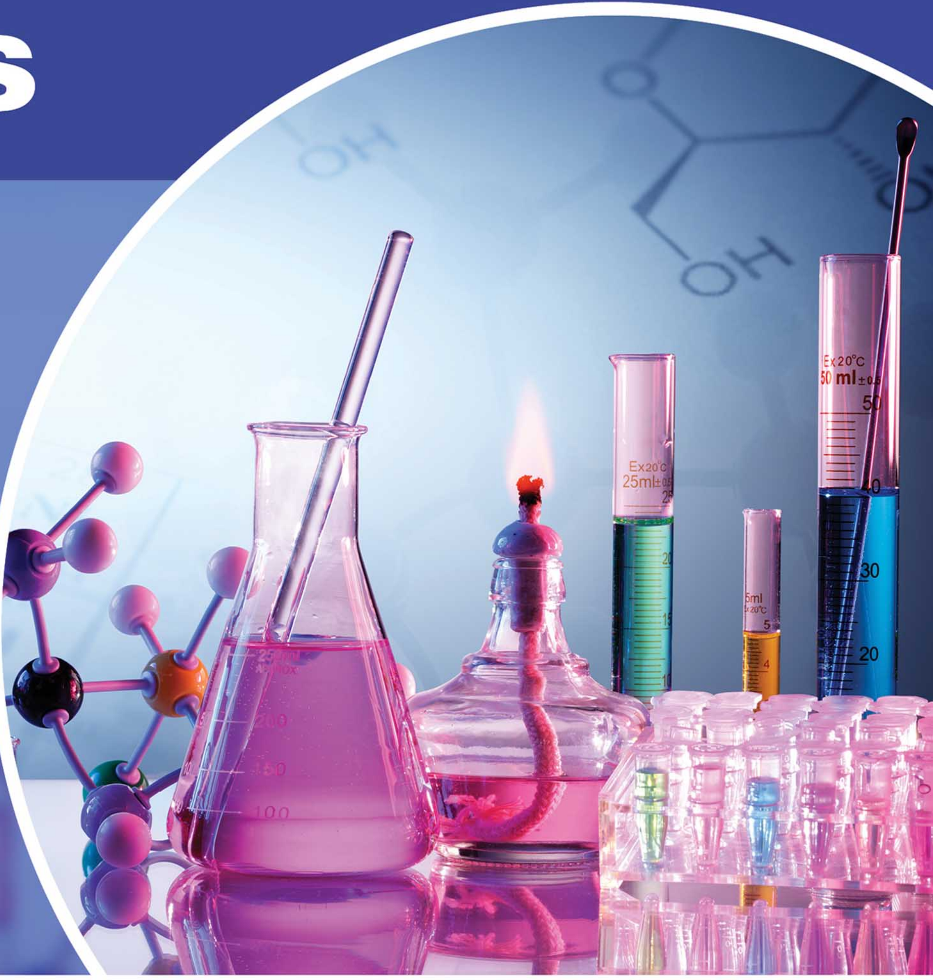
MHT-CET TRIUMPH CHEMISTRY

SOLUTIONS to MCQs



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Written in accordance with the latest MHT-CET Paper Pattern prescribed by
State Common Entrance Test Cell, Maharashtra State

TRIUMPH

MHT-CET CHEMISTRY SOLUTIONS to MCQs

Salient Features

- Detailed solutions provided for difficult MCQs as per the concepts emphasized in the syllabus
- **Smart Keys** (Smart Code, Caution, Thinking Hatke, Shortcut) - Multiple Study Techniques to enhance understanding of concepts and problem solving skills
- Solutions to Evaluation Test for each chapter
- Solutions to two Model Question Papers
- Solutions to Two MHT-CET 2023 Question Papers

Printed at: **Print to Print,** Mumbai

Balbharati Registration No.: 2018MH0022

P.O. No. 9809

TEID: 3236

PREFACE

Target's **Triumph MHT-CET Chemistry Solutions to MCQs** book provides students with holistic comprehension of principles of chemistry through solutions to MCQs based on the concepts emphasized in the syllabus.

It includes **Smart Keys** (Smart Code, Caution, Thinking Hatke, and Shortcut), which offer supplemental explanations for the tricky questions and are intended to help students how to approach problems in novel ways in the shortest possible time with accuracy.

- **Smart Code** showcases simple and smart mnemonic.
- **Caution** apprises students about mistakes often made while solving MCQs.
- **Shortcuts** comprise formulae based short cuts considering their usage in solving MCQ.
- **Thinking Hatke** reveals quick witted approach to crack the specific question.

Roadmaps for the sequences of organic reactions are drawn in the solutions to the newly added chapter **"Organic Reactions: Compilation of Organic Reaction Based MCQs"** making them a helpful novelty in learning organic chemistry.

Solutions to two **Model Question Papers** and two **MHT-CET 2023 Question Papers** are also included in this book.

All the features of this book are designed keeping the following elements in mind:
Time management, easy memorization or revision, and non-conventional yet simple methods for MCQ solving.

We hope the book benefits the learner as we have envisioned.

Publisher
Edition: First

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

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$\therefore$ $20.8 + 9.8 = 7.3 + x$

$x = 23.3$

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1. (A)
2. (A) Isotopes are the atoms of the same element having same atomic number (i.e., containing same number of protons and electrons) but different mass number (i.e., different number of neutrons).
3. (A)

1.8 Mole concept and molar mass

1. (D) 2. (C) 3. (C)
4. (C)

5. (D) Molecular formula of benzene is C_6H_6.

