SAMPLE CONTENT

36 YEARS
1988 - 2023

As per latest syllabus prescribed by NMC

PREVIOUS SOLVED PAPERS

1834 MCQs

Chapter-wise & Subtopic-wise

NEET (UG) CHEMISTRY

INCLUDES SOLVED QUESTION PAPER OF 2023

A comprehensive collection of NEET & AIPMT Questions from past 36 Years

Target Publications® Pvt. Ltd.

36

YEARS

1988 - 2023

1834 MCQs

Previous Solved Paper

Chapter-wise & Subtopic-wise

NEET CHEMISTRY

Updated as per latest syllabus prescribed by

NMC on 06th October, 2023

Salient Features

- A compilation of 36 years of AIPMT/NEET questions (1988-2023)
- Includes solved questions from **NEET (UG) 2023**
- Includes '1834' AIPMT/NEET MCQs
- Chapter-wise and Subtopic-wise segregation of questions
- Year-wise flow of content concluded with the latest questions
- Solutions provided wherever required
- Graphical analysis of questions: Chapter-wise and Subtopic-wise
- Separate list of questions excluded from the NEET (UG) 2024 syllabus

Scan the adjacent QR code in *Quill - The Padhai App* to view **NEET (UG) 2023 (Manipur)** question paper along with answers and solutions in PDF format.

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PREFACE

Target's '**NEET Chemistry: PSP (Previous Solved Papers)**' is a compilation of questions asked in the past 36 years (1988-2023) in the National Eligibility cum Entrance Test (NEET), formerly known as the All India Pre-Medical Test (AIPMT).

The book consists of chapter-wise categorization of questions. Each chapter is further segregated into subtopics and thereafter all the questions pertaining to a subtopic are arranged year-wise concluding with the latest year. To aid students, we have also provided solutions for questions wherever deemed necessary.

Considering the latest modifications in the syllabus of NEET (UG) examination, a list of questions based on the concepts excluded from the latest NEET (UG) 2024 syllabus is provided.

A graphical (% wise) analysis of the subtopics for the past 36 years as well as 11 years (2013 onwards) has been provided at the onset of every topic. Both the graphs will help the students to understand and analyse each subtopic's distribution for NEET/AIPMT (36 years) and NEET (UG) (11 Years).

We are confident that this book will comprehensively cater to needs of students and effectively assist them to achieve their goal.

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

A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

Publisher

Edition: Fourth

Frequently Asked Questions

Why this book?	• This book acts as a go-to tool to find all the AIPMT/NEET questions since the past 36 years at one place.
	• The subtopic wise arrangement of questions provides the break-down of a chapter into its important components which will enable students to design an effective learning plan.
	• The graphical analysis guides students in ascertaining their own preparation of a particular topic.
Why the need for two graphs?	Admission for undergraduate and post graduate medical courses underwent a critical change with the introduction of NEET in 2013. Although it received a huge backlash and was criticised for the following two years, NEET went on to replace AIPMT in 2016. The introduction of NEET brought in a few structural differences in terms of how the exam was conducted. Although the syllabus has majorly remained the same, the chances of asking a question from a particular subtopic are seen to vary slightly with the inception of NEET. The two graphs will fundamentally help the students to understand that the (weightage) distribution of a particular chapter can vary i.e., a particular subtopic having the most weightage for AIPMT may not necessarily be the subtopic with the most weightage for NEET.
How are the two graphs beneficial to the students?	• The two graphs provide a subtopic's weightage distribution over the past 36 years (for NEET/AIPMT) and over the past 11 years (for NEET-UG).
	• The students can use these graphs as a self-evaluation tool by analyzing and comparing a particular subtopic's weightage with their preparation of the subtopic. This exercise would help the students to get a clear picture about their strength and weakness based on the subtopics.
	• Students can also use the graphs as a source to know the most important as well as least important subtopics as per weightage of a particular chapter which will further help them in planning the study structure of a particular chapter. *(Note: The percentage-wise weightage analysis of subtopics is solely for the knowledge of students and does not guarantee questions from subtopics having the most weightage, in the future exams.* *Question classification of a subtopic is done as per the authors' discretion and may vary with respect to another individual.)*

Index

Usage of symbols:

☒ – *Complete chapter excluded from the NEET (UG) 2024 syllabus (in index)*

◑ – *Part of the chapter excluded from the NEET (UG) 2024 syllabus (in index)*

D – *Sub-topics or questions that are not part of the NCERT Rationalised (2023-24) textbooks (in book)*

