Sample

JEEnius AI

PREVIOUS YEAR QUESTIONS · 2000–2026

NEET (UG)

Chapter-wise PYQs

Chemistry

2000–2026 Questions from 27 years

Chapter-wise previous year questions with full solutions · NEET (UG) and AIPMT

1,292	145	29
QUESTIONS	FIGURES	CHAPTERS

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NEET (UG) Chapter-wise PYQs · Chemistry

Chapter-wise previous year questions with full solutions · NEET (UG) and AIPMT
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How to use this book

- **Chapter-wise, newest first.** Every chapter opens with its questions, latest year first, followed by an answer key and then full solutions. Attempt the questions before turning to the key.
- **Source line.** Each question shows where it was asked — exam and year, and re-examination where it applies, and its type when it is not a single-correct MCQ.
- **Weightage table.** Chemistry opens with a table of how often every chapter was asked, overall and in the last five years. Use it to plan revision.
- **More than an answer.** Solutions carry a difficulty rating, a suggested time and the topic; many add a quick approach, the common traps students fall into, and what to revise.
- **Ref numbers.** Each solution carries a Ref number. Quote it to report an error.

Questions by year

2000 **53**	2001 **47**	2002 **49**	2003 **46**	2004 **46**	2005 **52**	2006 **48**	2007 **50**	2008 **46**	2009 **46**	2010 **51**	2011 **47**	2012 **49**
2013 **45**	2014 **44**	2015 **42**	2016 **45**	2017 **38**	2018 **44**	2019 **40**	2020 **44**	2021 **44**	2022 **47**	2023 **42**	2024 **37**	2025 **44**
2026 **106**												

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NEET (UG) and AIPMT 2000–2026

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Chemistry

Chapter	All years	Last 5 years
Some Basic Concepts in Chemistry	42	11
Atomic Structure	40	7
Chemical Bonding and Molecular Structure	99	20
Chemical Thermodynamics	62	9
Solutions	45	12
Equilibrium	77	11
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Classification of Elements and Periodicity in Properties	33	12
P-Block Elements	69	16
d- and f-Block Elements	52	13
Co-ordination Compounds	87	19
Some Basic Principles of Organic Chemistry	67	21
Hydrocarbons	49	12
Organic Compounds Containing Halogens	40	12
Organic Compounds Containing Oxygen	109	22
Organic Compounds Containing Nitrogen	44	11
Biomolecules	33	5
Principles Related to Practical Chemistry	3	3
Solid State	40	4
States of Matter	22	4
Surface Chemistry	27	6
Hydrogen	9	3
s-Block Elements	21	3
Environmental Chemistry	14	1
Polymers	26	1
Chemistry in Everyday Life	14	2
General Principles and Processes of Isolation of Elements	20	2
Nuclear Chemistry	5	1

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CHEMISTRY · CHAPTER 1

Some Basic Concepts in Chemistry

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1 NEET 2026

The number of hydrogen atoms present in 5.4 g of urea is: (Given: Molar mass of urea : 60 g mol^{-1}, N_A : 6.022 × 10^{23} particles mol^{-1})

(A) 1.084×10^{23} **(B)** 1.084×10^{22}
(C) 2.168×10^{22} **(D)** 2.168×10^{23}

2 NEET 2026

When $1dm^3$ of CO_2 gas is passed over hot coke the volume of gaseous mixture after complete reaction at STP becomes $1.4dm^3$. The composition of the gaseous mixture at STP is:

(A) $0.8dm^3$ of CO, $0.8dm^3$ of CO_2
(B) $0.8dm^3$ of CO, $0.6dm^3$ of CO_2
(C) $0.6dm^3$ of CO, $0.8dm^3$ of CO_2
(D) $0.6dm^3$ of CO, $0.4dm^3$ of CO_2

3 NEET 2026 · RE-EXAM

The amount of carbon dioxide evolved upon complete combustion of 116 g of n-butane is (Given: atomic mass in amu H = 1, C = 12 and O = 16)

(A) 352 g **(B)** 322 g
(C) 176 g **(D)** 362 g

4 NEET 2025

Dalton's atomic theory could not explain which of the following?

(A) Law of conservation of mass
(B) Law of definite proportions
(C) Law of multiple proportions
(D) Gay-Lussac's law of gaseous volumes

5 NEET 2025

Among the following, choose the ones with equal number of atoms.

A. 212 g of $Na_2CO_3(s)$ [molar mass = 106 g]

B. 248 g of $Na_2O(s)$ [molar mass = 62 g]

C. 240 g of NaOH(s) [molar mass = 40 g]

D. 12 g of $H_2(g)$ [molar mass = 2 g]

E. 220 g of $CO_2(g)$ [molar mass = 44 g]

(A) A, B, and C only **(B)** A, B, and D only
(C) B, C, and D only **(D)** C, D, and E only

6 NEET 2024

Which indicator is used in the titration of sodium hydroxide with a weak acid at the end point?

(A) Phenolphthalein, pink to yellow
(B) Alkaline $KMnO_4$, colourless to pink
(C) Phenolphthalein, colourless to pink
(D) Methyl orange, yellow to pinkish red colour

7 NEET 2024

1.0 g of H_2 has same number of molecules as in:

(A) 14 g of N_2 **(B)** 18 g of H_2O
(C) 16 g of CO **(D)** 28 g of N_2

8 NEET 2024

The amount of glucose required to prepare 250 mL of M/20 aqueous solution is: (Molar mass of glucose: 180 g mol^{-1})

(A) 2.25 g **(B)** 4.5 g
(C) 0.44 g **(D)** 1.125 g

9 NEET 2024

On complete combustion, 0.3 g of an organic compound gave 0.2 g of CO_2 and 0.1 g of H_2O. The percentage composition of carbon and hydrogen in the compound, respectively, is:

(A) 4.07% and 15.02% **(B)** 18.18% and 3.70%
(C) 15.02% and 4.07% **(D)** 3.70% and 18.18%

10 NEET 2023

The right option for the mass of CO_2 produced by heating 20 g of 20% pure limestone is (Atomic mass of Ca = 40) [$CaCO_3 \rightarrow CaO + CO_2$]

(A) 1.12 g **(B)** 1.76 g
(C) 2.64 g **(D)** 1.32 g

11 NEET 2022 · NUMERICAL

What mass of 95% pure $CaCO_3$ will be required to neutralise 50 mL of 0.5 M HCl solution according to the following reaction?

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + 2H_2O_{(l)}$$

[Calculate upto second place of decimal point]

(A) 9.50 g **(B)** 1.25 g
(C) 1.32 g **(D)** 3.65 g

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12 NEET 2021

An organic compound contains 78% (by wt.) carbon and remaining percentage of hydrogen. The right option for the empirical formula of this compound is: [Atomic wt. of C is 12, H is 1]

(A) CH_4 (B) CH
(C) CH_2 (D) CH_3

13 NEET 2020

Which one of the followings has maximum number of atoms?