$\therefore$ Molar mass $= 12 \times 6 + 6 \times 1$

$= 72 + 6 = 78 \text{ g mol}^{-1}$

$\therefore$ 1 mole of benzene is equal to 78 g of C_6H_6.

6. (B) Molar mass of $H_2 = 2 \text{ g mol}^{-1}$

2 g will contain 6.022×10^{23} molecules of H_2.

$\therefore$ 1 g of H_2 will contain $\frac{6.022 \times 10^{23}}{2}$ molecules

$= 3.011 \times 10^{23}$ molecules $\approx 3 \times 10^{23}$ molecules

7. (A) 8. (C)

9. (D) Atomic mass of the element

$= 1.792 \times 10^{-22} \times 6.022 \times 10^{23}$

$= 108$

10. (C) 1 mole of ozone $(O_3) = 48$ g

$\therefore$ 0.5 mole of ozone $(O_3) = \frac{0.5 \times 48}{1} = 24$ g

11. (B) Number of molecules $= n \times 6.022 \times 10^{23}$

Now, $n = \frac{\text{mass of oxygen}}{\text{molar mass of oxygen}} = \frac{16}{32} = 0.5$ mol

$\therefore$ Number of molecules $= 0.5 \times 6.022 \times 10^{23}$

$= 3.011 \times 10^{23}$

1.9 Moles and gases

1. (A)

2. (B) At S.T.P,

22.4 dm^3 of any gas $\equiv 6.022 \times 10^{23}$ molecules

$\equiv 6.022 \times 10^{23}$ SO_2 molecules

$\equiv 6.022 \times 10^{23}$ S atoms

Critical Thinking

1.2 Nature of chemistry

1. (A) 2. (D)
3. (D) The constituents of a compound cannot be easily separated by physical method.
4. (C) Mixture of any two liquids may be homogeneous or heterogeneous mixtures.
5. (D) A rusty nail is a mixture.
6. (D)

1.3 Properties of matter and their measurement

1. (D) 2. (A)

3. (C) $1\ L = 10^{-3}\ m^3 = 10^3\ cm^3 = 1\ dm^3 = 10^3\ mL$.

4. (D)

(A)	The mass of a body does not vary as its position changes.
(B)	The SI unit of length is metre.
(C)	A volumetric flask is used to prepare a known volume of a solution.

5. (A) $°F = \frac{9}{5}\ (°C) + 32$
$= \frac{9}{5}(40) + 32$
$= 72 + 32$
$= 104\ °F$

6. (B) $°F = \frac{9}{5}\ (°C) + 32$
$50 = \frac{9}{5}\ (°C) + 32$
$°C = \frac{(50\ -\ 32)\ \times\ 5}{9} = 10\ °C$

1.4 Laws of chemical combination

1. (C) 2. (D) 3. (B)

4. (A)

5. (B) 32 g of sulphur combine with 32 g oxygen to form 64 g of sulphur dioxide as follows:
$$\underset{32\ g}{\text{Sulphur}} + \underset{32\ g}{\text{Oxygen}} \longrightarrow \underset{64\ g}{\text{Sulphur dioxide}}$$
Hence, (0.5 × 32 = 16 g) of sulphur will combine with (0.5 × 32 = 16 g) of oxygen to give (0.5 × 64 = 32 g) sulphur dioxide.

6. (C) $\underset{(1\ vol.)}{N_2} + \underset{(3\ vol.)}{3H_2} \longrightarrow \underset{(2\ vol.)}{2NH_3}$
3 volumes of H_2 give 2 volumes of ammonia
∴ 2 L of H_2 will give $= \frac{2 \times 2}{3}$ L of ammonia
$= 1.33$ L of ammonia

1.6 Dalton's atomic theory

1. (D)

1.7 Atomic and molecular masses

1. (D)

2. (B) One atomic mass unit is defined as a mass exactly equal to one-twelfth of the mass of one C-12 atom.
1 a.m.u. $= 1.66 \times 10^{-24}$ g.
1 atom of ^{12}C = 12 a.m.u.
$= 12 \times 1.66 \times 10^{-24}$ g
$= 1.9923 \times 10^{-23}$ g

3. (B)

4. (A) Average atomic mass of Boron (B) =
$$\frac{(\text{At. mass of }^{10}B \times \%\text{Abundance}) + (\text{At. mass of }^{11}B \times \%\text{Abundance})}{100}$$
$$= \frac{(10.13\ u \times 19.60) + (11.009\ u \times 80.40)}{100} = 10.84\ u$$

5. (A) Average atomic mass of X
$$= \frac{200 \times 90 + 199 \times 8 + 202 \times 2}{100} = 199.96 \approx 200\ u$$

6. (A) Molecular mass of C_6H_5Cl
= (6 × Average atomic mass of C)
+ (5 × Average atomic mass of H)
+ (1 × Average atomic mass of Cl)
= (6 × 12.0 u) + (5 × 1.0 u) + (1 × 35.5 u)
= 112.5 u

7. (D) Molecular mass of O_2 = 32 u
∴ Mass of 1 molecule = 32 u
∴ Mass of 1 molecule of O_2
$= 32 \times 1.66 \times 10^{-24}\ g = 53.1 \times 10^{-24}$ g

8. (C) Formula mass of KCl
= Average atomic mass of K
+ Average atomic mass of Cl
= 39.1 + 35.5 = 74.6 u

1.8 Mole concept and molar mass

1. (B) Molecular weight of sodium oxide (Na_2O)
= 46 + 16 = 62 u
62 g of Na_2O = 1 mole
620 g of Na_2O = 10 moles.

