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	$35.96755\ g\ mol^{-1}$	0.337
^{38}Ar	$37.96272\ g\ mol^{-1}$	0.063
^{40}Ar	$39.9624\ g\ mol^{-1}$	99.600

Answer:
Molar mass of Ar = 35.96755 x 0.00337 + 37.96272 x 0.00063 + 39.96924 x 0.99600 = 39.948 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 mol of He = $52 \times 6.022 \times 10^{23}$ atoms = **3.131×10^{25} atoms**

(ii) 1 atom of He = 4 u of He
4 u of He = 1 atom of He
$\therefore$ 52 u of He = $\frac{1}{4} \times 52$ atoms = **13 atoms**

(iii) 1 mole of He = 4 g = 6.022×10^{23} atoms
$\therefore$ 52 g of He = $\frac{6.022 \times 10^{23}}{4} \times 52$ atoms
= **7.8286×10^{24} 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:

Amount of carbon in 3.38 g CO_2 = $\frac{12}{44}$ × 3.38 g = 0.9218 g

Amount of hydrogen in 0.690 g H_2O = $\frac{2}{18}$ × 0.690 g = 0.0767 g

As compound contains only C and H, therefore, total mass of the compound
= 0.9218 + 0.0767 g = 0.9985 g

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

% of H in the cmpound = $\frac{0.0767}{0.9985} \times 100$ = 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

∴ Empirical formula = **CH**
10.0 L of the gas at STP weight = 11.6 g

∴ 22.4 L of the gas at S.T.P will weight = $\frac{11.6}{10.0}$ × 22.4 = 25.984 g ≈ 26 g

∴ Molar mass = **26 g mol^{-1}**
Empirical formula mass of CH = 12 + 1 = 13

∴ $n = \frac{\text{Molecular mass}}{\text{E.F. mass}} = \frac{26}{13} = 2$ ∴ Molecular formula = 2 × CH = **C_2H_2**

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

$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + CO_2(g) + H_2O(l).

What mass of $CaC0_3$ 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

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

Step 2. To calculate mass of $CaCO_3$ reacting completely with 0.9125 g of HCl
$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$(aq) + CO_2(g) + H_2O
2 mol of HCl, i.e., 2 x 36.5 g = 73 g HCl react completely with $CaCO_3$ = 1 mol = 100 g

∴ 0.6844 g HCl will react completely with $CaCO_3$ = $\frac{100}{73} \times 0.6844$ g = **0.938 g.**

Question 36. Chlorine is prepared in the laboratory by treating manganese dioxide (MnO_2) with aqueous hydrochloric acid according to the reaction.
4 HCl (aq) + MnO_2 (s) → 2 H_2O (l) + $MnCl_2$(aq) + Cl_2(g)
How many grams of HCl react with 5.0 g of manganese dioxide? (Atomic mass of Mn = 55 u)
Answer: 1 mole of MnO_2, i.e., 55 + 32 = 87 g MnO_2 react with 4 moles of HCl, i.e., 4 x 36.5 g = 146 g of HCl.

∴ 5.0 g of MnO_2 will react with HCl = $\frac{146}{87} \times 5.0$ g = **8.40 g**

********** END **********