SBCC JEE MAIN 2025 — FULL SOLUTIONS

Chapter: Some Basic Concepts of Chemistry

"Assignments don't test intelligence — they build it."

Topic–1 : Mole Concept & Avogadro Law

1. **Among 10^{-9} g of Pb, Po, Pr and Pt, element having highest number of atoms is [JEE Main 2025 – 3 Apr Morning]**

For equal mass, number of atoms $\propto \dfrac{1}{\text{atomic mass}}$.

Atomic masses (approx.): Pb ≈ 207, Po ≈ 209, Pr ≈ 141, Pt ≈ 195
Smallest atomic mass $\Rightarrow$ maximum atoms. Hence, Pr has the highest number of atoms.

Correct Option: (a)

2. **2.8×10^{-3} mol of CO_2 is left after removing 10^{21} molecules from its 'x' mg sample. Find initial mass of CO_2. ($N_A = 6.02 \times 10^{23}$) [JEE Main 2025 – 23 Jan Morning]**

Find moles removed from given molecules, then add remaining moles.

Moles removed:

$$n = \frac{10^{21}}{6.02 \times 10^{23}} = 1.66 \times 10^{-3} \text{ mol}$$

Initial moles:

$$n_i = 2.8 \times 10^{-3} + 1.66 \times 10^{-3} = 4.46 \times 10^{-3} \text{ mol}$$

Mass of CO_2:

$$m = 4.46 \times 10^{-3} \times 44 = 0.196 \text{ g} = 196.2 \text{ mg}$$

Correct Option: (b)

Topic–2 : Stoichiometry & Limiting Reagent

1. **Mass of magnesium required to produce 220 mL of hydrogen gas at STP on reaction with excess dilute HCl is [JEE Main 2025 – 3 Apr Evening]**

Use reaction stoichiometry and molar volume at STP.

Reaction:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

At STP, 22.4 L gas = 1 mol

$$220 \text{ mL } H_2 = 0.22 \text{ L} \Rightarrow n(H_2) = \frac{0.22}{22.4} = 0.00982 \text{ mol}$$

From equation:

$$n(Mg) = n(H_2) = 0.00982$$

Mass of Mg:

$$m = 0.00982 \times 24 = 0.2357 \text{ g} = 236 \text{ mg}$$

Correct Option: (d)

2. **X g of benzoic acid on reaction with aqueous $NaHCO_3$ released CO_2 that occupied 11.2 L at STP. Find X. [JEE Main 2025 – 24 Jan Morning]**

1 mole benzoic acid produces 1 mole CO_2.

$$11.2 \text{ L } CO_2 = \frac{11.2}{22.4} = 0.5 \text{ mol}$$

Reaction:

$$C_6H_5COOH + NaHCO_3 \rightarrow C_6H_5COONa + CO_2 + H_2O$$

So,

$$n(\text{benzoic acid}) = 0.5 \text{ mol}$$

Molar mass of benzoic acid = 122 g mol^{-1}

$$X = 0.5 \times 122 = 61 \text{ g}$$

Answer: 61 g

3. **When 81.0 g of aluminium reacts with 128.0 g of oxygen gas, the mass of aluminium oxide formed is (nearest integer). [JEE Main 2025 – 23 Jan Evening]**

Identify limiting reagent, then calculate product mass.

Reaction:

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$

Moles:

$$n(Al) = \frac{81}{27} = 3, \quad n(O_2) = \frac{128}{32} = 4$$

Required ratio:

$$4Al : 3O_2 \Rightarrow 3Al : 2.25O_2$$

Available O_2 is excess $\Rightarrow$ Al limiting.
From equation:

$$4Al \rightarrow 2Al_2O_3 \Rightarrow 3Al \rightarrow 1.5Al_2O_3$$

Molar mass of $Al_2O_3 = 102$

$$\text{Mass} = 1.5 \times 102 = 153 \text{ g}$$

Answer: 153 g

4. **In blast furnace reaction, find mass of iron produced (nearest integer). [JEE Main 2025 – 24 Jan Morning]**

Calculate limiting reagent using correct mole values.

Reaction:

$$Fe_3O_4 + 4CO \rightarrow 3Fe + 4CO_2$$

Given:

$$\text{Mass of } Fe_3O_4 = 2.32 \times 10^3 \text{ kg} = 2.32 \times 10^6 \text{ g}$$

$$\text{Mass of } CO = 2.8 \times 10^2 \text{ kg} = 2.8 \times 10^5 \text{ g}$$

Moles:

$$n(Fe_3O_4) = \frac{2.32 \times 10^6}{232} = 10^4$$

$$n(CO) = \frac{2.8 \times 10^5}{28} = 10^4$$

Stoichiometry requires:

$$1Fe_3O_4 : 4CO$$

CO is limiting reagent.
From equation:

$$4CO \rightarrow 3Fe \Rightarrow 10^4 CO \rightarrow 7500Fe$$

Mass of iron:

$$7500 \times 56 = 4.2 \times 10^5 \text{ g} = 42 \text{ kg}$$

Answer: 420 kg

5. **174.0 kg butane reacts with 320.0 kg O_2. Volume of water formed (litres). [JEE Main 2025 – 7 Apr Evening]**

Find limiting reagent, then water formed.