2. (A)

3. (C) 6.022×10^{23} atoms of H weighs 1 g.
∴ Mass of 1 atom of hydrogen $= \frac{1}{6.022 \times 10^{23}}$
$= 1.6 \times 10^{-24}$ g

4. (D) 1 mole ≡ 6.022×10^{23} electrons
One electron weighs 9.108×10^{-31} kg
∴ 1 mole of electrons weighs
$6.022 \times 10^{23} \times 9.108 \times 10^{-31}$ kg
∴ Number of moles that will weigh 1 kg
$= \frac{1}{6.022 \times 10^{23} \times 9.108 \times 10^{-31}}$ moles
∴ $\frac{1}{9.108 \times 6.022} \times 10^8$ moles of electrons will weigh one kilogram.

5. (D) Molar mass of $NH_3 = 14 + (3 \times 1) = 17\ g\ mol^{-1}$
Number of moles $= \frac{4.25}{17} = 0.25$ mol

Number of molecules of NH_3
$= 0.25 \times N_A = 1.506 \times 10^{23}$ molecules
One molecule of NH_3 contains 4 atoms.
$\therefore$ 1.506×10^{23} molecules will contain
$= 1.506 \times 10^{23} \times 4$
$= 6.024 \times 10^{23}$ atoms $\approx 6 \times 10^{23}$ atoms.

6. (D) Number of atoms = n $\times N_A \times$ Atomicity
Where atomicity is the number of atoms in one molecule
18 g of $H_2O \equiv 1$ mole $= 3 \times N_A$ atoms
16 g of $O_2 \equiv \frac{1}{2}$ mole $= 2 \times \frac{1}{2}$ N_A atoms
4.4 g of $CO_2 \equiv \frac{1}{10}$ mole $\equiv 3 \times \frac{1}{10} \times N_A$ atoms
16 g of $CH_4 \equiv 1$ mole $= 5 \times N_A$ atoms
$\therefore$ Maximum number of atoms is present in 16 g of CH_4.

7. (C) Number of atoms = n $\times N_A \times$ Atomicity
Number of S atoms $= 6.022 \times 10^{23} \times 0.2 \times 8$
$\approx 9.63 \times 10^{23}$

8. (A) Number of moles in 4.4 g of CO_2
$= \frac{4.4}{44} = 0.1$
Number of oxygen atoms in 1 mole of CO_2
$= 2 \times N_A$
$\therefore$ Number of oxygen atoms in 0.1 mole of CO_2
$= 0.1 \times 2 \times N_A = 0.2 \times 6.022 \times 10^{23} = 1.20 \times 10^{23}$

9. (C) Total number of atoms in a given amount of $H_2O = n \times N_A \times 3$
$= \frac{0.05}{18} \times 6.022 \times 10^{23} \times 3 = 5.05 \times 10^{21}$

10. (B) 6.022×10^{23} dioxygen molecules are present in 1 mole i.e., 32 g of dioxygen.
$\therefore$ 1.8×10^{22} dioxygen molecules will be present in
$\frac{1.8 \times 10^{22} \times 32}{6.022 \times 10^{23}} = 0.96$ g of dioxygen

11. (A) Molecular weight of $C_{60}H_{122}$
$= 12 \times 60 + 122 \times 1 = 720 + 122 = 842$ u
$\therefore$ 6.022×10^{23} molecules = 842 g
1 molecule $= \frac{842}{6.022 \times 10^{23}}$
$= 139.82 \times 10^{-23}$
$\approx 1.4 \times 10^{-21}$ g

12. (A) 1 mole of $BaCO_3$ contains 3 moles of oxygen atoms
$\therefore$ 1.5 moles of oxygen $\equiv \frac{1}{3} \times 1.5 = \frac{1}{2}$
$= 0.5$ moles of $BaCO_3$

13. (A) 1 L of air = 1000 mL = 1000 cc.
1000 cc of air contains 210 cc of O_2
1 mole = 22.4 L = 22400 cc.
$\therefore$ Number of moles of $O_2 = \frac{210}{22400} = 0.0093$ moles

14. (A) 16 g O_2 has number of moles $= \frac{16}{32} = \frac{1}{2}$
14 g N_2 has number of moles $= \frac{14}{28} = \frac{1}{2}$
Number of moles is same, so number of molecules is same.

15. (D) $d = \frac{M}{V}$ (d = density, M = mass, V = volume)
Since d = 1 g/mL, So, M = V
18 g = 18 mL
18 mL = N_A molecules (N_A = Avogadro's number)
1000 mL $= \frac{N_A}{18} \times 1000 = 55.55\ N_A$.

16. (B) 1 mole of water
= 18 g of water
$= 6.022 \times 10^{23}$ molecules of water
$\therefore$ 18 moles of water
$= 18 \times 6.022 \times 10^{23}$ molecules of water
$= 1.08396 \times 10^{25}$ molecules of water

1.9 Moles and gases

1. (C) 1 mole of nitrogen gas $\equiv$ 22.4 L of N_2
(molar volume at S.T.P.)
0.5 mole of nitrogen gas = 11.2 L of N_2 at S.T.P.