(A) 1 g of Ag(s) [Atomic mass of Ag = 108]
(B) 1 g of Mg(s) [Atomic mass of Mg = 24]
(C) 1 g of O_2(g) [Atomic mass of O = 16]
(D) 1 g of Li(s) [Atomic mass of Li = 7]

14 NEET 2018

In which case is number of molecules of water maximum?

(A) 18 mL of water
(B) 0.18 g of water
(C) 10^{-3} mol of water
(D) 0.00224 L of water vapours at 1 atm and 273 K

15 NEET 2017

Which of the following is dependent on temperature?

(A) Weight percentage (B) Molality
(C) Molarity (D) Mole fraction

16 AIPMT 2015

The number of water molecules is maximum in

(A) 18 gram of water (B) 18 moles of water
(C) 18 molecules of water (D) 1.8 gram of water

17 AIPMT 2015

If Avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change

(A) The ratio of chemical species to each other in a balanced equation
(B) The ratio of elements to each other in a compound
(C) The definition of mass in units of grams
(D) The mass of one mole of carbon

18 AIPMT 2015 · NUMERICAL

20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample? (At. wt. : Mg = 24)

(A) 60 (B) 84
(C) 75 (D) 96

19 AIPMT 2015 · NUMERICAL

What is the mass of the precipitate formed when 50 mL of 16.9% solution of $AgNO_3$ is mixed with 50 mL of 5.8% NaCl solution? (Ag = 107.8, N = 14, O = 16, Na = 23, Cl = 35.5)

(A) 7 g (B) 14 g
(C) 28 g (D) 3.5 g

20 AIPMT 2014

1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much? (At wt. Mg = 24; O = 16)

(A) Mg, 0.16 g (B) O_2, 0.16 g
(C) Mg, 0.44 g (D) O_2, 0.28 g

21 AIPMT 2014

When 22.4 litres of H_2(g) is mixed with 11.2 litres of Cl_2(g), each at S.T.P., the moles of HCl(g) formed is equal to _____.

(A) 1 mol of HCl(g) (B) 2 mol of HCl(g)
(C) 0.5 mol of HCl(g) (D) 1.5 mol of HCl(g)

22 AIPMT 2014

Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27°C under identical conditions. The ratio of the volume of gases H_2 : O_2 : methane would be

(A) 8 : 16 : 1 (B) 16 : 8 : 1
(C) 16 : 1 : 2 (D) 8 : 1 : 2

23 NEET 2013

6.02×10^20 molecules of urea are present in 100 mL of its solution. The concentration of solution is:

(A) 0.01 M (B) 0.001 M
(C) 0.1 M (D) 0.02 M

24 NEET 2013

How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70% HNO_3.

(A) 90.0 g conc. HNO_3 (B) 70.0 g conc. HNO_3
(C) 54.0 g conc. HNO_3 (D) 45.0 g conc. HNO_3

25 AIPMT 2010

25.3 g of sodium carbonate, Na_2CO_3, is dissolved in enough water to make 250 mL of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+, and carbonate ion, CO_3^{2-}, are respectively. Molar mass of Na_2CO_3 = 106 g mol^{-1}.

(A) 0.955 M and 1.910 M (B) 1.910 M and 0.955 M
(C) 1.90 M and 1.910 M (D) 0.477 M and 0.477 M

26 AIPMT 2010

The number of atoms in 0.1 mole of a triatomic gas is (N_a = 6.02×10^{23} mol^{-1})

(A) $6.026 \times 10^2 2$ (B) $1.806 \times 10^2 3$
(C) $3.600 \times 10^2 3$ (D) $1.800 \times 10^2 2$

27 AIPMT 2009

10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be

(A) 2 mol (B) 3 mol
(C) 4 mol (D) 1 mol

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28 AIPMT 2008

What volume of oxygen gas (O_2), measured at 0°C and 1 atm, is needed to burn completely 1 L of propane gas (C_3H_8) measured under the same conditions?

(A) 7 L **(B)** 6 L
(C) 5 L **(D)** 10 L

29 AIPMT 2008

An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be

(A) CH_3O **(B)** CHO
(C) CH_2O **(D)** CH_4O

30 AIPMT 2008

How many moles of lead (II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g of HCl?

(A) 0.044 **(B)** 0.333
(C) 0.011 **(D)** 0.029

31 AIPMT 2008

Volume occupied by one molecule of water (density = 1 g cm^{-3}) is

(A) 9.0×10^{-23} cm^3 **(B)** 6.023×10^{-23} cm^3
(C) 3.0×10^{-23} cm^3 **(D)** 5.5×10^{-23} cm^3

32 AIPMT 2007

Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 g mL^{-1}. The volume of acid required to make one litre of 0.1 M H_2SO_4 solution is:

(A) 11.10 mL **(B)** 16.65 mL
(C) 22.20 mL **(D)** 5.55 mL

33 AIPMT 2007

An element, X has the following isotopic composition: ^{200}X: 90%, ^{199}X: 8.0%, ^{202}X: 2.0%. The weighted average atomic mass of the naturally-occurring element X is closest to:

(A) 200 amu **(B)** 201 amu
(C) 202 amu **(D)** 199 amu

34 AIPMT 2004

The maximum number of molecules is present in:

(A) 5 L of N_2 gas at STP **(B)** 0.5 g of H_2 gas
(C) 10 g of O_2 gas **(D)** 15 L of H_2 gas at STP

35 AIPMT 2003

In Haber process, 30 litres of dihydrogen and 30 litres of dinitrogen were taken for reaction which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the above condition in the end?

(A) 20 litres ammonia, 20 litres nitrogen, 20 litres hydrogen
(B) 10 litres ammonia, 25 litres nitrogen, 15 litres hydrogen
(C) 20 litres ammonia, 10 litres nitrogen, 30 litres hydrogen
(D) 20 litres ammonia, 25 litres nitrogen, 15 litres hydrogen

36 AIPMT 2002

1 M and 2.5 litre NaOH solution is mixed with another 0.5 M and 3 litre NaOH solution. Find the molarity of the resultant solution.

(A) 0.80 M **(B)** 1.0 M
(C) 0.73 M **(D)** 0.50 M

37 AIPMT 2002

Which has maximum molecules?

(A) 7 g N_2 **(B)** 2 g H_2
(C) 16 g NO_2 **(D)** 16 g O_2

38 AIPMT 2002

The percentage of C, H and N in an organic compound are 40%, 13.3% and 46.7% respectively. The empirical formula is:

(A) $C_3H_{13}N_3$ **(B)** CH_2N
(C) CH_4N **(D)** CH_6N

39 AIPMT 2001

Molarity of liquid HCl if density of liquid HCl is 1.17 g/cc is:

(A) 36.5 **(B)** 18.25
(C) 32.05 **(D)** 42.10

40 AIPMT 2001

Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight. Given atomic weight of Se = 78.4, the minimum molecular weight of peroxidase anhydrous enzyme is:

(A) 1.568×10^4 **(B)** 1.568×10^3
(C) 15.68 **(D)** 2.136×10^4

41 AIPMT 2001

Specific volume of a cylindrical virus particle is 6.02×10^{-2} cc/g. Its radius and length are 7 Å and 10^4 Å respectively. If $N_a = 6.02 \times 10^{23}$, find the molecular weight of the virus.

