}{44g}\times N_A = 1.23N_A$

(d) for 18g of $CH_4 = \frac{18g\times5}{16g}\times N_A = 5.625N_A$

7. Which of the following contains maximum number of molecules?

(a) 1g CO_2

(b) 1g N_2

(c) 1g H_2

(d) 1g CH_4

Ans. (c) 1g H_2

Explanation: Number of molecules $= \frac{\text{mass of substance}}{\text{molar mass}} \times N_A$

For 1 g hydrogen $= \frac{1g}{2g}\times N_A = 0.5N_A = 0.5\times6.022\times10^{23}$

$= 3.011 \times 10^{23}$

Molar mass of other molecules are much higher than given mass, so number of molecules in them will be less than that in hydrogen.

8. Mass of one atom of oxygen is

(a) $\frac{16}{6.023 \times 10^{23}} g$

(b) $\frac{32}{6.023 \times 10^{23}} g$

(c) $\frac{1}{6.023 \times 10^{23}} g$

(d) 8 u

Ans. (a) $\frac{16}{6.023 \times 10^{23}} g$

Explanation: Mass of one atom of oxygen

$= \frac{\text{Atomic mass}}{\text{N}_\text{A}} = \frac{16}{6.023 \times 10^{23}} g$

9. 3.42 g of sucrose are dissolved in 18 g of water in a beaker. The number of oxygen atoms in the solution are

(a) 6.68 x 10^{23}

(b) 6.09 x 10^{22}

(c) 6.022 x 10^{23}

(d) 6.022 x 10^{21}

Ans. (a) 6.68 x 10^{23}

Explanation: Number of moles = mass of substance/molar mass

Molar mass of sucrose = 342 g

No. of moles for 3.42 g sucrose $= \frac{3.42\,g}{342\,g} = 0.01M$

1 M sucrose ($C_{11}H_{22}O_{11}$) contains $= 11 \times N_A$ atoms of oxygen

So, number of oxygen atoms in 0.01 M sucrose $= 0.11 N_A$

No. of moles for 18 g water $= \frac{18g}{18g} = 1M$

1 M water contains 1 N_A oxygen atoms

So, total number of oxygen atoms in given solution

$= 0.11N_A + 1.0N_A = 1.11 N_A$

$= 1.11 \times 6.022 \times 10^{23} = 6.68 \times 10^{23}$.

10. A change in the physical state can be brought about

(a) only when energy is given to the system

(b) only when energy is taken out from the system

(c) when energy is either given to, or taken out from the system

(d) without any energy change

Ans. (c) when energy is either given to, or taken out from the system

Explanation: When a solid changes into liquid, it takes energy. When a liquid changes into solid, it releases energy.

Atoms and Molecules

Short Answer Questions

11. Which of the following represent correct chemical formula? Name it.

(a) CaCl

(b) $BiPO_4$

(c) $NaSO_4$

(d) NaS

Ans. **(b)** In $BiPO_4$; with ions are trivalent and hence this shows the correct chemical formula. In option (a); Ca is bivalent while chlorine is monovalent. In options (c) and (d); Na is monovalent while sulphate and Sulphur are bivalent.

12. Write the molecular formulae for the following compounds

(a) Copper (II) bromide

Ans. $CuBr_2$

(b) Aluminium (III) nitrate

Ans. $Al(NO_3)_3$

(c) Calcium (II) phosphate

Ans. $Ca_3(PO_4)_2$

(d) Iron (III) sulphide

Ans. Fe_2S_3

(e) Mercury (II) chloride

Ans. $HgCl_2$

(f) Magesium (II) acetate

Ans. $Mg(CH_3COO)_2$

13. Write the molecular formulae of all the compounds that can be formed by the combination of following ions

$Cu^{2+},\ Na^{+},\ Fe^{3+},\ Cl^{-}, SO_4^{2-}, PO_4^{3-}$

Ans. $CuCl_2$/ $CuSO_4$/ $Cu_3(PO_4)_2$

$NaCl$/ Na_2SO_4/ Na_3PO_4

$FeCl_3$/ $Fe_2(SO_4)_3$ / $FePO_4$

14. Write the cations and anions present (if any) in the following compounds

(a) CH_3COONa

(b) NaCl

(c) H_2

(d) NH_4NO_3

Ans.