Reaction:

$$C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$$

Moles:

$$n(C_4H_{10}) = \frac{174000}{58} = 3000$$

$$n(O_2) = \frac{320000}{32} = 10000$$

Required O_2:

$$3000 \times 6.5 = 19500 \Rightarrow O_2 \text{ limiting}$$

From equation:

$$6.5O_2 \rightarrow 5H_2O \Rightarrow 10000O_2 \rightarrow 7692H_2O$$

Mass of water:

$$7692 \times 18 = 138456 \text{ g} \Rightarrow 138 \text{ L}$$

Answer: 138 L

6. **Mass of $CaCl_2$ formed when 250 mL of 0.76 M HCl reacts with excess $CaCO_3$. [JEE Main 2025 – 2 Apr Morning]**

HCl is limiting reagent.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

Moles of HCl:

$$0.25 \times 0.76 = 0.19$$

Moles of $CaCl_2$:

$$\frac{0.19}{2} = 0.095$$

Molar mass of $CaCl_2 = 111$

$$\text{Mass} = 0.095 \times 111 = 10.545 \text{ g}$$

Correct Option: (c)

7. **Amount of CaO produced on heating 150 kg limestone (75% pure) is (nearest integer). [JEE Main 2025 – 4 Apr Evening]**

Calculate pure $CaCO_3$ first.

Pure $CaCO_3 = 0.75 \times 150 = 112.5$ kg
Reaction:

$$CaCO_3 \rightarrow CaO + CO_2$$

$$100 \text{ g } CaCO_3 \rightarrow 56 \text{ g } CaO$$

$$CaO = \frac{56}{100} \times 112.5 = 63 \text{ kg}$$

Answer: 63 kg

Topic–3 : Concentration Terms (Solutions)

1. **Density of 3 M NaCl solution is 1.25 g mL^{-1}. The molality of the solution is [JEE Main 2025 — 22 Jan — Evening]**

Convert molarity to molality using density.

Volume of solution = 1 L Mass of solution = $1.25 \times 1000 = 1250$ g
Moles of NaCl = 3 Mass of NaCl = $3 \times 58.5 = 175.5$ g
Mass of solvent:

$$1250 - 175.5 = 1074.5 \text{ g} = 1.0745 \text{ kg}$$

Molality:

$$m = \frac{3}{1.0745} = 2.79$$

Correct Option: (a) 2.79 m

2. **The molarity of a 70% (mass/mass) aqueous solution of a monobasic acid (X) is ____ $\times 10^{-1}$ M. [JEE Main 2025 — 28 Jan — Morning]**

Assume 1 L solution, use density and mass percentage.

Mass of solution $= 1.25 \times 1000 = 1250$ g

Mass of acid:

$$0.70 \times 1250 = 875 \text{ g}$$

Moles of acid:

$$\frac{875}{70} = 12.5$$

Molarity:

$$12.5 \text{ M} = 125 \times 10^{-1} \text{ M}$$

Answer: 125

3. **Concentrated nitric acid is labelled as 75% by mass. The volume in mL of the solution which contains 30 g of nitric acid is ____. [JEE Main 2025 — 28 Jan — Evening]**

Use mass percentage and density.

Mass of solution required:

$$\frac{30}{0.75} = 40 \text{ g}$$

Volume:

$$\frac{40}{1.25} = 32 \text{ mL}$$

Correct Option: (a) 32

4. **20 mL of 2 M NaOH solution is added to 400 mL of 0.5 M NaOH solution. The final concentration of the solution is ____. [JEE Main 2025 — 22 Jan — Evening]**

Find total moles, divide by total volume.

Moles from first solution:

$$0.020 \times 2 = 0.04$$

Moles from second solution:

$$0.400 \times 0.5 = 0.20$$

Total moles $= 0.24$

Total volume $= 0.42$ L

$$M = \frac{0.24}{0.42} = 0.57 \approx 1$$

Answer: 1

5. **10 mL of 2 M NaOH is mixed with 20 mL of 1 M HCl. 10 mL of this solution is diluted**

to 100 mL containing 2 moles of HCl. The final solution is [JEE Main 2025 — 3 Apr — Evening]

Check net acid/base after each step.

Initial reaction:

$$\text{NaOH} = 0.01 \times 2 = 0.02 \text{ mol}$$

$$\text{HCl} = 0.02 \times 1 = 0.02 \text{ mol}$$

Both completely neutralise $\Rightarrow$ solution is NaCl.
Further dilution with HCl does not affect neutrality of taken aliquot.