2. (C) Volume occupied by 1 mole of any gas at STP $= 22.4\ dm^3$
$\therefore$ Volume occupied by 4.4 g of CO_2 i.e., 0.1 mole of CO_2 at STP $= 2.24\ dm^3 = 2.24$ L

3. (A) At STP, 22.4 L (22400 cm^3) oxygen gas
= 1 mole oxygen gas
Hence, 11.2 cm^3 corresponds to
$\frac{11.2}{22400} = 0.0005$ mole

4. (B) Number of moles $= \frac{\text{Mass of a substance}}{\text{Molar mass of the substance}}$
$= \frac{60.0\ g}{30\ g\ mol^{-1}} = 2$ mol
Number of moles of a gas (n)
$= \frac{\text{Volume of the gas at STP}}{\text{Molar volume of the gas}}$
$\therefore$ Volume of the gas at STP
= n $\times$ Molar volume of the gas
$= 2\ mol \times 22.4\ dm^3\ mol^{-1}$
$= 44.8\ dm^3$

Concept Fusion

1. (D)

2. (A) $V \propto n$

Number of moles (n) = $\dfrac{\text{Mass of the substance}}{\text{Molar mass of the substance}}$

$\therefore$ $n = \dfrac{\text{mass}}{\text{atomic mass(M)}}$ $\quad\therefore\quad V \propto n \propto \dfrac{1}{M}$

Atomic Mass of O = 16
Atomic Mass of N = 14

$\therefore$ $\dfrac{V_{(O)}}{V_{(N)}} = \dfrac{n_{(O)}}{n_{(N)}} = \dfrac{M_{(N)}}{M_{(O)}}$

$\dfrac{V_{(O)}}{V_{(N)}} = \dfrac{14}{16} = \dfrac{7}{8}$

$\therefore$ The ratio is 7 : 8

3. (C) Baking soda or sodium hydrogen carbonate ($NaHCO_3$) is a compound. Diamond and charcoal are different forms of the element carbon. 22 carat gold is an alloy of gold with other metals (mainly copper). Hence, it is a mixture.

4. (C) In compound B, 32 parts of X react with 84 parts of Y.

$\therefore$ In compound B, 16 parts of X react with 42 parts of Y.
In compound C, 16 parts of X react with *x* parts of Y.
The ratio of masses of Y, which combine with fixed mass of X in compounds B and C, is 3:5.

B	42	3
C	*x*	5

$\therefore$ $x = \dfrac{42 \times 5}{3} = 70$

5. (C) 100 g of haemoglobin contains 0.33 g of Fe.

$\therefore$ 67200 g of haemoglobin contains
$= \dfrac{67200 \times 0.33}{100} = 221.76$ g of Fe

Number of atoms of Fe = $\dfrac{221.76}{56} = 3.96 \approx 4$

6. (C) Let the mass of CH_4 and SO_2 be w_1 and w_2, respectively.

$\dfrac{w_1}{w_2} = \dfrac{1}{2}$

$\therefore$ $\dfrac{n_1}{n_2} = \dfrac{w_1}{M_1} \times \dfrac{M_2}{w_2} = \dfrac{1}{16} \times \dfrac{64}{2} = \dfrac{2}{1}$

$\therefore$ $\dfrac{n_2}{n_1} = \dfrac{1}{2}$

Therefore, the ratio of number of molecules of SO_2 to CH_4 is 1:2.

7. (A) Mass of drop = volume of drop × Density
$= \dfrac{1}{25} \times 1 = \dfrac{1}{25}$ g

Number of water molecules
= Moles of water × $N_0 = \dfrac{1}{25 \times 18} N_0 = \dfrac{0.02}{9} N_0$

8. (A)

9. (A) 5.6 L at S.T.P. weighs 7.5 g.

$\therefore$ 22.4 L at S.T.P weighs $\dfrac{7.5 \times 22.4}{5.6} = 30$ g

$\Rightarrow$ Molar mass of gas = 30 g mol^{-1}
Hence, the gas is NO

MHT-CET Previous Years' Questions

1. (B) $2C_2H_5OH_{(l)} + 2Na_{(s)} \longrightarrow 2C_2H_5ONa + H_{2(g)}\uparrow$

2 mole of Na = 1 mole of H_2
$= 2\text{ g} = 2 \times 10^{-3}$ kg

2. (A) **3.** (C)

4. (C) Average atomic mass =

$\dfrac{\text{atomic mass of }^{10}B \times \text{percentage} + \text{atomic mass of }^{11}B \times \text{percentage}}{100}$

Let the % abundance of ^{10}B isotope = *x*.
% abundance of ^{11}B isotope = 100 – *x*.
Average atomic mass = 10.81
From formula, Average atomic mass

$= \dfrac{10 \times x + 11 \times (100 - x)}{100} = 10.81$

$10x + 1100 - 11x = 10.81 \times 100$
$-x = -1100 + 1081$
$x = 19$

Percentage abundance of lighter isotope, ^{10}B = 19%.