(A) 1.54 kg/mol **(B)** 1.54×10^4 kg/mol
(C) 3.08×10^4 kg/mol **(D)** 3.08×10^3 kg/mol

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42 AIPMT 2000

Volume of CO_2 obtained by the complete decomposition of 9.85 g $BaCO_3$ is:

(A) 2.24 L **(B)** 1.12 L
(C) 0.84 L **(D)** 0.56 L

Answer key · Some Basic Concepts in Chemistry

1 D	2 B	3 A	4 D	5 B	6 C
7 A	8 A	9 B	10 B	11 C	12 D
13 D	14 A	15 C	16 B	17 D	18 B
19 A	20 A	21 A	22 C	23 A	24 D
25 B	26 B	27 C	28 C	29 A	30 D
31 C	32 D	33 A	34 D	35 B	36 C
37 B	38 C	39 C	40 A	41 B	42 B

Solutions · Some Basic Concepts in Chemistry

1 **Answer: D** Ref 6681

Medium ~1 min Mole Concept

QUICK APPROACH Start by calculating the number of moles of urea using its mass and molar mass, then use Avogadro's number and the number of hydrogen atoms per molecule to find the total hydrogen atoms.

Structure of urea : $H_2N-\overset{\overset{O}{||}}{C}-NH_2$

Mole of urea = $\frac{5.4}{60} = 0.09$

Number of hydrogen atoms = $0.09 \times 4 \times 6.022 \times 10^{23}$

$= 2.1679 \times 10^{23}$

$= 2.168 \times 10^{23}$

2 **Answer: B** Ref 6697

Medium ~1.5 min Stoichiometry and Gas Laws

The reaction is:

$CO_2 + C(s) \rightarrow 2CO$

Initially, volume of $CO_2 = 1dm^3$.

Let x be the volume of CO_2 that reacts. Then volume of CO_2 left = $1 - x$, and volume of CO formed = $2x$.

Total volume after reaction = $(1 - x) + 2x = 1 + x$.

Given total volume = $1.4dm^3$.

$1 + x = 1.4$

$x = 0.4dm^3$

Volume of CO_2 remaining = $1 - 0.4 = 0.6dm^3$

Volume of CO formed = $2 \times 0.4 = 0.8dm^3$

Hence, the mixture contains $0.8dm^3$ of CO and $0.6dm^3$ of CO_2.

3 **Answer: A** Ref 6858

Medium Percentage Composition by Combustion Analysis

In NCERT Class 11, *Some Basic Concepts of Chemistry*, stoichiometry rests on the mole concept and balanced equations derived from the law of conservation of mass. n-Butane is C_4H_{10}; its molar mass is $4 \times 12 + 10 \times 1 = 58$ g mol^{-1}. Hence 116 g is exactly $116/58 = 2$ mol.

The balanced combustion equation is
$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
so 2 mol butane yields 8 mol CO_2. Molar mass of CO_2 is $12 + 2 \times 16 = 44$ g mol^{-1}; mass of CO_2 formed = $8 \times 44 = 352$ g.

Option C (176 g) arises from using only 1 mol butane (common oversight of the given mass). Option B (322 g) reflects an incorrect molar mass for butane or CO_2. Option D (362 g) may come from adding the mass of water or an unbalanced equation.

Thus the correct option is [A] 352 g.

4 **Answer: D** Ref 4610

Medium ~1 min

Dalton's Atomic Theory and Laws of Chemical Combination

Dalton's atomic theory successfully explained important laws of chemical combination such as the law of conservation of mass, law of definite proportions, and law of multiple proportions. However, it could not explain Gay-Lussac's law of gaseous volumes, because Dalton assumed atoms of the same element do not combine to form molecules like H_2, O_2, N_2, etc. The concept of molecules and Avogadro's hypothesis later explained gaseous volume relationships correctly.

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COMMON TRAPS

- **Treating Dalton's theory as unable to explain conservation of mass.** Dalton's atomic theory explains "Law of conservation of mass" because atoms are neither created nor destroyed in a chemical reaction; only rearranged. *Avoid it:* For each option, map it to a Dalton postulate before selecting: conservation of mass ↔ atoms are indivisible/indestructible in chemical reactions.
- **Confusing definite proportions with gaseous volume proportions.** Dalton's atomic theory explains the "Law of definite proportions" because compounds form by atoms combining in fixed simple ratios, producing fixed mass composition. *Avoid it:* Check whether the law talks about mass composition of a compound or volumes of gases. Dalton explains fixed mass ratios, not gaseous volume ratios.

REVISE Create a one-page chart separating laws explained by Dalton from laws requiring Avogadro/molecular concept. · Underline negative words like "could not" in every MCQ before reading options.

5 **Answer: B** Ref 4629

Medium ~1.5 min Mole Concept and Number of Atoms

Use the relation:

$$\text{Number of atoms} = \frac{\text{given mass}}{\text{molar mass}} \times \text{atomicity} \times N_A$$

For Na_2CO_3, atomicity is 6.

$$\frac{212}{106} \times 6 \times N_A$$

$$= 12N_A$$

For Na_2O, atomicity is 3.

$$\frac{248}{62} \times 3 \times N_A$$

$$= 12N_A$$

For NaOH, atomicity is 3.

$$\frac{240}{40} \times 3 \times N_A$$

$$= 18N_A$$

For H_2, atomicity is 2.

$$\frac{12}{2} \times 2 \times N_A$$

$$= 12N_A$$

For CO_2, atomicity is 3.

$$\frac{220}{44} \times 3 \times N_A$$

$$= 15N_A$$

So A, B, and D have equal number of atoms.

COMMON TRAPS

- **Counting molecules/formula units instead of atoms.** Total atoms = moles of substance × atomicity $\times N_A$, not just moles $\times N_A$ unless atomicity is 1. *Avoid it:* After calculating moles, write the atomicity beside every formula before comparing.
- **Using molar mass number as atomicity.** Molar mass is used only in the denominator to get moles; atomicity is counted from subscripts in the chemical formula. *Avoid it:* Separate the calculation into two columns: moles = mass/molar mass; atoms per unit = sum of subscripts.

REVISE The distinction between molecules/formula units and atoms in mole concept questions. · Practice atomicity counting from formulae, especially compounds with invisible subscript 1 and diatomic gases.

6 **Answer: C** Ref 4486

Medium ~1 min Acid-base titration and indicators

For a weak acid and strong base titration, the equivalence point lies in the alkaline range. Phenolphthalein is the suitable indicator because it changes colour in the alkaline pH range. In acidic or neutral medium, phenolphthalein is colourless, and in alkaline medium it becomes pink. Hence, at the end point, the observed colour change is colourless to pink.

7 **Answer: A** Ref 4506

Easy ~1 min Mole Concept and Avogadro's Number

For the same number of molecules, the number of moles must be the same because number of molecules is proportional to moles.