Anions	Cations
(a) CH_3COO^-	Na^+
(b) Cl^-	Na^+
(c) It is a covalent compound	--------
(d) NO_3^-	NH_4^+

15. Give the formulae of the compounds formed from the following sets of elements

(a) Calcium and fluorine

Ans. CaF_2

(b) Hydrogen and sulphur

Ans. H_2S

(c) Nitrogen and hydrogen

Ans. NH_3

(d) Carbon and chlorine

Ans. CCl_4

(e) Sodium and oxygen

Ans. Na_2O

(f) Carbon and oxygen

Ans. CO, CO_2

16. Which of the following symbols of elements are incorrect? Give their correct symbols

(a) Cobalt CO

(b) Carbon c

(c) Aluminium AL

(d) Helium He

(e) Sodium So

Ans. (a) Incorrect, the correct symbol of cobalt is Co

(b) Incorrect, the correct symbol of carbon is C

(c) Incorrect, the correct symbol of aluminium is Al

(d) Correct (He)

(e) Incorrect, the correct symbol of sodium is Na

17. Give the chemical formulae for the following compounds and compute the ratio by mass of the combining elements in each one of them. (You may use appendix-III).

(a) Ammonia

(b) Carbon monoxide
(c) Hydrogen chloride
(d) Aluminium fluoride
(e) Magnesium sulphide

Ans. (a) NH_3; ratio N : H = 14 : 3
(b) CO; ratio C : O = 3 : 4
(c) HCl; ratio H : Cl = 1 : 35.5 or 2 : 71
(d) AlF_3; ratio Al : F = 9 : 19
(e) MgS; ratio Mg : S = 3 : 4

18. State the number of atoms present in each of the following chemical species

(a) CO_3^{2-}

Ans. 4

(b) PO_4^{3-}

Ans. 5

(c) P_2O_5

Ans. 7

(d) CO

Ans. 2

19. What is the fraction of the mass of water due to neutrons?

Ans. Mass of one mole (Avogadro Number) of neutrons ~ 1 g

$$\text{Mass of one neutron} = \frac{1}{\text{Avogadro Number } (N_A)}\, g$$

$$\text{Mass of one molecule of water} = \frac{\text{molar mass}}{N_A} = \frac{18}{N_A}\, g$$

There are 8 neutrons in one atom of oxygen

$$\text{Mass of 8 neutrons} = \frac{8}{N_A}$$

Fraction of mass of water due to neutrons $\square \frac{8}{18}$

20. Does the solubility of a substance change with temperature? Explain with the help of an example.

Ans. Yes, it is a temperature dependent property. The solubility generally, increases with increase in temperature. For example, you can dissolve more sugar in hot water than in cold water.

21. Classify each of the following on the basis of their atomicity.

(a) F_2
(b) NO_2
(c) N_2O
(d) C_2H_6
(e) P_4
(f) H_2O_2
(g) P_4O_{10}
(H) O_3
(i) HCl
(j) CH_4
(k) He
(l) Ag

Ans. (a) 2 atom
(b) 3 atom
(c) 3 atom
(d) 8 atom
(e) 4 atom
(f) 4 atom
(g) 14 atom
(h) 3 atom
(i) 2 atom
(j) 5 atom
(k) 1 atom (noble gases are always monoatomic)
(l) Polyatomic (because metals are bound by metallic bond and any measurable quantity of a metal can contain millions of atoms.)

22. You are provided with a fine white coloured powder which is either sugar or salt. How would you identify it without tasting?