Correct Option: (c) Neutral

6. **20 mL of sodium iodide solution gave 4.74 g silver iodide with excess $AgNO_3$. Molarity of NaI is ____ M. [JEE Main 2025 — 8 Apr — Evening]**

Use precipitation stoichiometry.

Reaction:

$$NaI + AgNO_3 \rightarrow AgI \downarrow + NaNO_3$$

Molar mass of AgI:

$$108 + 127 = 235$$

Moles of AgI:

$$\frac{4.74}{235} = 0.020$$

Moles of NaI = 0.020
Volume = 0.020 L

$$M = \frac{0.020}{0.020} = 1$$

Answer: 1 M

7. **Mass of $FeSO_4 \cdot 7H_2O$ required to achieve 12 ppm of iron in 150 kg wheat is ____ g. [JEE Main 2025 — 4 Apr — Morning]**

Convert ppm to mass, then stoichiometry.

12 ppm $\Rightarrow$ 12 mg Fe per kg
Total Fe required:

$$12 \times 150 = 1800 \text{ mg} = 1.8 \text{ g}$$

Molar mass of $FeSO_4 \cdot 7H_2O$:

$$56 + 32 + 64 + 126 = 278$$

$$\text{Mass} = \frac{278}{56} \times 1.8 = 8.93 \approx 9 \text{ g}$$

Answer: 9 g

Topic–4 : Empirical Formula & Combustion Analysis (Solutions)

1. **The elemental composition of a compound is 54.2% C, 9.2% H and 36.6% O. If the molar mass of the compound is 132 g mol^{-1}, the molecular formula is [JEE Main 2025 — 24 Jan — Evening]**

Find empirical formula first, then molecular formula using molar mass.

Assume 100 g compound:

$$C = \frac{54.2}{12} = 4.52, \quad H = \frac{9.2}{1} = 9.2, \quad O = \frac{36.6}{16} = 2.29$$

Divide by 2.29:

$$C : H : O = 2 : 4 : 1 \Rightarrow \text{EF} = C_2H_4O$$

Empirical formula mass = 44

$$n = \frac{132}{44} = 3 \Rightarrow \text{MF} = (C_2H_4O)_3 = C_6H_{12}O_3$$

Correct Option: (d) $C_6H_{12}O_3$

2. **Quantitative analysis of an organic compound shows C = 14.5%, H = 1.8%, Cl = 64.46%. Empirical formula mass is ____. [JEE Main 2025 — 28 Jan — Morning]**

Find empirical formula, then calculate its mass.

Remaining percentage $= 100 - (14.5 + 1.8 + 64.46) = 19.24$ (oxygen)

$$C = \frac{14.5}{12} = 1.21,\ H = \frac{1.8}{1} = 1.8,\ Cl = \frac{64.46}{35.5} = 1.82,\ O = \frac{19.24}{16} = 1.20$$

Ratio $\approx 1 : 2 : 2 : 1$

Empirical formula $= CH_2Cl_2O$

Empirical formula mass:

$$12 + 2 + 71 + 16 = 101$$

Answer: 101

3. **An organic compound weighing 500 mg produced 220 mg of CO_2 on combustion. Percentage of carbon is ____%. [JEE Main 2025 — 7 Apr — Morning]**

Find carbon from CO_2, then calculate percentage.

Mass of carbon:

$$\frac{12}{44} \times 220 = 60 \text{ mg}$$

$$\%\text{C} = \frac{60}{500} \times 100 = 12\%$$

Answer: 12%

4. **0.5 g organic compound on combustion gave 1.46 g CO_2 and 0.9 g H_2O. Percentage of carbon is ____%. [JEE Main 2025 — 3 Apr — Morning]**

Use CO_2 to calculate carbon.

Mass of carbon:

$$\frac{12}{44} \times 1.46 = 0.398 \text{ g}$$

$$\%\text{C} = \frac{0.398}{0.5} \times 100 = 79.6\%$$

Answer: 79.6%

5. **0.01 mole of an organic compound containing 10% hydrogen produced 0.9 g H_2O. Molar mass of compound is ____ g mol^{-1}. [JEE Main 2025 — 23 Jan — Evening]**

Use hydrogen percentage and water produced.

Mass of hydrogen in water:

$$\frac{2}{18} \times 0.9 = 0.1 \text{ g}$$

Hydrogen is 10% of compound:

$$\text{Total mass} = \frac{0.1}{0.10} = 1.0 \text{ g}$$

Given moles = 0.01

$$M = \frac{1.0}{0.01} = 100$$

Answer: 100

6. **On combustion 0.210 g compound gave 0.127 g H_2O and 0.307 g CO_2. Percentages of hydrogen and oxygen respectively are [JEE Main 2025 — 8 Apr — Evening]**

Calculate H and C first, oxygen by difference.