For 1.0 g of H_2:

$$n = \frac{1}{2}$$

$n = 0.5$ mol

So, it contains:

$0.5N_A$ molecules

Now check option A, 14 g of N_2. Molar mass of N_2 is 28 g/mol.

$$n = \frac{14}{28}$$

$n = 0.5$ mol

So, 14 g of N_2 also contains:

$0.5N_A$ molecules

Hence, 1.0 g of H_2 has the same number of molecules as 14 g of N_2.

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8 **Answer: A** Ref 4497

Easy ~1 min Molarity and concentration of solutions

Use the molarity formula for mass of solute.

$$M = \frac{w \times 1000}{M_m \times V}$$

Here, molarity is:

$$M = \frac{1}{20}$$

Molar mass of glucose:

$M_m = 180 \text{ g mol}^{-1}$

Volume of solution:

$V = 250 \text{ mL}$

Substitute the values:

$$\frac{1}{20} = \frac{w \times 1000}{180 \times 250}$$

Rearrange for mass:

$$w = \frac{180 \times 250}{20 \times 1000}$$

$w = 2.25 \text{ g}$

So, the amount of glucose required is 2.25 g.

9 **Answer: B** Ref 4520

Medium ~1.5 min Percentage Composition by Combustion Analysis

For carbon, all carbon in the organic compound is converted into CO_2.

Mass of carbon in CO_2:

$$\frac{12}{44} \times 0.2$$

Percentage of carbon:

$$\%C = \frac{12 \times 0.2 \times 100}{44 \times 0.3}$$

$\%C = 18.18\%$

For hydrogen, all hydrogen in the organic compound is converted into H_2O.

Mass of hydrogen in H_2O:

$$\frac{2}{18} \times 0.1$$

Percentage of hydrogen:

$$\%H = \frac{2 \times 0.1 \times 100}{18 \times 0.3}$$

$\%H = 3.70\%$

So, the percentage composition of carbon and hydrogen is 18.18% and 3.70%, respectively.

COMMON TRAPS

- **Using mass of CO_2 directly as mass of carbon.** From the solution step "Mass of carbon in CO_2: $\frac{12}{44} \times 0.2$", carbon mass must be extracted using the molar-mass fraction 12/44. *Avoid it:* Before percentage calculation, write: mass of element = mass of product × (atomic mass contribution of element / molar mass of product).
- **Using mass of H_2O directly as mass of hydrogen.** The solution explicitly uses "Mass of hydrogen in H_2O: $\frac{2}{18} \times 0.1$", because only 2 g of hydrogen is present in 18 g water. *Avoid it:* Circle the subscript in H_2O and write H mass contribution = 2, molar mass = 18, so the multiplier is 2/18, not 1 or 18/2.

REVISE Molar mass fractions: C in CO_2 = 12/44 and H in H_2O = 2/18. · In every combustion-analysis question, box the original organic compound mass and use it only in the final percentage denominator.

10 **Answer: B** Ref 6495

Medium ~1 min Stoichiometry and Percentage Purity

$CaCO_3 \rightarrow CaO + CO_2$

From 100 g $CaCO_3$ → 44 g CO_2 produced

As $CaCO_3$ is 20% pure

Mass of pure $CaCO_3$ = 20 × (20/100) = 4 g

So, 100 g $CaCO_3$ → 44 g CO_2

4 g $CaCO_3$ → (44/100) × 4 g CO_2

= 1.76 g CO_2

11 **Answer: C** Ref 6266

Medium ~1.5 min Stoichiometry and Purity Calculations

Step 1: Calculate moles of HCl

Moles of HCl = Molarity × Volume (in L)

Moles of HCl = $0.5 \times \frac{50}{1000}$

Moles of HCl = 0.025 mol

Step 2: From the balanced equation, 2 moles of HCl react with 1 mole of $CaCO_3$

Moles of $CaCO_3$ required = $\frac{0.025}{2}$

Moles of $CaCO_3$ required = 0.0125 mol

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Step 3: Calculate mass of pure $CaCO_3$

Molar mass of $CaCO_3$ = $40 + 12 + (3 \times 16)$

Molar mass of $CaCO_3$ = 100 g/mol

Mass of pure $CaCO_3$ = Moles × Molar mass

Mass of pure $CaCO_3$ = 0.0125×100

Mass of pure $CaCO_3$ = 1.25 g

Step 4: Account for purity of sample

Since the sample is 95% pure, the required mass of impure sample is:

Mass of impure sample = $\frac{\text{Mass of pure } CaCO_3}{\text{Purity fraction}}$

Mass of impure sample = $\frac{1.25}{0.95}$

Mass of impure sample = 1.3157 g

Rounding to two decimal places: 1.32 g

12 **Answer: D** Ref 6089

Medium ~1 min Empirical Formula

Element Mass percentage No. of mole Mole ratio
C 78% $\frac{78}{12} = 6.5$ $\frac{6.5}{6.5} = 1$
H 22% $\frac{22}{1} = 22$ $\frac{22}{6.5} = 3.38 \approx 3$

Based on above calculation, possible empirical formula is CH_3.

13 **Answer: D** Ref 5949

Medium ~1 min Mole Concept

Number of atoms = (given mass / molar mass) $\times N_A \times$ atomicity.

For Ag: $(1/108) \times N_A \times 1 = 0.00925 N_A$ atoms.

For Mg: $(1/24) \times N_A \times 1 = 0.0416 N_A$ atoms.

For O_2: $(1/32) \times N_A \times 2 = 0.0625 N_A$ atoms.

For Li: $(1/7) \times N_A \times 1 = 0.1428 N_A$ atoms.

Since $0.1428 N_A$ is the largest value, 1 g of Li has the maximum number of atoms.

14 **Answer: A** Ref 5383

Medium ~1 min Mole Concept

To find the maximum number of molecules, we calculate the number of moles in each case and multiply by Avogadro's number (N_A).

Option (1): 18 mL of water
Mass of water = $18 \times 1 = 18$ g
Moles of water = $\frac{18}{18} = 1$
Molecules of water = $1 \times N_A = N_A$

Option (2): 0.18 g of water
Moles of water = $\frac{0.18}{18} = 10^{-2}$
Molecules of water = $10^{-2} N_A$

Option (3): 10^{-3} mol of water
Molecules of water = $10^{-3} N_A$

Option (4): 0.00224 L of water vapours at 1 atm and 273 K
Moles of water = $\frac{0.00224}{22.4} = 10^{-4}$
Molecules of water = $10^{-4} N_A$

Comparing the number of molecules: $N_A > 10^{-2} N_A > 10^{-3} N_A > 10^{-4} N_A$. Hence, option (1) has the maximum number of molecules.

15 **Answer: C** Ref 5250

Easy ~0.5 min Concentration Terms

Molarity is defined as the number of moles of solute per litre of solution. Since volume of solution changes with temperature, molarity is temperature dependent. Weight percentage, molality, and mole fraction involve masses or moles, which are independent of temperature.

16 **Answer: B** Ref 4866

Easy ~0.5 min Mole Concept

To find the maximum number of water molecules, we compare the number of molecules in each option.