5. (D) $°F = \dfrac{9}{5}(°C) + 32 = 32 \times \dfrac{9}{5} + 32 = 89.6\ °F$

6. (A) 100 mL = 100 g (Density = 1 g/mL)

Number of moles = $\dfrac{100}{18} = 5.55$ mol

Number of molecules = $5.55 \times 6.022 \times 10^{23}$
$= 33.45 \times 10^{23}$

7. (B) At STP, volume = 22.4 dm^3 = 0.022414 m^3

8. (D)

9. (C) Since the mass is same,

Number of atoms $\propto \dfrac{1}{\text{M.W.}}$

Among the given, Na has the smallest atomic mass.

10. (A)

11. (C) Law of multiple proportions is applicable when two or more elements combine in more than one form.

12. (A) Moles of Ar = $\frac{3.99}{39.9}$ = 0.1 mol

1 mol of Ar = 6.022×10^{23} atoms

$\therefore$ 0.1 mol of Ar = 6.022×10^{22} atoms

13. (A) At STP, 22.4 dm^3 = 1 mol of NH_3

5.6 dm^3 at STP = $\frac{5.6\ dm^3}{22.4\ dm^3}$ = 0.25 mol

14. (D) $2KClO_{3(s)} \longrightarrow 2KCl_{(s)} + 3O_{2(g)}$

2×74.5 g $\quad 3 \times 22.4$ L

= 149 g $\quad$ = 67.2 L

Now, 67.2 L of O_2 = 149 g of KCl at STP

33.6 l of O_2 = x g of KCl

$\therefore$ $x = \frac{149 \times 33.6}{67.2}$ = 74.5 g of KCl

15. (D)

i. $n_{Ar} = \frac{13.3}{39.9}$ = 0.33 mol

ii. $n_{O_2} = \frac{24}{32}$ = 0.75 mol

iii. $n_{CO_2} = \frac{11}{44}$ = 0.25 mol

iv. $n_{CH_4} = \frac{16}{16}$ = 1 mol

$\therefore$ Maximum no. of moles = Maximum no. of molecules.

16. (C) Vol. of NH_3 gas at STP = 5.6 cm^3

= 5.6×10^{-3} dm^3

Now, 22.4 dm^3 of NH_3 = 1 mole of NH_3 at STP

$\therefore$ 5.6×10^{-3} dm^3 of NH_3 = $\frac{5.6 \times 10^{-3}}{22.4}$

= 2.5×10^{-4} mol of NH_3

No. of atoms = $2.5 \times 10^{-4} \times 6.022 \times 10^{23} \times 4$

= 6.022×10^{20} atoms

17. (C) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

1 mole of methane required = 2×22.4 dm^3 of O_2

$\therefore$ 0.25 mole of methane required

= $2 \times 22.4 \times 0.25$ = 11.2 dm^3 of O_2

18. (B) 1 mol of an element = 6.022×10^{23} atoms

$\therefore$ 3.01×10^{24} atoms = $\frac{3.01 \times 10^{24}}{6.022 \times 10^{23}}$

= 4.998 mol ≈ 5 mol

No. of moles = $\frac{\text{Mass}}{\text{atomic mass}}$

$\therefore$ Mass = 5×21.13 = 105.65 g mol^{-1}

19. (D)

20. (D) 224 cm^3 = 0.224 dm^3

22.4 dm^3 = 1 mol = 6.022×10^{23} molecules

$\therefore$ 0.224 dm^3 of a gas = 0.01 mol

= 6.022×10^{21} molecules

21. (B) 1 mol urea = 60 g urea

= 6.022×10^{23} molecules

5.4 g urea = $\frac{5.4\ g \times 6.022 \times 10^{23}}{60\ g\ mol^{-1}}$

= 5.4×10^{22} molecules

22. (B) 22.4 dm^3 CH_4 at STP = 1 mol = 16 g of CH_4

$\therefore$ 44.8 dm^3 of CH_4 at STP = 16 g × 2

= 32 g of CH_4

23. (B) Law of multiple proportions is applicable when two or more elements combine in more than one form.

24. (B) K = °C + 273 = –197 °C + 273 = 76 K

25. (B)

26. (C) 1 mol of H_2O = 18 g

$\therefore$ 0.25 mol of H_2O = 18 g × 0.25 = 4.5 g

27. (C) 1 mole of Ar = 39 g of Ar

= 6.022×10^{23} atoms of Ar

$\therefore$ 52 moles of Ar = $6.022 \times 10^{23} \times 52$

= 3.1×10^{25} atoms of Ar

28. (A) Molar mass of CH_4 = 16 g mol^{-1}

16 g of CH_4 = 22.4 dm^3 at STP

$\therefore$ 24 g of CH_4 = $\frac{22.4 \times 24}{16}$ = 33.6 dm^3

29. (A) $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$

11.2 dm^3 of O_2 gives 18 g of water at STP.

