HOTS (Higher Order Thinking Skills)

Q. 1. A colorless liquid is thought to be a pure compound. Analysis of three samples of the material yield the following results.

	Mass of Sample	**Mass of carbon**	**Mass of Hydrogen**
Sample 1	1.0 g	0.862 g	0.138 g
Sample 2	1.549 g	1.335 g	0.214 g
Sample 3	0.988 g	0.852 g	0.136 g

Could the material be a pure compound?

Ans. Analysis

	Mass of Carbon	**+**	**Mass of Hydrogen**	**=**	**Mass of Sample**
Sample 1	0.862 g	+	0.138 g	=	1.0 g
Sample 2	1.335 g	+	2.214 g	=	1.549 g
Sample 3	0.852 g	+	0.136 g	=	0.988 g

Yes, the material is a pure compound as all the three samples have the same composition.

Q. 2. A big drop has volume 1.0 mL. How many molecules of water are there is this drop, If the density of water is 1g/mL?

Ans. Volume of drop of water = 1.0 mL

Density of water = 1.0 g/mL

∴ Mass of drop of water = Volume × Diabesity = 1.0 g

Molecular mass of H_2O = 2 × 1 u + 1 × 16 u = 18 u

Gram molecular mass of water = 18 g/mol

18 g of water contains = 6.022×10^{23} molecular

∴ 1 g of water contains = $\frac{6.022 \times 10^{23}}{18}$ = molecular

= 3.34×10^{22} molecules

Q. 3. What is the fraction of the mass of water due to neutrons?

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

Mass of the one neutrons = $\frac{1}{Avogadro\ Number\ (N_A)}$ g

Mass of 8 molecule of water = $\frac{Molar\ mass}{N_A}$ = $\frac{18}{N_A}$ g

There are 8 neurons of water = $\frac{18}{N_A}$

Mass of one molecule of water = $\frac{Molar\ mass}{N_A}$ = $\frac{18}{N_A}$ g

Fraction off mass of the water due to neutrons $\sim \frac{8}{18}$.

Q. 4. 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 power, 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.

Q. 5. Calculate the number of electrons present in 15.4 of carbon tetrachloride (CCI_4).

Ans. Number of moles of CCI_4 = $\frac{Mass\ of\ CCI_4}{Molecular\ mass\ of\ CCI_4}$ = $\frac{15.4\ g}{154\ g}$

$\because$ = 0.1 mole

1 mole of CCI_4 = 6.022×10^{23} molecules of CCI_4

$\therefore$ 0.1 mole of CCI_4= $0.1 \times 6.022 \times 10^{23}$ moles of CCI_4

= 6.022×10^{22} molecules of CCI_4

We know that one atom of carbon has 6 electrons and one atom of chlorine has 17 electrons.
Therefore, one molecule of CCI_4 will contain 6 + (4 × 17) = 74 electrons.

$\therefore$ Number of electrons in 6.022×10^{22} molecules of CCI_4

= $74 \times 6.022 \times 10^{22}$ electrons

= 445.6×10^{22} electrons

= 4.456×10^{24} electrons