Ans. On heating the powder, it will char if it is a sugar.
Alternatively, the powder may be dissolved in water and checked for its conduction of electricity. If it conducts, it is a salt.

23. Calculate the number of moles of magnesium present in a magnesium ribbon weighing 12 g. Molar atomic mass of magnesium is 24g mol^{-1}.

Ans. Number of moles = mass/molar mass = 12 g/24 g = 0.5 mol

Atoms and Molecules

Long Answer Questions

24. Verify by calculating that

(a) 5 moles of CO_2 and 5 moles of H_2O do not have the same mass.

Ans. CO_2 has molar mass = 44g mol^{-1}

5 moles of CO_2 have molar mass = 44 × 5= 220 g

H_2O has molar mass = 18 g mol^{-1}

5 moles of H_2O have mass = 18 × 5 g= 90 g

(b) 240 g of calcium and 240 g magnesium elements have a mole ratio of 3:5.

Ans. Number of moles in 240g Ca metal $= \frac{240}{40} = 6$

Number of moles in 240g of Mg metal $= \frac{240}{24} = 10$

Ratio 6: 10 = 3: 5

25. Find the ratio by mass of the combining elements in the following compounds. (You may use Appendix-III)

(a) $CaCO_3$

Ans. Ca: C: O_3 = 40: 12: 16 × 3 = 40: 12: 48 = 10: 3: 12

(b) $MgCl_2$

Ans. Mg: CI_2 = 24: 35.55 × 2 = 24: 71

(c) H_2SO_4

Ans. H_2: S: O_4 = 1 × 2: 32: 16 × 4 = 2: 32: 64 = 1: 16: 32

(d) C_2H_5OH

Ans. C_2: H_6: O = 12 × 2: 1 × 6: 16 = 24: 6: 16 = 12: 3: 8

(e) NH_3

Ans. N: H_3 = 14: 1 × 3 = 14: 3

(f) $Ca(OH)_2$

Ans. Ca: O_2: H_2 = 40: 16 × 2: 1 × 2 = 40: 32: 2 = 20: 16: 1

26. Calcium chloride when dissolved in water dissociates into its ions according to the following equation.

$$CaCl_2(aq) \rightarrow Ca^{2+}(aq) + 2Cl^{-}(aq)$$

Calculate the number of ions obtained from $CaCl_2$ when 222 g of it is dissolved in water.

Ans. 1 mole of calcium chloride = 111g

∴ 222g of $CaCl_2$ is equivalent to 2 moles of $CaCl_2$

Since 1 formula unit $CaCl_2$ gives 3 ions, therefore, 1 mol of $CaCl_2$ will give 3 moles of ions
2 moles of $CaCl_2$ would give $3\times 2 = 6$ moles of ions.
No. of ions = No. of moles of ions × Avogadro number
= 6 × 6.022 × 10^{23}
= 36.132 × 10^{23}
= 3.6132 × 10^{24} ions

27. The difference in the mass of 100 moles each of sodium atoms and sodium ions is 5.48002 g. Compute the mass of an electron.

Ans. A sodium atom and ion, differ by one electron. For 100 moles each of sodium atoms and ions there would be a difference of 100 moles of electrons.
Mass of 100 moles of electrons= 5.48002 g

$$\text{Mass of 1 mole of electron} = \frac{5.48002}{100}\,g$$

$$\text{Mass of one electron} = \frac{5.48002}{100\times 6.022\times 10^{23}} = 9.1\times 10^{-28}\,g = 9.1\times 10^{-31}\,kg$$

28. Cinnabar (HgS) is a prominent ore of mercury. How many grams of mercury are present in 225 g of pure HgS? Molar mass of Hg and S are 200.6 g mol^{-1} and 32 g mol^{-1} respectively.

