# Chapter 3

# 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) $6.022 \times 10^{23}$ molecules of water
(iv) $1.2044 \times 10^{25}$ molecules of water
(a) (i) (b) (i) and (iv)
(c) (ii) and (iii) (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

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

**4.** The chemical symbol for sodium is
(a) So (b) Sd (c) NA (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 $H_2O$

**6.** Which of the following has maximum number of atoms?
(a) 18g of $H_2O$
(b) 18g of $O_2$
(c) 18g of $CO_2$
(d) 18g of $CH_4$

**7.** Which of the following contains maximum number of molecules?
(a) 1g $CO_2$
(b) 1g $N_2$
(c) 1g $H_2$
(d) 1g $CH_4$

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**8.** Mass of one atom of oxygen is

(a) $\frac{16}{6.023\times10^{23}}$ g (b) $\frac{32}{6.023\times10^{23}}$ g

(c) $\frac{1}{6.023\times10^{23}}$ g (d) 8u

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

(a) $6.68 \times 10^{23}$

(b) $6.09 \times 10^{22}$

(c) $6.022 \times 10^{23}$

(d) $6.022 \times 10^{21}$

**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

## Short Answer Questions

**11.** Which of the following represents a correct chemical formula? Name it.

(a) CaCl (b) $BiPO_4$ (c) $NaSO_4$ (d) NaS

**12.** Write the molecular formulae for the following compounds

(a) Copper (II) bromide

(b) Aluminium (III) nitrate

(c) Calcium (II) phosphate

(d) Iron (III) sulphide

(e) Mercury (II) chloride

(f) Magnesium (II) acetate

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

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

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

(a) $CH_3COONa$

(b) NaCl

(c) $H_2$

(d) $NH_4NO_3$

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

(a) Calcium and fluorine

(b) Hydrogen and sulphur

(c) Nitrogen and hydrogen

(d) Carbon and chlorine

(e) Sodium and oxygen

(f) Carbon and oxygen

**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

**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

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

(a) $CO_3^{2-}$

(b) $PO_4^{3-}$

(c) $P_2O_5$

(d) CO

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

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

**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

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

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

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## 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.

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

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

(a) $CaCO_3$ (d) $C_2H_5OH$

(b) $MgCl_2$ (e) $NH_3$

(c) $H_2SO_4$ (f) $Ca(OH)_2$

**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.

**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.

**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.

**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 ($5.98 \times 10^{24}$kg). Which one of the two is heavier and by how many times?

**30.** A sample of vitamic C is known to contain $2.58 \times 10^{24}$ oxygen atoms. How many moles of oxygen atoms are present in the sample?

**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 is heavier? (b) Whose container has more number of atoms?

**32.** Fill in the missing data in the Table 3.1

***Table 3.1***

| **Species** | $H_2O$ | $CO_2$ | Na atom | $MgCl_2$ |
|---|---|---|---|---|
| **Property** | | | | |
| No. of moles | 2 | — | — | 0.5 |
| No. of particles | — | $3.011 \times 10^{23}$ | — | — |
| Mass | 36g | — | 115 g | — |

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

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**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) $10^{-12}$

**35.** Express each of the following in kilograms

(a) $5.84\times10^{-3}$ mg

(b) 58.34 g

(c) 0.584g

(d) $5.873\times10^{-21}$ g

**36.** Compute the difference in masses of $10^3$ moles each of magnesium atoms and magnesium ions.

(Mass of an electron = $9.1\times10^{-31}$ kg)

**37.** Which has more number of atoms?

100g of $N_2$ or 100 g of $NH_3$

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

**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?

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

**41.** Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions. (Mass of an electron is $9.1\times10^{-28}$ g). Which one is heavier?

**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.

**43.** A sample of ethane ($C_2H_6$) gas has the same mass as $1.5\times10^{20}$ molecules of methane ($CH_4$). How many $C_2H_6$ molecules does the sample of gas contain?

**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 ————.

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

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

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

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**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.