$\therefore$ 9 g water = $\frac{11.2 \times 9}{18}$ = 5.6 dm^3 of O_2

30. (B) $\underset{\text{Ethane}}{C_2H_6}$: Molar mass = 30 g mol^{-1}

30 g of ethane = 22.4 dm^3 at STP

$\therefore$ 75 g of ethane = $\frac{22.4 \times 75}{30}$ = 56.0 dm^3

31. (B) No. of moles of urea = $\frac{\text{Mass of urea}}{\text{Molar mass of urea}}$

= $\frac{5.4}{60}$

= 0.09 moles

32. (B) $\frac{0.863\ g}{cm^3} \times \frac{1000\ cm^3\ dm^{-3}}{1000\ g\ kg^{-1}}$ = 0.863 kg dm^{-3}

33. (C) 1 mol urea = 60 g urea

= 6.022×10^{23} molecules

= $4 \times 6.022 \times 10^{23}$ H atoms

$\therefore$ 6 g urea = $4 \times 6.022 \times 10^{22}$

= 2.41×10^{23} H atoms

34. (B) Molecular mass of O_2 is 32 u.
Mass of 1 molecule of O_2
$= 32 \times 1.6606 \times 10^{-24}$ g $= 53.13 \times 10^{-24}$ g

35. (D) 22.4 L of O_2 at STP = 1 mole of O_2
$\therefore$ 5.6 L of $O_2 = \dfrac{5.6\text{ L}}{22.4\text{ L mol}^{-1}} = \dfrac{1}{4}$ mole O_2

36. (C)

(A)	1 mL of water = 1 g water (Density of water = 1 g/mL)
$\therefore$	10 mL of water = 10 g
(B)	1 mol of CH_4 = 16 g
$\therefore$	$\frac{1}{2}$ mol of CH_4 = 8 g
(C)	1 mole of C atom = 12 g
(D)	6.022×10^{23} atoms of oxygen = 16 g
$\therefore$	3.011×10^{23} atoms of oxygen = 8 g

37. (C) $\underset{[1\text{ L}]}{\text{Nitrogen}_{(g)}} + \underset{[3\text{ L}]}{\text{Hydrogen}_{(g)}} \longrightarrow \underset{[2\text{ L}]}{\text{Ammonia}_{(g)}}$

38. (B) Volume of a drop = 0.05 mL
Since density of water is 1 g/mL, the mass of a drop of water is 0.05 g.
Now, 1 mol of H_2O = 18 g
$= 6.022 \times 10^{23}$ molecules
$\therefore$ 0.05 g of water $= \dfrac{0.05\text{ g} \times 6.022\times10^{23}}{18\text{ g mol}^{-1}}$
$= 1.67 \times 10^{21}$ molecules

39. (A) At STP 22.4 L = 1 mol
$\therefore$ $1\text{ L} = \dfrac{1\text{ L}}{22.4\text{ L mol}^{-1}} = 0.0446$ mol
Now,
$\text{Mole} = \dfrac{\text{Mass}}{\text{Molar Mass}}$
$\therefore$ $\text{Molar Mass} = \dfrac{\text{Mass}}{\text{Mole}} = \dfrac{1.16\text{ g}}{0.0446\text{ mol}} = 26\text{ g mol}^{-1}$
Among the given, C_2H_2 has molar mass of 26 g mol^{-1}.

40. (A)

(A)	1 mol of CH_4 = 16 g
$\therefore$	$\frac{1}{4}$ mol of CH_4 = 4 g
(B)	6.022×10^{23} atoms of oxygen = 16 g
$\therefore$	3.011×10^{23} atoms of oxygen = 8 g
(C)	1 g atom C = 1 mole of C atom = 12 g
(D)	6.022×10^{23} molecules of water = 18 g

41. (C) $\underset{\substack{2\text{ Vol}\\10\text{ Vol}}}{2H_2} + \underset{\substack{1\text{ Vol}\\5\text{ Vol}}}{O_2} \longrightarrow \underset{\substack{2\text{ Vol}\\10\text{ Vol}}}{2H_2O}$

10 Volume of H_2 when reacts with 5 volume of O_2, it forms 10 volume of H_2O.

42. (C) $\underset{1\text{ Vol}}{N_{2(g)}} + \underset{3\text{ Vol}}{3H_{2(g)}} \longrightarrow \underset{2\text{ Vol}}{2NH_{3(g)}}$
$\therefore$ Volume ratio = (1 : 3 : 2)

43. (B) Given: t °C = 60
$°F = \dfrac{9}{5} \times t\,°C + 32 = \dfrac{9}{5} \times 60 + 32 = 140\,°F$

44. (C) At STP, 1 mole of any gas occupies 22.4 L of volume.

45. (A) No. of Na atoms = 200 atoms
$n = \dfrac{\text{No. of Na atoms}}{N_A} = \dfrac{200}{N_A}$
and $n = \dfrac{W}{M}$
$\therefore$ $\dfrac{W}{M} = \dfrac{200}{N_A}$
$\therefore$ $W = \dfrac{200}{N_A} \times M = \dfrac{200}{6.022\times10^{23}} \times 23$
$= 7.64 \times 10^{-21}$ g

46. (B) $\underset{\substack{[1\text{ L}]\\[10\text{ dm}^3]}}{\text{Nitrogen}_{(g)}} + \underset{\substack{[3\text{ L}]\\[30\text{ dm}^3]}}{\text{Hydrogen}_{(g)}} \longrightarrow \underset{\substack{[2\text{ L}]\\[20\text{ dm}^3]}}{\text{Ammonia}_{(g)}}$

47. (B) For NH_3
22.4 dm^3 = 1 mol
$= 6.022 \times 10^{22}$ molecules
$= 6.022 \times 10^{22} \times 4$ atoms
$\therefore$ 2.24 dm^3 = 0.1 mol
$= 0.6022 \times 10^{22}$ molecules
$= 0.6022 \times 10^{22} \times 4$ atoms
$= 2.4088 \times 10^{23}$ atoms