Ans. Molar mass of HgS = 200.6 + 32 = 232.6 g mol^{-1}
Mass of Hg in 232.6 g of HgS = 200.6 g

$$\text{Mass of Hg in 225 g of HgS} = \frac{200.6}{232.6}\times 225 = 194.04\,g$$

29. The mass of one steel screw is 4.11g. Find the mass of one mole of these steel screws. Compare this value with the mass of the Earth (5.98 x 10^{24}kg). Which one of the two is heavier and by how many times?

Ans. One mole of screws weigh = 2.475 × 10^{24} g = 2.475 × 10^{21} kg

$$\frac{\text{Mass of the Earth}}{\text{Mole of 1 mole of screws}} = \frac{5.98\times 10^{24}\,\text{Kg}}{2.475\times 10^{21}\,\text{Kg}} = 2.4\times 10^{3}$$

Mass of earth is 2.4×10^{3} times the mass of screws
The earth is 2400 times heavier than one mole of screws.

30. A sample of vitamin C is known to contain 2.58×10^{24} oxygen atoms. How many moles of oxygen atoms are present in the sample?

Ans. 1 mole of oxygen atoms = 6.023×10^{23} atoms

$$\therefore \text{ Number or moles of oxygen atoms} = \frac{2.58\times 10^{24}}{6.022\times 10^{23}} = 4.28\,mol$$

4.28 moles of oxygen atoms.

31. Raunak took 5 moles of carbon atoms in a container and Krish also took 5 moles of sodium atoms in another container of same weight. (a) Whose container heavier? (b) Whose container has more number of atoms?

Ans. (a) Mass of sodium atoms carried by Krish $= (5 \times 23)g = 115g$

While mass of carbon atom carried by Raunak $= (5 \times 12)g = 60g$

Thus, Krish's container is heavy

(b) Both the bags have same number of atoms as they have same number of moles of atoms.

32. Fill in the missing data in the Table 3.1

Species property	**H_2O**	**CO_2**	**Na atom**	**$MgCl_2$**
No. of moles	**2**	**-**	**-**	**0.5**
No. of particles	**-**	3.011×10^{23}	**-**	**-**
Mass	**36 g**	**-**	**115 g**	**-**

Ans.

Species Property	H_2O	CO_2	Na atom	$MgCl_2$
No. of moles	2	0.5	5	0.5
No. of particles	1.2044×10^{24}	3.011×10^{23}	3.011×10^{24}	3.011×10^{23}
Mass	36 g	22 g	115 g	47.5 g

33. The visible universe is estimated to contain 10^{22} stars. How many moles of stars are present in the visible universe?

Ans. Number of moles of stars $= \dfrac{10^{22}}{6.023 \times 10^{23}}$ = 0.0166 moles

34. What is the SI prefix for each of the following multiples and submultiples of a unit?

(a) 10^3 (b) 10^{-1} (c) 10^{-2} (d) 10^{-6} (e) 10^{-9} (f) 10^{-12}

Ans. (a) kilo

(b) deci

(c) centi

(d) micro

(e) nano

(f) pico

35. Express each of the following in kilograms

(a) 5.84×10^{-3} mg

Ans. $5.84\times10^{-9}\,\text{Kg}$

(b) 58.34 g

Ans. $5.834\times10^{-2}\,\text{Kg}$

(c) 0.584 g

Ans. $5.84\times10^{-4}\,\text{Kg}$

(d) 5.873×10^{-21} g

Ans. $5.873\times10^{-24}\,\text{Kg}$

36. Compute the difference in masses of 10^3 moles each of magnesium atoms and magnesium ions. (Mass of an electron = 9.1×10^{-31} kg)

Ans. A Mg^{2+} ion and Mg atom differ by two electrons.

