Atoms and Molecules: In-Text Questions

[Page 32]

Q.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

Sol. In given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.

Sodium carbonate (5.3 g) + ethanoic acid (6g) → sodium ethanoate (8.2 g) + carbon dioxide (2.2 g) + water (0.9 g)

Given: Mass of sodium carbonate = 5.3g
Mass of ethanoic acid = 6g
Mass of sodium ethanoate = 8.2g
Mass of carbon dioxide = 2.2
Mass of water = 0.9g
Total mass before the reaction or reactant side = (5.3 + 6) g = 11. 3g
Total mass after the reaction or product side = (8.2 + 2.2 + 0.9) g = 11.3g
Since, Total mass before the reaction = Total mass after the reaction
So, the given observations are in agreement with the law of conservation of mass.

[Page 33]

Q.1 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 3g of hydrogen gas?

Sol. Given:
The ratio of hydrogen and oxygen by mass to form water = 1:8.
The mass of oxygen gas required to react completely with 1g of hydrogen gas = 8g
So, the mass of oxygen gas required to react completely with 3g of hydrogen gas = 8 × 3g = 24 g

Q.2 Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?

Sol. Postulate of Dalton's atomic theory is the result of the law of conservation of mass is: Atoms are indivisible particles. It can neither be created nor destroyed in a chemical reaction.

Q.3 Which postulate of Dalton's atomic theory can explain the law of definite proportions?

Sol. The postulate of Dalton's atomic theory which can explain the law of definite proportion is: The relative number and kinds of atoms in a given compound are constant.

[Page 35]

Q.1 Define atomic mass unit.

Sol. Atomic mass unit is defined as (1/12) of the mass of one atom of carbon - 12 is called one atomic mass unit. The relative atomic masses of all the elements have been found with respect to standard atom of element which is an atom of Carbon-12. It is written as 'u'

Q.2 Why is it not possible to see an atom with naked eyes?

Sol. The size of an atom is too small which is not possible to see it with naked eyes.

[Page 39]

Q.1 Write down the formula of

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

Sol. **The formula of given compounds:**

(i) Sodium oxide: Na_2O
(ii) Aluminium chloride: $AlCl_3$
(iii) Sodium suphide: Na_2S
(iv) Magnesium hydroxide: $Mg(OH)_2$

Q.2 Write down the names of compounds represented by the following formula:

(i) $Al_2(SO4)_3$
(ii) $CaCl_2$
(iii) K_2SO_4
(iv) KNO_3
(v) $CaCO_3$

Sol. **The names of given compounds**

(i) $Al(SO_4)_3$: Aluminium sulphate
(ii) $CaCl_2$: Calcium chloride
(iii) K_2SO_4: Potassium sulphate
(iv) $CaCO_3$: Calcium carbonate

Q.3 What is meant by the term chemical formula?

Sol. The chemical formula of a compound means the symbolic representation of its composition. From this, we can know the number of atoms of different elements that constitute the compound.

Example: the chemical formula of sodium chloride is NaCl, In this compound, one sodium atom and one chlorine atom are chemically bonded together to form one molecule of the Sodium chloride compound.

Q.4 How many atoms are present in a

(i) H_2S molecule and
(ii) PO_3^{-4} ion?

Sol. (i) In an H_2S molecule, 3 atoms are present; 2 atoms of hydrogen and 1 atom of sulphur.
(ii) In a PO_4^{-3} ion, five atoms are present; 1 atom of phosphorus and 4 atoms of oxygen.

[Page 40]

Q.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.

Sol. Molecular mass of the given compounds are:

Molecular mass of $H_2 = 2 \times 1 =$ **2u**
Molecular mass of $O_2 = 2 \times 16 =$ **32u**
Molecular mass of $Cl_2 = 2 \times 35.5 =$ **71 u**
Molecular mass of $CO_2 = 12 + 2 \times 16 =$ **44 u**
Molecular mass of $CH_4 = 12 + 4 \times 1 =$ **16 u**
Molecular mass of $C_2H_6 = 2 \times 12 + 6 \times 1 =$ **30u**
Molecular mass of $C_2H_4 = 2 \times 12 + 4 \times 1 =$ **28u**
Molecular mass of $NH_3 = 14 + 3 \times 1 =$ **17 u**
Molecular mass of $CH_3OH = 12 + 4 \times 1 + 16 =$ **32 u**

Q.2 Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given masses of Zn = 65u, Na= 23u, K =39u, C = 12u, and O = 16u.

Sol. The formula unit masses of given compounds are:

Formula unit mass of ZnO = 65 + 16 = 81 u

Formula unit mass of Na_2O = 2 × 23 + 16 = 62u

Formula unit mass of K_2CO_3 = 2 × 39 + 12 + 3 × 16 = 138u

[Page 42]

Q.1 If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

Sol. Given: One mole of carbon atoms weighs = 12g

1 mole of carbon contains – 6.022×10^{23} atoms

Then, mass of 6.022×10^{23} number of carbon atoms = 12g

Therefore, mass of 1 atom of carbon = $\frac{12}{6.022 \times 10^{22}} g$ = 1.9926 × 10−23g

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

Sol. Given: Mass of sodium = 100 g

Atomic mass of Na = 23u

Then, gram atomic mass of Na = 23g

Now, 23g of Na contains = 6.022×10^{23} atoms

Thus, 100g of Na contains = $\frac{6.022 \times 10^{23}}{23} \times 100$ atoms = **2.6182×10^{24}** atoms

Given: atomic mass of Fe = 56u

gram atomic mass of Fe = 56g

Since, 56 g of Fe contains = 6.022×10^{23} atoms

So, 100 g of Fe = $\frac{6.022 \times 10^{23}}{56} \times 100$ atoms = **1.0753×10^{24}** atoms

So, 100 grams of sodium contain more number of atoms than 100 grams of iron.