



Question 31. How many significant figures should be present in the answer of the following?

(i) $\frac{0.02856 \times 298.15 \times 0.112}{0.5785}$ (ii) 5×5.364 (iii) $0.0125 + 0.7864 + 0.0215$

Answer:

(i) The least precise term has 3 significant figures (i.e., in 0.112).

Hence, the answer should have 3 significant figures.

(ii) Leaving the exact number (5), the second term has 4 significant figures. Hence, the answer should have 4 significant figures.

(iii) In the given addition, the least number of decimal places in the term is 4. Hence, the answer should have 4 significant.

Question 32. Use the data given in the following table to calculate the molar mass of naturally occurring argon.

Isotope	Isotopic molar mass	Abundance
^{36}Ar	$35.96755 \text{ g mol}^{-1}$	0.337
^{38}Ar	$37.96272 \text{ g mol}^{-1}$	0.063
^{40}Ar	$39.9624 \text{ g mol}^{-1}$	99.600

Answer:

$$\text{Molar mass of Ar} = 35.96755 \times 0.00337 + 37.96272 \times 0.00063 + 39.9624 \times 0.99600 = 39.948 \text{ g mol}^{-1}$$

Question 33. Calculate the number of atoms in each of the following:

(i) 52 moles of He (ii) 52 u of He (iii) 52 g of He

Answer:

(i) 1 mol of He = 6.022×10^{23} atoms

$$\therefore 52 \text{ mol of He} = 52 \times 6.022 \times 10^{23} \text{ atoms} = 3.131 \times 10^{25} \text{ atoms}$$

(ii) 1 atom of He = 4 u of He

$$4 \text{ u of He} = 1 \text{ atom of He}$$

$$\therefore 52 \text{ u of He} = \frac{1}{4} \times 52 \text{ atoms} = 13 \text{ atoms}$$

(iii) 1 mole of He = 4 g = 6.022×10^{23} atoms

$$\therefore 52 \text{ g of He} = \frac{6.022 \times 10^{23}}{4} \times 52 \text{ atoms} \\ = 7.8286 \times 10^{24} \text{ atoms.}$$

Question 34. A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide, 0.690 g of water and no other products. A volume of 10.0 L (measured at S.T.P.) of this welding gas is found to weigh 11.6 g. Calculate (i) empirical formula, (ii) molar mass of the gas, and (iii) molecular formula.

Answer:

$$\text{Amount of carbon in 3.38 g CO}_2 = \frac{12}{44} \times 3.38 \text{ g} = 0.9218 \text{ g}$$

$$\text{Amount of hydrogen in 0.690 g H}_2\text{O} = \frac{2}{18} \times 0.690 \text{ g} = 0.0767 \text{ g}$$

As compound contains only C and H, therefore, total mass of the compound
 $= 0.9218 + 0.0767 \text{ g} = 0.9985 \text{ g}$

$$\% \text{ of C in the compound} = \frac{0.9218}{0.9985} \times 100 = 92.32$$

$$\% \text{ of H in the compound} = \frac{0.0767}{0.9985} \times 100 = 7.68$$

Calculation of Empirical Formula

Element	% by mass	Atomic mass	Moles of the element	Simplest molar ratio	Simplest whole no. molar ratio
C	92.32	12	$\frac{92.32}{12} = 7.69$	1	1
H	7.68	1	$\frac{7.68}{1} = 7.68$	1	1

\therefore Empirical formula = **CH**

10.0 L of the gas at STP weight = 11.6 g

$$\therefore 22.4 \text{ L of the gas at S.T.P will weight} = \frac{11.6}{10.0} \times 22.4 = 25.984 \text{ g} \approx 26 \text{ g}$$

\therefore Molar mass = **26 g mol⁻¹**

Empirical formula mass of CH = 12 + 1 = 13

$$\therefore n = \frac{\text{Molecular mass}}{\text{E.F. mass}} = \frac{26}{13} = 2 \quad \therefore \text{Molecular formula} = 2 \times \text{CH} = \text{C}_2\text{H}_2$$

Question 35. Calcium carbonate reacts with aqueous HCl according to the reaction



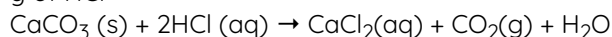
What mass of CaCO₃ is required to react completely with 25 mL of 0.75 M HCl?

Answer: Step 1. To calculate mass of HCl in 25 mL of 0.75 m HCl

1000 mL of 0.75 M HCl contain HCl = 0.75 mol = 0.75 x 36.5 g = 24.375 g

$$\therefore 25 \text{ mL of 0.75 HCl will contain HCl} = \frac{24.375}{1000} \times 25 \text{ g} = 0.6844 \text{ g}.$$

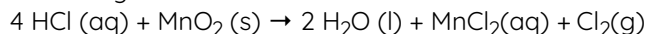
Step 2. To calculate mass of CaCO₃ reacting completely with 0.9125 g of HCl



2 mol of HCl, i.e., 2 x 36.5 g = 73 g HCl react completely with CaCO₃ = 1 mol = 100 g

$$\therefore 0.6844 \text{ g HCl will react completely with CaCO}_3 = \frac{100}{73} \times 0.6844 \text{ g} = 0.938 \text{ g}.$$

Question 36. Chlorine is prepared in the laboratory by treating manganese dioxide (MnO₂) with aqueous hydrochloric acid according to the reaction.



How many grams of HCl react with 5.0 g of manganese dioxide?

(Atomic mass of Mn = 55 u)

Answer: 1 mole of MnO₂, i.e., 55 + 32 = 87 g MnO₂ react with 4 moles of HCl, i.e., 4 x 36.5 g = 146 g of HCl.

$$\therefore 5.0 \text{ g of MnO}_2 \text{ will react with HCl} = \frac{146}{87} \times 5.0 \text{ g} = 8.40 \text{ g}$$

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