10^3 moles of Mg^{2+} and Mg atoms would differ by

$10^3\times2$ moles of electrons

Mass of 2×10^3 moles of electrons $= 2\times10^3\times6.023\times10^{23}\times9.1\times10^{-31}\,\text{Kg}$

$\Rightarrow 2\times6.022\times9.1\times10^{-5}\,\text{Kg}$

$\Rightarrow 109.6004\times10^{-5}\,\text{Kg}$

$\Rightarrow 1.096\times10^{-3}\,\text{Kg}$

37. Which has more number of atoms?

(i) 100g of N_2

Ans. 100 g of $N_2 = \frac{100}{28}$ moles

Number of molecules $= \frac{100}{28}\times6.022\times10^{23}$

Number of atoms $= \frac{2\times100}{28}\times6.022\times10^{23} = 43.01\times10^{23}$

(ii)100 g of NH_3

Ans. 100 g of $NH_3 = \frac{100}{17}$ moles $= \frac{100}{17}\times6.022\times10^{23}$ molecules

$= \frac{100}{17}\times6.022\times10^{23}\times4$ atoms

$= 141.69\times10^{23}$

NH_3 would have more atoms.

38. Compute the number of ions present in 5.85 g of sodium chloride.

Ans. 5.85 g of NaCl $= \frac{5.85}{58.5} = 0.1$ moles

Or 0.1 moles of NaCl particle

Each NaCl particle is equivalent to one Na^+ one CI^-

$\Rightarrow$ 2 ions

$\Rightarrow$ Total moles of ions = 0.1 × 2

$\Rightarrow$ 2 moles

No. of ions $= 0.2 \times 6.022 \times 10^{23}$

$\Rightarrow 1.2042 \times 10^{23}$ ions

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

Ans. One gram of gold sample will contain $\frac{90}{100} = 0.9g$ of gold

Number of moles of gold $= \frac{\text{mass of gold}}{\text{atomic mass of gold}}$

$$= \frac{0.9}{197} = 0.0046$$

One moles of gold contains N_A atoms $= 6.022 \times 10^{23}$

$\therefore 0.0046$ mole of gold will contain $= 0.0046 \times 6.022 \times 10^{23}$

$$= 2.77 \times 10^{21}$$

40. What are ionic and molecular compounds? Give examples.

Ans. Atoms of different elements join together in definite proportions to form molecules of compounds. Examples— water, ammonia, carbondioxide. Compounds composed of metals and non-metals contain charged species. The charged species are known as ions. An ion is a charged particle and can be negatively or positively charged. A negatively charged ion is called an anion and the positively charged ion is called cation. Examples— sodium chloride, calcium oxide.

41. Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions. (Mass of an electron is 9.1×10^{-28} g). Which one is heavier?

Ans. Mass of 1 mole of aluminium atom = the molar mass of aluminium = 27 g mol^{-1}

An aluminium atom needs to lose three electrons to become an ion, AI^{3+}

For one mole of AI^{3+} ion, three moles of electrons are to best lost.

The mass of three moles of electrons $= 3 \times (9.1 \times 10^{-28}) \times 6.022 \times 10^{23} g$

$$= 27.3 \times 6.022 \times 10^{-5} g$$

$= 164.400 \times 10^{-5}\ g$

= 0.00164 g

Molar mass of $Al^{3+} = (27 - 0.00164)\ g\ mol^{-1} = 26.998\ g\ mol^{-1}$

Difference = 27 – 26.9984 = 0.0016 g

42. A silver ornament of mass 'm' gram is polished with gold equivalent to 1% of the mass of silver. Compute the ratio of the number of atoms of gold and silver in the ornament.

Ans. Mass of silver = m g

Mass of gold $= \frac{m}{100}\ g$

Number of atoms of silver $= \frac{\text{mass}}{\text{atomic mass}} \times N_A$

$= \frac{m}{108} \times N_A$

Number of atoms of gold $= \frac{m}{100 \times 197} \times N_A$

Ratio of number of atoms of gold to silver = Au: Ag

$= \frac{m}{100 \times 197} \times N_A : \frac{m}{108} \times N_A$

$= 108 : 100 \times 197$

$= 108 : 19700$

$= 1 : 182.41$

43. A sample of ethane (C_2H_6) gas has the same mass as 1.5×10^{20} molecules of methane (CH_4). How many C_2H_6 molecules does the sample of gas contain?