Option (1): 18 gram of water
18 g H_2O = 1 mole H_2O
= N_A molecules of H_2O

Option (2): 18 moles of water
= $18 \times N_A$ molecules of H_2O

Option (3): 18 molecules of water
= 18 molecules

Option (4): 1.8 gram of water
1.8 g H_2O = 0.1 mole H_2O
= $0.1 \times N_A$ molecules of H_2O

Since $18 \times N_A$ is the largest value, option (2) has the maximum number of water molecules.

17 **Answer: D** Ref 4874

Medium ~1 min Mole Concept and Avogadro's Number

The mass of one mole of a substance is defined as the mass of Avogadro's number of particles. If Avogadro's number is changed, the number of particles in one mole changes, which directly changes the mass of one mole of any substance, including carbon. The ratio of chemical species in a balanced equation and the ratio of elements in a compound are based on stoichiometry and atomic/molecular composition, which are independent of the definition of a mole. The definition of mass in grams is based on the kilogram standard and is not affected by Avogadro's number.

18 **Answer: B** Ref 4879

Medium ~1 min Percentage Purity

The decomposition reaction is:

$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$

Molar mass of $MgCO_3$ = 24 + 12 + 48 = 84 g/mol

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Molar mass of MgO = 24 + 16 = 40 g/mol

From the stoichiometry, 84 g of $MgCO_3$ produces 40 g of MgO.

Let x be the mass of pure $MgCO_3$ that produces 8.0 g of MgO.

$$x = \frac{84 \times 8}{40}$$

$x = 16.8$ g

Percentage purity of $MgCO_3$ in the sample:

$$\% \text{ purity} = \frac{16.8}{20.0} \times 100$$

$= 84\%$

19 **Answer: A** Ref 4895

Medium ~2 min Stoichiometry

Step 1: Calculate moles of $AgNO_3$

$n_{AgNO_3} = \frac{50 \times 16.9}{100 \times 169.8} \approx 0.05$ mol

Step 2: Calculate moles of NaCl

$n_{NaCl} = \frac{50 \times 5.8}{100 \times 58.5} \approx 0.05$ mol

Step 3: Reaction

$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$

Initial: 0.05 mol $AgNO_3$, 0.05 mol NaCl

Final: 0 mol $AgNO_3$, 0 mol NaCl, 0.05 mol AgCl

Step 4: Mass of AgCl precipitate

Mass of AgCl = 0.05×143.3

$= 7.16$

≈ 7 g

20 **Answer: A** Ref 2889

Medium ~1.5 min Stoichiometry and Limiting Reagent

Balanced reaction:

$2Mg + O_2 \rightarrow 2MgO$

Moles of Mg:

$$n_{Mg} = \frac{1.0}{24}$$

$n_{Mg} = 0.0417$ mol

Moles of O_2:

$$n_{O_2} = \frac{0.56}{32}$$

$n_{O_2} = 0.0175$ mol

From the balanced equation, 1 mol of O_2 reacts with 2 mol of Mg.

Mg required for 0.0175 mol O_2:

n_{Mg} required $= 2 \times 0.0175$

n_{Mg} required $= 0.035$ mol

Mass of Mg required:

m_{Mg} required $= 0.035 \times 24$

m_{Mg} required $= 0.84$ g

Mg left in excess:

m_{Mg} left $= 1.0 - 0.84$

m_{Mg} left $= 0.16$ g

So, oxygen is the limiting reagent and magnesium is left in excess by 0.16 g.

21 **Answer: A** Ref 2901

Medium ~1 min Stoichiometry and Limiting Reagent

At S.T.P., 22.4 L of any gas contains 1 mol.

Moles of H_2:

$n_{H_2} = 1$

Moles of Cl_2:

$n_{Cl_2} = 0.5$

Balanced reaction:

$H_2 + Cl_2 \rightarrow 2HCl$

According to the reaction, 1 mol H_2 reacts with 1 mol Cl_2. Here, Cl_2 is the limiting reagent because only 0.5 mol Cl_2 is available.

From the balanced equation:

1 mol Cl_2 gives 2 mol HCl

So, 0.5 mol Cl_2 gives:

$n_{HCl} = 0.5 \times 2$

$n_{HCl} = 1$

Therefore, 1 mol of HCl(g) is formed.

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22 **Answer: C** Ref 2918

Medium ~1 min Mole Concept and Avogadro's Law

For gases under identical temperature and pressure conditions, volume is directly proportional to number of moles according to Avogadro's law.

$V \propto n$

For equal masses, let the mass of each gas be m.

Molar mass of H_2 = 2 g/mol

Molar mass of O_2 = 32 g/mol

Molar mass of CH_4 = 16 g/mol

Number of moles of H_2:

$$n_{H_2} = \frac{m}{2}$$

Number of moles of O_2:

$$n_{O_2} = \frac{m}{32}$$

Number of moles of CH_4:

$$n_{CH_4} = \frac{m}{16}$$

So, volume ratio is the mole ratio:

$V_{H_2} : V_{O_2} : V_{CH_4} = \frac{m}{2} : \frac{m}{32} : \frac{m}{16}$

Cancel m:

$V_{H_2} : V_{O_2} : V_{CH_4} = \frac{1}{2} : \frac{1}{32} : \frac{1}{16}$

Multiply by 32:

$V_{H_2} : V_{O_2} : V_{CH_4} = 16 : 1 : 2$

Therefore, the correct answer is option C.

23 **Answer: A** Ref 2596

Easy ~1 min Molarity and Avogadro Number

Number of molecules given is converted into moles using Avogadro's number.

$$n = \frac{6.02 \times 10^{20}}{6.02 \times 10^{23}}$$

$n = 1.0 \times 10^{-3}$ mol

Volume of solution:

$V = 0.1$ L

Molarity is given by:

$$M = \frac{n}{V}$$

$$M = \frac{1.0 \times 10^{-3}}{0.1}$$

$M = 0.01$ M

Therefore, the concentration of the urea solution is 0.01 M.

24 **Answer: D** Ref 2767

Medium ~1 min Concentration Terms and Solution Preparation

To prepare 250 mL of 2.0 M HNO_3, first find the moles of pure HNO_3 required.

$V = 0.250$ L

$n = M \times V$

$n = 2.0 \times 0.250$

$n = 0.50$ mol

Molar mass of HNO_3 is 63 g/mol.

$m = n \times$ molar mass

$m = 0.50 \times 63$

$m = 31.5$ g

So, 31.5 g of pure HNO_3 is needed.

The concentrated acid is 70% HNO_3 by mass, so mass of concentrated solution required is:

mass $= \frac{31.5}{0.70}$

mass $= 45.0$ g

Therefore, 45.0 g of concentrated HNO_3 solution should be used.

25 **Answer: B** Ref 2006

Medium ~1.5 min Molarity and Dissociation of Electrolytes

First find the moles of Na_2CO_3.

$$n = \frac{25.3}{106}$$

$n = 0.2387$ mol

Volume of solution:

$V = 0.250$ L

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Molarity of Na_2CO_3:

$$M = \frac{0.2387}{0.250}$$

$M = 0.955$ M

Complete dissociation of sodium carbonate is:

$Na_2CO_3 \rightarrow 2Na^+ + CO_3^{2-}$

So, carbonate ion concentration equals the molarity of Na_2CO_3.