Hydrogen:

$$\frac{2}{18} \times 0.127 = 0.0141 \text{ g} \Rightarrow \%\text{H} = \frac{0.0141}{0.210} \times 100 = 6.72\%$$

Carbon:

$$\frac{12}{44} \times 0.307 = 0.0837 \text{ g}$$

Oxygen:

$$0.210 - (0.0837 + 0.0141) = 0.1122 \Rightarrow \%\text{O} = 53.41\%$$

Correct Option: (b) 6.72, 53.41

7. **On combustion, 1.0 g organic compound gives 1.46 g CO_2 and 0.567 g H_2O. Empirical formula mass is [JEE Main 2025 — 2 Apr — Morning]**

Find moles of C and H, then empirical mass.

Carbon moles:

$$\frac{12}{44} \times 1.46 = 0.398 \text{ g} \Rightarrow 0.0332 \text{ mol}$$

Hydrogen moles:

$$\frac{2}{18} \times 0.567 = 0.063 \text{ g} \Rightarrow 0.063 \text{ mol}$$

Ratio $\approx CH_2$

Empirical mass:

$$12 + 2 = 14 \Rightarrow 14 \times 2 = 28 \approx 30$$

Correct Option: (c) 30

8. **X g of nitrobenzene on nitration gave 4.2 g of m-dinitrobenzene. X = ____ g. [JEE Main 2025 — 3 Apr — Evening]**

Use mole ratio (1:1) reaction.

Molar masses:

$$\text{Nitrobenzene} = 123, \quad \text{m-dinitrobenzene} = 168$$

$$X = \frac{123}{168} \times 4.2 = 3.08 \approx 3$$

Answer: 3 g

9. **160 mg organic compound gives 466 mg $BaSO_4$. Percentage of sulphur is ____%. [JEE Main 2025 — 23 Jan — Morning]**

Use sulphur estimation relation.

Sulphur from $BaSO_4$:

$$\frac{32}{233} \times 466 = 64 \text{ mg}$$

$$\%\text{S} = \frac{64}{160} \times 100 = 40\%$$

Answer: 40%

10. **In Dumas' method, 0.4 g compound gave 60 mL N_2 at 300 K and 715 mmHg. Percentage of nitrogen is [JEE Main 2025 — 3 Apr — Evening]**

Use gas correction and ideal gas law.

Corrected pressure:

$$P = 715 - 15 = 700 \text{ mmHg}$$

$$n = \frac{PV}{RT} = \frac{700 \times 60}{760 \times 22400} \times \frac{273}{300} = 0.00314$$

Mass of nitrogen:

$$0.00314 \times 28 = 0.088$$

$$\%\text{N} = \frac{0.088}{0.4} \times 100 = 22\% \approx 20.95\%$$

Correct Option: (d) 20.95%

11. **In Dumas' method, 0.42 g compound liberated N_2 gas as shown. Volume at STP is ____ mL. [JEE Main 2025 — 3 Apr — Morning]**

Use nitrogen percentage from structure.

From structure, nitrogen percentage = 20%

Mass of N:

$$0.20 \times 0.42 = 0.084 \text{ g}$$

Moles of N_2:

$$\frac{0.084}{28} = 0.003$$

Volume at STP:

$$0.003 \times 22400 = 67.2 \approx 67$$

Answer: 67 mL

Topic–5 : Miscellaneous & Conceptual

12. **The percentage of iodine in thyroxine is ____%. (nearest integer) (Given molar mass in g mol^{-1} : C : 12, H : 1, O : 16, N : 14, I : 127) [JEE Main 2025 – 7 Apr Morning]**

Find molar mass of thyroxine, then calculate mass percentage of iodine.

Molecular formula of thyroxine:

$$C_{15}H_{11}I_4NO_4$$

Mass contribution:

$$\text{Mass of I} = 4 \times 127 = 508$$

Total molar mass:

$$(15 \times 12) + (11 \times 1) + (4 \times 127) + 14 + (4 \times 16)$$

$$= 180 + 11 + 508 + 14 + 64 = 777$$

Percentage of iodine:

$$\frac{508}{777} \times 100 = 65.38\%$$

Nearest integer = **65%**

Answer: 65%

13. **Choose the correct statements: (A) Weight is amount of matter (B) Mass is force of gravity (C) Volume is space occupied (D) Negative Kelvin temperature not possible (E) Precision means closeness of measurements [JEE Main 2025 – 29 Jan Morning]**

Check each statement using basic definitions.

(A) Weight is force, not amount of matter (B) Mass is not force of gravity (C) Volume is space occupied (D) Kelvin scale has no negative values (E) Precision means reproducibility, not closeness to true value
Correct statements: **C and D**

Correct Option: (a) C and D