Ans. Mass of 1 molecules of $CH_4 = \frac{16g}{N_A}$

Mass of 1.5×10^{20} molecules of methane $= \frac{1.5 \times 10^{20} \times 16}{N_A}\ g$

Mass of 1 molecules of $C_2H_6 = \frac{30}{N_A}\ g$

Mass of molecules of C_2H_6 is $= \frac{1.5 \times 10^{20} \times 16}{N_A}\ g$

$\therefore$ number of molecules of ethane $= \frac{1.5 \times 10^{20} \times 16}{N_A} = \frac{N_A}{30} = 0.8 \times 10^{20}$

44. Fill in the blanks

(a) In a chemical reaction, the sum of the masses of the reactants and products remains unchanged. This is called _____.

Ans. Law of conservation of mass

(b) A group of atoms carrying a fixed charge on them is called _____.

Ans. Polyatomic ion

(c) The formula unit mass of $Ca_3(PO_4)_2$ is _____.

Ans. (3 × atomic mass of Ca) + (2 × atomic mass of phosphorus) + (8 × atomic mass of oxygen) = 310

(d) Formula of sodium carbonate is and that of ammonium sulphate is _____.

Ans. Na_2CO_3; $(NH_4)_2SO_4$

45. Complete the following crossword puzzle (Fig. 3.1) by using the name of the chemical elements. Use the data given in Table 3.2.

Across	Down
2. The element used by Rutherford during his α–scattering experiment.	1. A white lustrous metal used for making ornaments and which tends to get tarnished black in the presence of moist air.
3. An element which forms rust on exposure to moist air	4. Both brass and bronze are alloys of the element
5. A very reactive non–metal stored under water	6. The metal which exists in the liquid state at room temperature
7. Zinc metal when treated with dilute hydrochloric acid produces a gas of this element which when tested with burning splinter produces a pop sound.	8. An element with symbol Pb

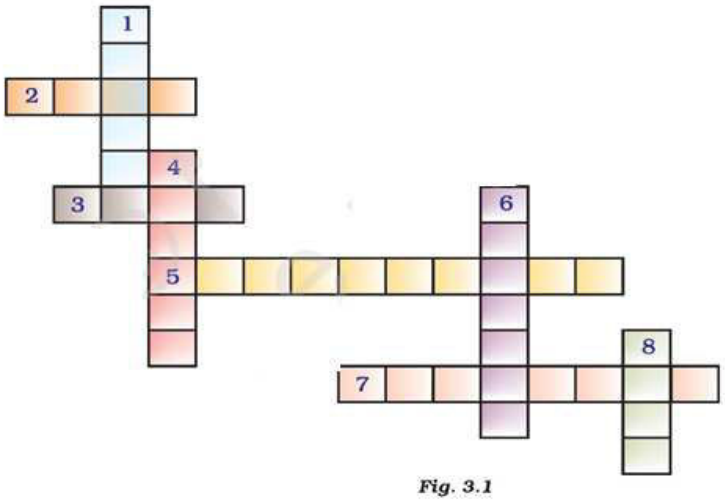
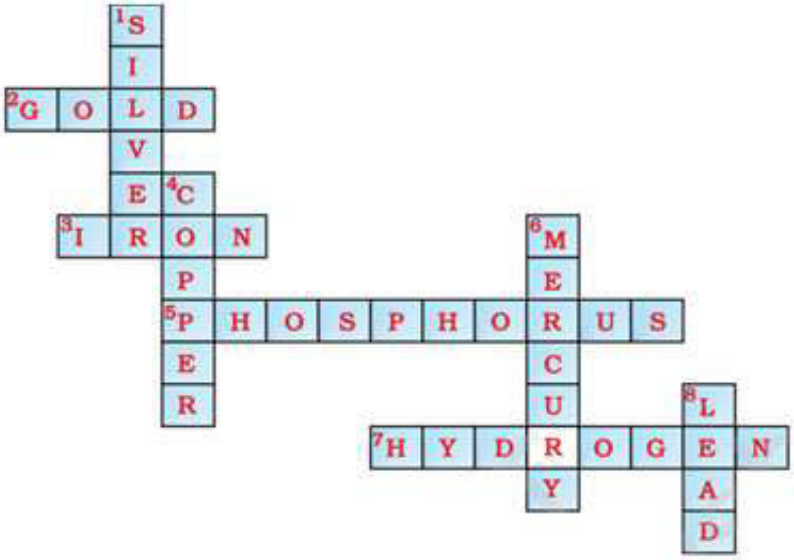