$[CO_3^{2-}] = 0.955$ M

Sodium ion concentration is twice the molarity of Na_2CO_3.

$[Na^+] = 2 \times 0.955$

$[Na^+] = 1.910$ M

Therefore, the molar concentrations of Na^+ and CO_3^{2-} are 1.910 M and 0.955 M respectively.

26 **Answer: B** Ref 2026

Easy ~1 min Mole Concept

A triatomic gas molecule contains 3 atoms per molecule.

Number of molecules in 0.1 mole:

$n = 0.1 \times N_A$

$n = 0.1 \times 6.02 \times 10^{23}$

$n = 6.02 \times 10^{22}$ molecules

Since each molecule has 3 atoms, total number of atoms:

$N = 3 \times 6.02 \times 10^{22}$

$N = 1.806 \times 10^{23}$ atoms

So, the correct answer is option B.

27 **Answer: C** Ref 1830

Medium ~1 min Stoichiometry and Limiting Reagent

Balanced reaction:

$2H_2 + O_2 \rightarrow 2H_2O$

Moles of hydrogen:

$$n_{H_2} = \frac{10}{2}$$

$n_{H_2} = 5$ mol

Moles of oxygen:

$$n_{O_2} = \frac{64}{32}$$

$n_{O_2} = 2$ mol

From the balanced equation, 1 mol O_2 gives 2 mol H_2O.

So, 2 mol O_2 will give:

$n_{H_2O} = 2 \times 2$

$n_{H_2O} = 4$ mol

O_2 is the limiting reagent, so the amount of water produced is 4 mol.

28 **Answer: C** Ref 1621

Easy ~1 min Stoichiometry and Gay-Lussac's Law of Gaseous Volumes

For complete combustion of propane, write the balanced equation:

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

At the same temperature and pressure, gaseous volumes are directly proportional to moles.

So, from the equation:

1 volume of propane requires 5 volumes of oxygen.

Given propane volume:

$V_{C_3H_8} = 1$ L

Required oxygen volume:

$V_{O_2} = 5 \times 1$

$V_{O_2} = 5$ L

Therefore, the volume of oxygen required is 5 L.

COMMON TRAPS

- **Using 10 oxygen atoms as 10 volumes of O_2.** The equation coefficient before O_2 is found by dividing total O atoms required by 2: 10 O atoms = 5 O_2 molecules/volumes. *Avoid it:* After counting O atoms on product side, always ask whether the reactant is O or O_2 before writing the coefficient.
- **Balancing hydrogen as $8H_2O$ instead of $4H_2O$.** 8 H atoms in propane require 4 H_2O molecules, because each water molecule has 2 H atoms. *Avoid it:* When balancing H, divide the number of H atoms by 2 to get the H_2O coefficient.

REVISE Hydrocarbon combustion balancing using $C_xH_y + O_2 \rightarrow xCO_2 + y/2\ H_2O$. · Practise distinguishing coefficients from subscripts in chemical equations.

29 **Answer: A** Ref 1632

Medium ~1.5 min Empirical Formula from Percentage Composition

For 100 g of compound:

Carbon percentage = 38.71%, so mass of carbon = 38.71 g.

Hydrogen percentage = 9.67%, so mass of hydrogen = 9.67 g.

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Oxygen percentage is found by subtracting from 100.

$O = 100 - 38.71 - 9.67$

$O = 51.62$

Now convert masses into moles.

For carbon:

$$n_C = \frac{38.71}{12}$$

$n_C = 3.226$

For hydrogen:

$$n_H = \frac{9.67}{1}$$

$n_H = 9.67$

For oxygen:

$$n_O = \frac{51.62}{16}$$

$n_O = 3.226$

Divide all mole values by the smallest value, 3.226.

$$C = \frac{3.226}{3.226}$$

$C = 1$

$$H = \frac{9.67}{3.226}$$

$H = 3$

$$O = \frac{3.226}{3.226}$$

$O = 1$

Therefore, the empirical formula is CH_3O.

30 **Answer: D** Ref 1637

Medium ~1.5 min Limiting Reagent and Stoichiometry

Balanced reaction:

$PbO + 2HCl \rightarrow PbCl_2 + H_2O$

Molar mass of PbO:

$207 + 16 = 223$

Moles of PbO:

$n = 6.5/223$

$n = 0.029$ mol

Molar mass of HCl:

$1 + 35.5 = 36.5$

Moles of HCl:

$n = 3.2/36.5$

$n = 0.0877$ mol

From the balanced equation, 1 mol PbO needs 2 mol HCl. For 0.029 mol PbO, required HCl is:

$n = 2 \times 0.029$

$n = 0.058$ mol

Available HCl is 0.0877 mol, which is more than required. So PbO is the limiting reagent.

Therefore, moles of $PbCl_2$ formed will be equal to moles of PbO used:

$n = 0.029$ mol

Correct answer: 0.029

31 **Answer: C** Ref 3036

Medium ~1 min Mole Concept and Avogadro's Number

Density of water is 1 g cm^{-3}, so 18 g of water occupies 18 cm^3.

1 mole of water contains Avogadro number of molecules.

$N_A = 6.023 \times 10^{23}$

Volume occupied by one molecule is:

$$V = \frac{18}{6.023 \times 10^{23}}$$

$V = 2.99 \times 10^{-23}$

So, the volume occupied by one molecule of water is approximately 3.0×10^{-23} cm^3.

Hence, option C is correct.

32 **Answer: D** Ref 1440

Medium ~1 min Molarity and concentration of solutions

For 1 litre of 0.1 M H_2SO_4 solution, required moles of H_2SO_4 are:

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$n = M \times V$

$n = 0.1 \times 1$

$n = 0.1$ mol

Molar mass of H_2SO_4 is 98 g/mol.

Mass of pure H_2SO_4 needed:

$m = n \times M_m$

$m = 0.1 \times 98$

$m = 9.8$ g

The concentrated acid is 98% by mass, so mass of acid solution required is:

$$\frac{98}{100} \times w = 9.8$$

$w = 10$ g

Using density:

$$d = \frac{m}{V}$$

$$V = \frac{m}{d}$$

$$V = \frac{10}{1.80}$$

$V = 5.55$ mL

Therefore, the required volume is 5.55 mL.

COMMON TRAPS

- **Treating 98% by mass as molarity or 98 M.** 98% by mass means 98 g pure H_2SO_4 in 100 g acid solution, not 98 mol/L. *Avoid it:* Convert mass percent + density to mass of solution or molarity before dilution calculations.
- **Ignoring 98% purity and using 9.8 g solution directly.** 9.8 g is pure H_2SO_4 required; acid solution mass must be slightly larger because it is 98% w/w. *Avoid it:* Label every mass as 'pure solute' or 'solution' before applying density.

