ICSE CLASS 10 CHEMISTRY – PRACTICE PAPER

STEP-BY-STEP SOLUTIONS AND MARKING SCHEME

Chapter 5: Mole Concept and Stoichiometry | Maximum Marks: 40

SECTION A (20 Marks)

Question 1 [8 × 1 = 8]

Part	Ans	Step-by-step reasoning
(i)	(b)	Molar mass of CO_2 = 12 + 2 × 16 = 44 g. Moles = 22 ÷ 44 = **0.5**.
(ii)	(c)	Equal volumes contain equal numbers of molecules (Avogadro's law), so convert to one unit (cm^3): P = 250, Q = 0.2 dm^3 = 200, R = 0.3 litre = 300, S = 150. The largest volume is R (300 cm^3).
(iii)	(a)	Moles = 5.6 ÷ 22.4 = 0.25. Molar mass of CH_4 = 12 + 4 = 16 g. Mass = 0.25 × 16 = **4 g**.
(iv)	(d)	From the equation 2 volumes of C_2H_2 need 5 volumes of O_2 (Gay-Lussac's law). 10 cm^3 needs (5 ÷ 2) × 10 = **25 cm^3**.
(v)	(b)	Relative molecular mass = 2 × V.D. = 64. SO_2 = 32 + 32 = 64. (O_2 = 32, CO_2 = 44, NH_3 = 17.)
(vi)	(c)	(A) is true. (R) is Avogadro's law and is true. Since 1 mole of every gas has the same number of molecules, it occupies the same volume (22.4 dm^3) at STP. So (R) explains (A).
(vii)	(a)	The ratio C : H : O = 6 : 12 : 6 = 1 : 2 : 1, so the empirical formula is **CH_2O**.
(viii)	(d)	Each CO_2 molecule has 2 oxygen atoms. Atoms = 0.5 × 2 × 6 × 10^{23} = **6 × 10^{23}**.

Question 2 [3 + 3 = 6]

(i) **[3 × 1]**

(a) **22.4** – the molar volume of a gas at STP.

(b) **2** – relative molecular mass = 2 × vapour density.

(c) **molecules** – Avogadro's law.

(ii) **[3 × 1]**

(a) 0.5 × 22.4 = 11.2 dm^3 → **4**.

(b) 2 g of H_2 = 1 mole = 6 × 10^{23} molecules → **2**.

(c) Molar mass of NaOH = 23 + 16 + 1 = 40 g; 0.1 × 40 = 4 g → **3**.

Statement 1 (22.4 dm^3) is the extra option.

Question 3 [3 + 3 = 6]

(i) **[3 × 1]**

(a) **Gay-Lussac's law of combining volumes**: when gases react, they do so in volumes which bear a simple ratio to one another and to the volumes of the gaseous products, all measured at the same temperature and pressure. (Here N_2 : H_2 : NH_3 = 20 : 60 : 40 = 1 : 3 : 2.)

(b) 1 volume of N_2 needs 3 volumes of H_2: 50 × 3 = **150 cm^3**.

(c) By **Avogadro's law** equal volumes contain equal numbers of molecules. 20 cm^3 of NH_3 would contain y molecules, so 40 cm^3 contains **2y molecules**.

(ii) **[3 × 1]**

(a) Molar mass of H_2SO_4 = 2 + 32 + 64 = 98 g. Moles = 9.8 ÷ 98 = **0.1 mole**.

(b) Moles of CO_2 = 8.8 ÷ 44 = 0.2. Volume = 0.2 × 22.4 = **4.48 dm^3**.

(c) Moles of H_2O = 3.6 ÷ 18 = 0.2. Molecules = 0.2 × 6 × 10^{23} = **1.2 × 10^{23}**.

SECTION B (20 Marks)

Question 4 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) Reading the graph at 16 g: **11.2 dm^3**.

(b) From the graph, 32 g of X occupies 22.4 dm^3 (the molar volume), so the gram molecular mass of X is **32 g**.

(c) 16 g = 16 ÷ 32 = 0.5 mole. Molecules = 0.5 × 6 × 10^{23} = **3 × 10^{23}**.