Fig. 3.1

Ans. (1) Silver (2) Gold (3) iron (4) Copper (5) Phosphorus (6) Mercury (7) Hydrogen (8) Lead



46. (a) In this crossword puzzle (Fig 3.2), names of 11 elements are hidden Symbols of these are given below. Complete the puzzle.

1. Cl, 2. H, 3. Ar, 4. O, 5. Xe, 6. N, 7. He, 8. F, 9. Kr, 10. Rn, 11. Ne

(b) Identify the total number of inert gases their names and symbols from this cross-word puzzle.

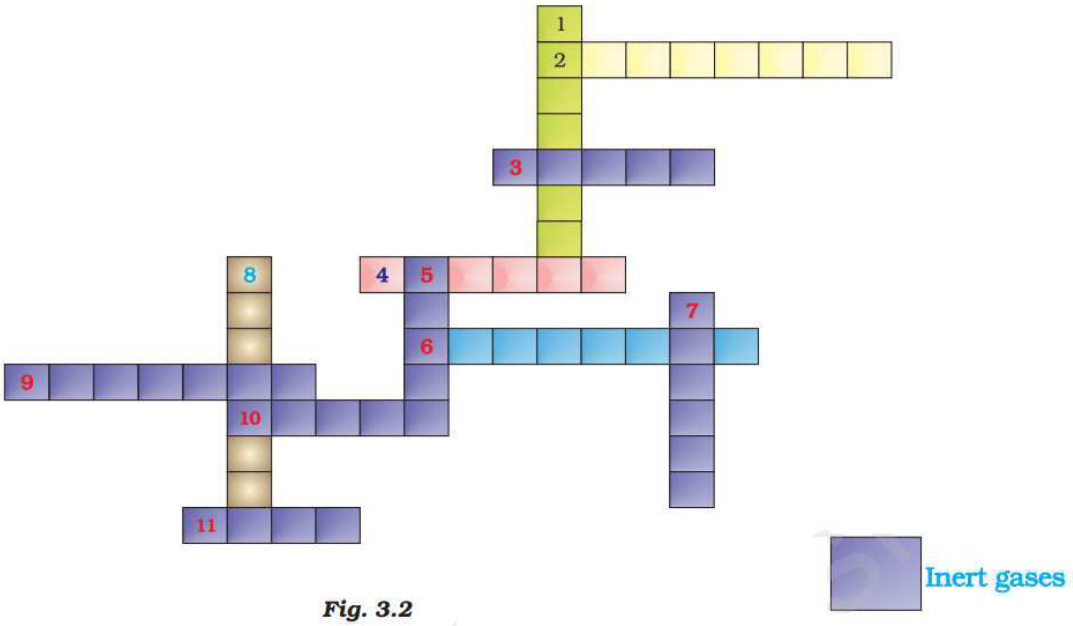
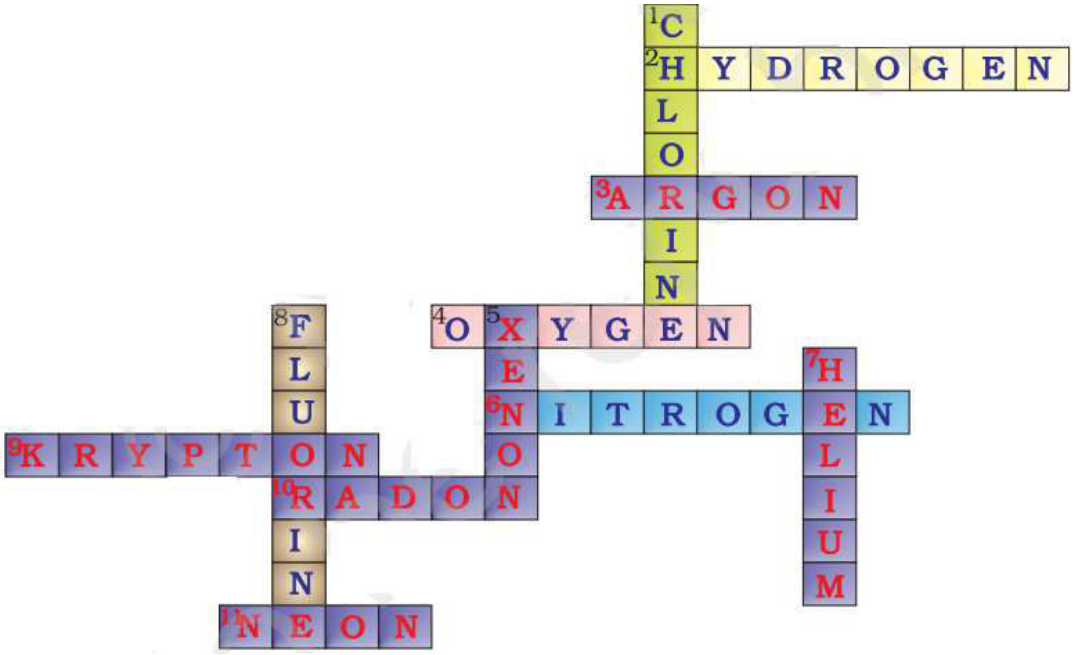