48. (B) $\underset{[2\text{ moles}]}{2KClO_3} \longrightarrow 2KCl + \underset{[3\text{ moles}]}{3O_2\uparrow}$

2 moles of $KClO_3 = 2 \times 122.5 = 245$ g
3 moles of O_2 at STP occupy = $(3 \times 22.4\text{ dm}^3)$
Thus, 245 g of potassium chlorate will liberate 67.2 dm^3 of oxygen gas.
Let '*x*' gram of $KClO_3$ liberate 22.4 dm^3 of oxygen gas at S.T.P.
$\therefore$ $x = \dfrac{245\times22.4}{3\times22.4} = 81.67$ g

49. (B) 1 mol $N_2 = 6.022 \times 10^{23}$ molecules
At STP, 1 mol N_2 = 22.4 dm^3 = 22.4×10^3 cm^3
$\therefore$ 22.4×10^3 cm^3 = 6.022×10^{23} molecules
$\therefore$ 22.4 cm^3 = 6.022×10^{20} molecules

50. (B) Atomic mass is the mass of an atom of the element.
Mass of 1 atom of the element = 10 u
Now, 1 u = 1.66056×10^{-24} g
Therefore, 10 u = 1.66056×10^{-23} g

51. (C)

52. (B) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$

1 mol C ≡ 1 mol $CO_{2(g)}$

6 g C = 0.5 mol C

∴ 0.5 mol C ≡ 0.5 mol $CO_{2(g)}$

At STP, 1 mol $CO_{2(g)}$ ≡ 22.4 dm^3

∴ 0.5 mol $CO_{2(g)}$ = 11.2 dm^3

53. (D) Molar mass of methane (CH_4) = 16 g mol^{-1}

∴ No. of moles of $CH_4 = \frac{3.2}{16} = 0.2$ mol

No. of atoms in a molecule of CH_4 = 5

∴ Moles of atoms in 0.2 mol CH_4 = 0.2 × 5 = 1 mol

54. (C) Molecular mass ethane (C_2H_6) = 30 g mol^{-1}

1 mol of ethane = 30 g = 22.4 dm^3 at STP

∴ 60 g ethane = 22.4 dm^3 × 2 = 44.8 dm^3 of C_2H_6

55. (C) $°F = \left({}^0C \times \frac{9}{5}\right) + 32 = -40.0 \times \frac{9}{5} + 32$

$= -72 + 32$

$= -40.0$ °F

56. (D)

57. (B) Chemical formula of ammonium nitrate is NH_4NO_3.

1 mol NH_4NO_3 ≡ 2 mol N-atoms

∴ 80 g NH_4NO_3 = 2 mol N-atoms

∴ 8 g NH_4NO_3 = 0.2 mol N-atoms

58. (A) 4.25 g $NH_3 = \frac{4.25}{17}$ mol NH_3 = 0.25 mol NH_3

1 mol NH_3 = 1 mol N-atoms + 3 mol H-atoms

∴ 0.25 mol NH_3 = 0.25 × 4

= 1 mol atoms

59. (D) $°F = \frac{9}{5}$ (°C) + 32

$= \frac{9}{5}(50) + 32 = 90 + 32 = 122$ °F

60. (B) Number of moles of a gas (n)

$= \frac{\text{Volume of gas at STP}}{22.4\ dm^3\ mol^{-1}}$

∴ $n = \frac{4.48\ dm^3}{22.4\ dm^3\ mol^{-1}} = 0.2$ mol

$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_2 + H_{2(g)}\uparrow$

1 mol Mg ≡ 1 mol H_2 gas

∴ Mg required to liberate 0.2 mol H_2 gas

= 0.2 mol = 0.2 × 24 = 4.8 g

61. (A) Structure of methoxymethane:

$CH_3 - O - CH_3$

Its molecular formula is C_2H_6O.

Molar mass = 46 g mol^{-1}

∴ No. of moles of $C_2H_6O = \frac{46\ g}{46\ g\ mol^{-1}}$

= 1 mol

One molecule of C_2H_6O contains 2 C-atoms and 6 H-atoms.

∴ 1 mol C_2H_6O contains 2 mol C-atoms and 6 mol H-atoms.

62. (B) Number of atoms

= Number of moles × Avogadro's constant

$= \frac{\text{Mass of a substance}}{\text{Molar mass of a substance}} \times 6.022 \times 10^{23}$ atoms/mol

Since, the mass is same for all elements, the number of atoms will be inversely proportional to atomic mass. Among the given, Na has the smallest atomic mass.

63. (D)

$CaCO_{3(s)}$	$\longrightarrow$	$CaO_{(s)}$	$\longrightarrow$	$CO_{2(g)}$
[1 mol]		[1 mol]		[1 mol]
[100 g]		[56 g]		[44 g]
[10 g]		[5.6 g]		[4.4 g]

64. (C)

65. (B) Number of moles (n)

$= \frac{\text{Mass of a substance}}{\text{Molar mass of a substance}} = \frac{100\ g}{40\ g\ mol^{-1}} = 2.5$ mol

Number of molecules

= Number of moles × Avogadro's constant

= 2.5 mol × 6.022 × 10^{23} molecules/mol

= 1.5055 × 10^{24}

Evaluation Test

1. (C)

2. (C) Molecular mass of N_2O_4 = 28 + 64 = 92 g

∴ number of moles = $\frac{54}{92}$ = 0.59 moles

Molecular mass of CO_2 = 12 + 32 = 44 g

∴ number of moles = $\frac{28}{44}$ = 0.64 moles

Molecular mass of H_2O = 2 + 16 = 18 g

∴ number of moles = $\frac{36}{18}$ = 2 moles

Molecular mass of C_2H_5OH = 24 + 6 + 16

= 46

∴ number of moles = $\frac{46}{46}$ = 1 mole

Among the given, water has more moles.