REVISE W/w% meaning: mass solute per 100 g solution. · Practice deriving stock molarity from percentage by mass and density.

33 **Answer: A** Ref 1462

Easy ~1 min Average Atomic Mass and Isotopic Abundance

Weighted average atomic mass is calculated using isotopic masses and their fractional abundances.

$$\bar{M} = \sum m_i f_i$$

Substitute the given values:

$\bar{M} = 200 \times 0.90 + 199 \times 0.08 + 202 \times 0.02$

$\bar{M} = 180 + 15.92 + 4.04$

$\bar{M} = 199.96$ amu

Since 199.96 amu is closest to 200 amu, the correct answer is 200 amu.

COMMON TRAPS

- **Treating percentages as whole numbers in the weighted average.** In $\bar{M} = \sum m_i f_i$, f_i must be a fraction: 90% = 0.90, 8.0% = 0.08, 2.0% = 0.02. *Avoid it:* Before substituting, write a conversion row: 90%→0.90, 8.0%→0.08, 2.0%→0.02 and verify the fractions sum to 1.00.
- **Using simple arithmetic mean instead of weighted mean.** Average atomic mass is weighted by abundance; isotopes present at 90%, 8%, and 2% do not contribute equally. *Avoid it:* Circle the percentages and ask whether the isotopes have equal abundance; only use simple mean if equal abundance is explicitly given.

REVISE The formula $\bar{M} = \sum m_i f_i$ and the meaning of fractional abundance. · Use a mass-abundance table for every isotope-average calculation.

34 **Answer: D** Ref 1005

Easy ~1 min Mole Concept

Number of molecules is directly proportional to number of moles. So compare moles in each option.

At STP:

1 mol gas occupies 22.4 L

For option A:

$$n = \frac{5}{22.4}$$

$n = 0.223$ mol

For option B:

$$n = \frac{0.5}{2}$$

$n = 0.25$ mol

For option C:

$$n = \frac{10}{32}$$

$n = 0.3125$ mol

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For option D:

$$n = \frac{15}{22.4}$$

$n = 0.67$ mol

Option D has the maximum number of moles, so it has the maximum number of molecules.

COMMON TRAPS

- **Using atomic mass instead of molecular mass for diatomic gases.** For gases written as molecules, molar mass must include the full formula: H_2 = 2 g mol^{-1}, O_2 = 32 g mol^{-1}, N_2 = 28 g mol^{-1}. *Avoid it:* Circle the subscript in "H_2", "O_2", and "N_2" before substituting into n = mass/molar mass.
- **Treating the coefficient-like number in L or g as directly the molecule count.** Number of molecules is proportional to moles, not directly to the printed numerical value when units differ. Volumes at STP use n = V/22.4; masses use n = m/M. *Avoid it:* Write a units column beside every option: L at STP must be converted with 22.4 L mol^{-1}; g must be converted with molar mass.

REVISE The two conversion rules used here: for gas volume at STP, n = V/22.4; for mass, n = m/M. · Memorize molar masses of common diatomic molecules: H_2 = 2, N_2 = 28, O_2 = 32 g mol^{-1}.

35 **Answer: B** Ref 775

Medium ~1 min Stoichiometry and Limiting Reagent

Balanced reaction for Haber process:

$N_2 + 3H_2 \rightarrow 2NH_3$

At the same temperature and pressure, gas volumes react in the same ratio as mole coefficients.

30 litres H_2 needs 10 litres N_2 for complete reaction, so H_2 is the limiting reagent.

Theoretical ammonia formed:

$$30 \times \frac{2}{3}$$

20

So expected NH_3 = 20 litres.

But yield is only 50%, so actual NH_3 formed:

$$20 \times \frac{50}{100}$$

10

To form 10 litres NH_3, H_2 consumed:

$$10 \times \frac{3}{2}$$

15

N_2 consumed:

$$10 \times \frac{1}{2}$$

5

Remaining H_2:

$30 - 15$

15

Remaining N_2:

$30 - 5$

25

Final gaseous mixture contains 10 litres ammonia, 25 litres nitrogen and 15 litres hydrogen.

COMMON TRAPS

- **Treating the 50% yield as 20 L NH_3 still present in final mixture.** The phrase "yielded only 50% of the expected product" means actual NH_3 = 50% of theoretical NH_3, so 20 L becomes 10 L. *Avoid it:* After finding theoretical product, always write a separate line: actual product = theoretical product × %yield/100.
- **Subtracting reactants for the theoretical 20 L product instead of actual 10 L product.** If only 10 L NH_3 is formed, use "To form 10 litres NH_3, H_2 consumed: $10 \times \frac{3}{2} = 15$" and "$N_2$ consumed: $10 \times \frac{1}{2} = 5$". *Avoid it:* Before subtracting from initial reactants, circle the actual product volume and use that number in stoichiometric back-calculation.

REVISE Gaseous volume stoichiometry: coefficient ratio = volume ratio at same T and P. · Practice percent-yield questions where unreacted reactants remain in the final mixture.

36 **Answer: C** Ref 565

Medium ~1 min Molarity of mixed solutions

For mixing solutions of the same solute, use total moles divided by total volume.

Moles from first NaOH solution:

$n_1 = M_1V_1$

$n_1 = 1 \times 2.5$

$n_1 = 2.5$ mol

Moles from second NaOH solution:

$n_2 = M_2V_2$

$n_2 = 0.5 \times 3$

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$n_2 = 1.5$ mol

Total moles:

$n = n_1 + n_2$

$n = 2.5 + 1.5$

$n = 4.0$ mol

Total volume:

$V = 2.5 + 3$

$V = 5.5$ L

Resultant molarity:

$$M = \frac{n}{V}$$

$$M = \frac{4.0}{5.5}$$

$M = 0.727$

So, the molarity is approximately 0.73 M.

COMMON TRAPS

- **Adding volumes as 5.0 L instead of 5.5 L.** For same-solute mixing, final volume is the sum of the given volumes if no contraction is mentioned: 2.5 L + 3 L = 5.5 L. *Avoid it:* Write the volume addition vertically or explicitly: 2.5 + 3.0 = 5.5, not 5.0.
- **Averaging molarities without volume weighting.** Molarity of a mixture is not the arithmetic mean unless equal volumes are mixed. Use total moles divided by total volume: $(M_1V_1 + M_2V_2)/(V_1 + V_2)$. *Avoid it:* Check whether the volumes attached to the two molarities are equal. If not, use weighted average by volume.

REVISE The formula for same-solute mixing: $M_f = \frac{M_1V_1+M_2V_2}{V_1+V_2}$. · Before solving, label each given number with units: 1 M, 2.5 L, 0.5 M, 3 L.

37 **Answer: B** Ref 574

Easy ~1 min Mole Concept

Number of molecules is directly proportional to number of moles.

$n = mass/molar\ mass$

For 7 g N_2:

$n = 7/28$

$n = 0.25$ mol

For 2 g H_2:

$n = 2/2$

$n = 1$ mol

For 16 g NO_2:

$n = 16/46$

$n \approx 0.35$ mol

For 16 g O_2:

$n = 16/32$

$n = 0.5$ mol

Since H_2 has the maximum number of moles, it has the maximum number of molecules.