Fig. 3.2

Ans. (a)



(b) Insert Gases: There are total six insert six inert gases present in this crossword, i.e. helium (He), Argon (Ar), Xenon (Xe), Krypton (Kr), Radon (Rn) and Neon (Ne).

47. Write the formulae for the following and calculate the molecular mass for each one of them.

(a) Caustic potash

Ans. KOH

$(39 + 16 + 1) = 56\ g\ mol^{-1}$

(b) Baking powder

Ans. $NaHCO_3$

$23 + 1 + 12 + (3 \times 16) = 84\ g\ mol^{-1}$

(c) Lime stone

Ans. $CaCO_3$

$40 + 12 + (3 \times 16) = 100\ g\ mol^{-1}$

(d) Caustic soda

Ans. NaOH

$23 + 16 + 1 = 40\ g\ mol^{-1}$

(e) Ethanol

Ans. $C_2H_5OH = C_2H_6O$

$2 \times 12 + (6 \times 1) + 16 = 46\ g\ mol^{-1}$

(f) Common salt

Ans. NaCI

$23 + 35.5 = 58.5\ g\ mol^{-1}$

48. In photosynthesis, 6 molecules of carbon dioxide combine with an equal number of water molecules through a complex series of reactions to give a molecule of glucose having a molecular formula $C_6H_{12}O_6$. How many grams of water would be required to produce 18 g of glucose? Compute the volume of water so consumed assuming the density of water to be 1 g cm^{-3}.

Ans. $6CO_2 + 6H_2O \xrightarrow[\text{sunlight}]{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2$

1 mole of glucose needs 6 moles of water

180 g of glucose needs (6 × 18) g of water

1 g of glucose will need $\frac{108}{180} g$ of water.

18 g of glucose would need $\frac{108}{180} \times 18$ g of water = 10.8 g

Volume of water used $= \frac{\text{Mass}}{\text{Density}} = \frac{10.8}{1 g\ \text{cm}^{-3}} = 10.8 \text{cm}^3.$