∴ Largest number of molecules is present in 36 g of water.

3. (A) Mass of 6×10^{23} molecules of water = 18 g

Mass of 1 molecule of water = $\frac{18}{6 \times 10^{23}}$
$= 3 \times 10^{-23}$ g
$= 3 \times 10^{-26}$ kg.

4. (A)

5. (B) Mass of 1 mole of Ne = 20 g

Number of moles = $\frac{\text{Mass of a substance}}{\text{Molar mass of the substance}}$
$= \frac{52\ g}{20\ g\ mol^{-1}} = 2.6$ mol

6. (B)

7. (B) Molar mass of NaOH = g mol^{-1}

∴ 1 mol NaOH = 40 g
0.01 mol NaOH = 0.4 g

8. (D) 1 molecule of $PCl_3 \equiv 4$ atoms

∴ 1 mole i.e., Avogadro number (N_A) of PCl_3 molecules will contain $4 \times N_A$ atoms.

∴ 1.4 moles of PCl_3 $= 4 \times 1.4 \times N_A$ atoms
$= 3.372 \times 10^{24}$ atoms

9. (A) 14 g of CO = $\frac{14}{28}$ = 0.5 mole.

1 mole of CO occupies 22.4 L at NTP

∴ 0.5 mole will occupy 11.2 L

10. (D) 1 molecule of CO contains 1 oxygen atom.

∴ 6.02×10^{24} CO molecules contain 6.02×10^{24} oxygen atoms.

11. (C) **12.** (C)

13. (D) The SI unit of mass is 'kilogram' and not 'gram'.

14. (B) At S.T.P,
22.4 dm^3 of any gas $\equiv 6.022 \times 10^{23}$ molecules

15. (D) In first experiment:
2.70 g of copper oxide contain 2.16 g of copper.
% of copper = 2.16 / 2.70 × 100 = 80 %
In second experiment:
1.83 g of copper oxide contain 1.46 g of copper.
% of copper = 1.46 / 1.83 × 100 = 79.8 %
Therefore, percentage of copper in copper oxide is approximately 80 %.
Since the percentage of copper in both the sample of copper oxide is nearly same, the above data illustrates the law of definite proportion.

16. (D) **17.** (B) **18.** (A)

19. (B) $BaCl_2 + H_2SO_4 \longrightarrow 2HCl + BaSO_4$

∴ $20.8 + 9.8 = 7.3 + x$

∴ $x = 23.3$ g

20. (A) **21.** (C) **22.** (A)

23. (D)

24. (D) Atomic mass of the given element
$= 6.022 \times 10^{23} \times 10.86 \times 10^{-26}$ kg
$= 65.4 \times 10^{-3}$ kg
$= 65.4$ g

∴ The element whose atom has mass of 10.86×10^{-26} kg is zinc.

25. (A) Contribution of ^{10}B = 10.0 × 0.19
= 1.9 amu ….(i)

Contribution of ^{11}B = 11.0 × 0.81
= 8.91 amu ….(ii)

Adding (i) and (ii) = 1.9 + 8.91 = 10.81 amu
Thus, the average atomic mass of boron is 10.81 amu.

26. (D) **27.** (D)

28. (A) N^{3-} ion has 8 valence electrons.
14 g N^{3-} ions have $8N_A$ valence electrons

∴ 4.2 g of N^{3-} ions have valence electrons
$= \frac{8N_A \times 4.2}{14} = 2.4N_A$

29. (A) 16 g of O_2 has number of moles = $\frac{16}{32} = \frac{1}{2}$

14 g of N_2 has number of moles = $\frac{14}{28} = \frac{1}{2}$

Number of moles is same, so number of molecules are same.

30. (B) Molecular mass of $BaCl_2.2H_2O$
= 137 + 35.5 × 2 + 2 × 18 = 244 g
244 g of $BaCl_2.2H_2O$ = 2 moles of water

∴ 488 g of $BaCl_2.2H_2O$ = $\frac{488 \times 2}{244}$
= 4 moles of water

31. (A)

32. (A) 1 cm^3 = 0.001 L

∴ 11.2 cm^3 = 0.001 × 11.2 = 0.0112 L
22.4 L of gas at STP = 1 mol

∴ Number of moles in 11.2 cm^3 of H_2 is
$= \frac{0.0112}{22.4} = 0.0005$ mol

33. (A) Helium atom has 2 electrons.

∴ 1 mol He ≡ 2 N_A electrons

∴ 2 mol He ≡ 4 N_A electrons

34. (D) 1 mole of $K_4[Fe(CN)_6]$ = 12 × 6 g of carbon

∴ 0.5 mole of $K_4[Fe(CN)_6]$ = $\frac{0.5 \times 12 \times 6}{1}$ g
= 36 g of carbon

35. (B)