COMMON TRAPS

- **Choosing the largest given mass instead of calculating moles.** For different substances, number of molecules is proportional to moles, not directly to mass. Use n = mass / molar mass. *Avoid it:* For each option, write mass and molar mass side by side before comparing: A 7/28, B 2/2, C 16/46, D 16/32.
- **Forgetting diatomic molecular formulas in molar mass.** Molar mass of a molecule equals sum of atomic masses multiplied by subscripts: N_2 = 28 g/mol, H_2 = 2 g/mol, O_2 = 32 g/mol. *Avoid it:* Circle every subscript in the option before calculating molar mass.

REVISE Molar mass calculation for diatomic gases and polyatomic molecules. · Practice comparing number of particles using moles without unnecessarily multiplying by Avogadro's number.

38 **Answer: C** Ref 610

Medium ~1.5 min Empirical Formula from Percentage Composition

Assume 100 g of the compound.

Mass of C = 40 g, H = 13.3 g, N = 46.7 g.

Convert masses into moles:

$$n_C = \frac{40}{12}$$

$n_C = 3.33$

$$n_H = \frac{13.3}{1}$$

$n_H = 13.3$

$$n_N = \frac{46.7}{14}$$

$n_N = 3.34$

Divide all mole values by the smallest value, approximately 3.33:

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C ratio = 1

H ratio = 4

N ratio = 1

So, the empirical formula is CH_4N.

COMMON TRAPS

- **Using percentages directly as subscripts.** Percentage composition must first be converted to masses by assuming 100 g, then to moles using atomic masses. *Avoid it:* Write the explicit chain: % → g in 100 g sample → moles → divide by smallest.
- **Rounding mole values before ratio division.** In empirical formula calculation, whole-number rounding is done after normalizing ratios, not before. *Avoid it:* Keep at least 2 decimal places until after dividing all moles by the smallest.

REVISE Memorize the empirical formula workflow: assume 100 g → convert to moles → divide by smallest → round/simple whole-number ratio. · Keep 2–3 significant figures in intermediate mole values and round only after normalization.

39 **Answer: C** Ref 384

Medium ~1 min Molarity and Concentration Terms

Given density of liquid HCl is 1.17 g/cc.

Since 1 L = 1000 cc, mass of 1 L liquid HCl is:

Mass $= 1.17 \times 1000$

Mass $= 1170$ g

Molar mass of HCl is:

36.5 g/mol

Molarity means moles per litre:

$$M = \frac{\text{mass in 1 L}}{\text{molar mass}}$$

$$M = \frac{1170}{36.5}$$

$M = 32.05$

Therefore, molarity of liquid HCl is 32.05 M.

COMMON TRAPS

- **Treating density 1.17 g/cc as mass of 1 L without multiplying by 1000.** Molarity is moles per litre, so the mass must be mass in 1 litre = density × 1000 cc. *Avoid it:* Before applying M = mass/molar mass, explicitly write volume = 1 L = 1000 cc.
- **Using molar mass 36.5 as the answer directly.** Molarity is mol/L; molar mass is g/mol. They are different quantities. *Avoid it:* Check units: an answer to molarity must come from moles per litre, not grams per mole.

REVISE Molarity definition: M = moles of solute per litre of solution. · Practice density-to-molarity formula for pure liquids: M = density(g/mL) × 1000 / molar mass(g/mol).

40 **Answer: A** Ref 385

Medium ~1 min Percentage Composition and Molecular Weight

For minimum molecular weight, assume one atom of Se is present in one molecule of the enzyme.

Percentage of Se by mass is given by:

$$\% \text{ of Se} = \frac{\text{atomic mass of Se}}{\text{molecular weight of enzyme}} \times 100$$

Given:

$\%$ of Se $= 0.5$

Atomic mass of Se:

78.4

So,

$$0.5 = \frac{78.4}{M} \times 100$$

$$M = \frac{78.4 \times 100}{0.5}$$

$M = 15680$

$M = 1.568 \times 10^4$

Therefore, the minimum molecular weight of peroxidase anhydrous enzyme is 1.568×10^4.

COMMON TRAPS

- **Treating 0.5% as 0.5 fraction instead of percent in the formula.** 0.5% means 0.5 per 100 = 0.005 as a fraction. In the percentage equation, keep ×100; in the fraction equation, use 0.005. *Avoid it:* Write either % = mass fraction × 100, or mass fraction = %/100, never mix them.
- **Misinterpreting minimum molecular weight as total mass for multiple Se atoms.** Minimum molecular weight means choose the smallest integer count of Se atoms consistent with the percent composition, i.e., one Se atom. *Avoid it:* For minimum molar mass from elemental percentage, set number of atoms of the specified element n = 1 unless the question explicitly states otherwise.

REVISE Percentage composition formula: % element = mass of element in one molecule or mole / molar mass × 100. · Practice converting percentages to fractions before substitution.

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41 **Answer: B** Ref 388

Hard ~2 min Mole Concept and Molecular Mass

Volume of one cylindrical virus particle is given by:

$V = \pi r^2 l$

Radius:

$r = 7 \times 10^{-8}$ cm

Length:

$l = 10^4 \times 10^{-8}$ cm

$l = 10^{-4}$ cm

Now,

$V = \pi \times (7 \times 10^{-8})^2 \times 10^{-4}$

$V = \pi \times 49 \times 10^{-16} \times 10^{-4}$

$V = 154 \times 10^{-20}$ cm³

$V = 1.54 \times 10^{-18}$ cm³

Volume of 1 mole of virus particles:

$V_m = 1.54 \times 10^{-18} \times 6.02 \times 10^{23}$

$V_m = 9.27 \times 10^5$ cm³/mol

Specific volume means volume per gram:

Specific volume $= 6.02 \times 10^{-2}$ cc/g

So molar mass in g/mol:

$$M = \frac{9.27 \times 10^5}{6.02 \times 10^{-2}}$$

$M = 1.54 \times 10^7$ g/mol

Converting into kg/mol:

$M = 1.54 \times 10^4$ kg/mol

Therefore, the molecular weight of the virus is 1.54×10^4 kg/mol.

42 **Answer: B** Ref 208

Easy ~1 min Mole Concept and Stoichiometry

On heating, barium carbonate decomposes as:

$BaCO_3 \rightarrow BaO + CO_2$

Molar mass of $BaCO_3$:

$137 + 12 + 48 = 197$

So, molar mass of $BaCO_3$ is 197 g/mol.

Moles of $BaCO_3$ in 9.85 g:

$$n = \frac{9.85}{197}$$

$n = 0.05$ mol

From the balanced equation, 1 mol $BaCO_3$ gives 1 mol CO_2.

So, moles of CO_2 formed:

$n = 0.05$ mol

At STP, 1 mol gas occupies 22.4 L.

Volume of CO_2:

$V = 0.05 \times 22.4$

$V = 1.12$ L

Therefore, the correct answer is 1.12 L.

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Sample



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