***Table 3.2***

| Across | Down |
|---|---|
| 2. The element used by Rutherford during his α–scattering experiment<br>3. An element which forms rust on exposure to moist air<br>5. A very reactive non–metal stored under water<br>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. | 1. A white lustrous metal used for making ornaments and which tends to get tarnished black in the presence of moist air<br>4. Both brass and bronze are alloys of the element<br>6. The metal which exists in the liquid state at room temperature<br>8. An element with symbol Pb |

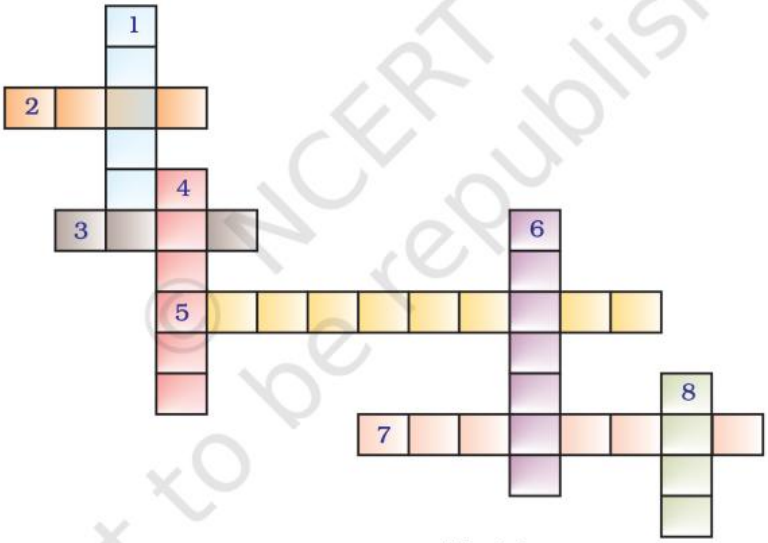



***Fig. 3.1***

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



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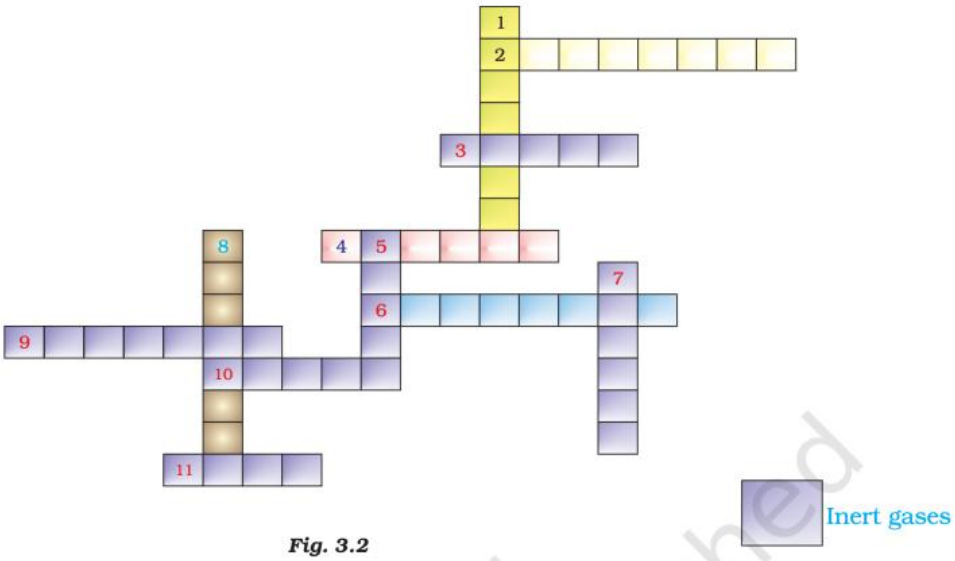



*Fig. 3.2*

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

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

(a) Caustic potash
(b) Baking powder
(c) Lime stone
(d) Caustic soda
(e) Ethanol
(f) Common salt

**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 $cm^{-3}$.

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