(d) Vapour density = relative molecular mass ÷ 2 = 32 ÷ 2 = **16**.

(ii) **[3 × 1]**

(a) Atomicity = molecular mass ÷ atomic mass = 32 ÷ 16 = **2** (X is diatomic, i.e. oxygen, O_2).

(b) 0.5 mole of molecules = 3 × 10^{23} molecules; each has 2 atoms, so atoms = 2 × 3 × 10^{23} = **6 × 10^{23}**.

(c) 8 g = 8 ÷ 32 = 0.25 mole. Volume = 0.25 × 22.4 = **5.6 dm^3** (it can also be read from the graph).

(iii) **[3 × 1]**

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O(l)$: 1 volume of methane needs 2 volumes of oxygen and gives 1 volume of CO_2. Water is a liquid, so its volume is negligible.

(a) Oxygen used = 2 × 40 = **80 cm^3**.

(b) CO_2 formed = **40 cm^3**.

(c) Oxygen left = 100 − 80 = 20 cm^3. Total gas = 40 + 20 = **60 cm^3**, consisting of 40 cm^3 CO_2 and 20 cm^3 unused O_2.

Question 5 [4 + 3 + 3 = 10]

(i) **[4]**

(a) and (b) Completed table: [1 + 1]

Element	% by mass	At. mass	Relative moles	Simplest ratio
Carbon	85.7	12	85.7 ÷ 12 = 7.14	7.14 ÷ 7.14 = 1
Hydrogen	14.3	1	14.3 ÷ 1 = 14.3	14.3 ÷ 7.14 = 2

(c) C : H = 1 : 2, so the empirical formula is **CH_2**. [1]

(d) Empirical formula mass = 12 + 2 × 1 = **14**. [1]

(ii) **[3 × 1]**

(a) Relative molecular mass = 2 × V.D. = 2 × 28 = **56**.

(b) n = molecular mass ÷ empirical formula mass = 56 ÷ 14 = **4**.

(c) Molecular formula = $(CH_2)_4$ = **C_4H_8**.

(iii) **[3 × 1]**

(a) $(NH_4)_2SO_4 = 2(14 + 4) + 32 + 64 = 36 + 96 =$ **132**.

(b) Two nitrogen atoms: $2 \times 14 =$ **28 g**.

(c) Percentage of N = $(28 \div 132) \times 100 =$ **21.2%**.

Question 6 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

Quantity	Zn	2HCl	$ZnCl_2$	H_2
(a) Mass of 2HCl		$2 \times 36.5 =$ **73 g**		
(b) Mass of $ZnCl_2$			$65 + 71 =$ **136 g**	
(c) Volume of H_2 at STP				$1 \times 22.4 =$ **22.4 dm^3**
(d) Molecules of H_2				1 mole = **6×10^{23}**

(ii) **[3 × 1]**

Moles of $H_2 = 5.6 \div 22.4 = 0.25$ mole. From the equation, 1 mole of Zn gives 1 mole of H_2, 2 moles of HCl are needed and 1 mole of $ZnCl_2$ is formed.

(a) Zn = 0.25 mole = $0.25 \times 65 =$ **16.25 g**.

(b) HCl = 0.5 mole = $0.5 \times 36.5 =$ **18.25 g**.

(c) $ZnCl_2$ = 0.25 mole = $0.25 \times 136 =$ **34 g**.

(iii) **[3 × 1]**

Molar mass of $CaCO_3 = 40 + 12 + 48 = 100$ g. 25 g = 0.25 mole. $CaCO_3 \rightarrow CaO + CO_2$ is a 1 : 1 : 1 ratio.

(a) CaO = $0.25 \times 56 =$ **14 g**.

(b) $CO_2 = 0.25 \times 22.4 =$ **5.6 dm^3**.

(c) Percentage yield = (actual ÷ expected) × 100 = $(12.6 \div 14) \times 100 =$ **90%**.

Marks summary	Section A: Q1 = 8, Q2 = 6, Q3 = 6 → **20** | Section B: any two of Q4, Q5, Q6 at 10 each → **20** | Total = **40**