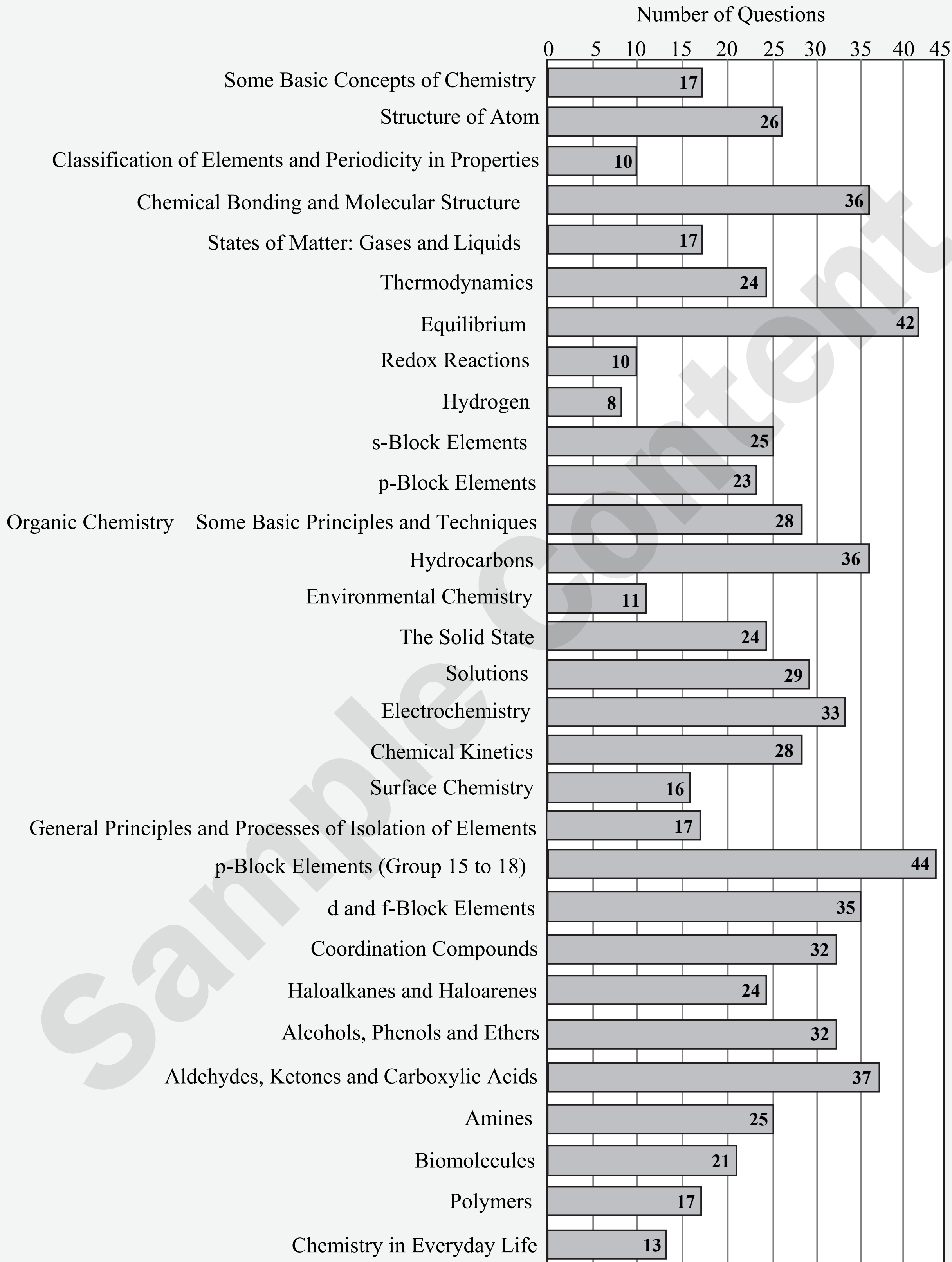
Questions based on the concepts excluded from the NEET (UG) 2024 Syllabus

Chapter Name	Sub-topic Name	Questions not part of NEET (UG) 2024 Syllabus	Page no.
2. Structure of Atom	2.1 Fundamental particles	All Questions	9
	2.2 Atomic number and mass number		10
5. States of Matter: Gases and Liquids	Entire chapter is deleted		39
6. Thermodynamics	6.8 Third law of thermodynamics	All Questions	48
9. Hydrogen	Entire chapter is deleted		81
10. s-Block Elements	Entire chapter is deleted		84
11. p-Block Elements	11.4 Important compounds of boron: Borax, orthoboric acid, and diborane	All Questions	93
	11.5 Aluminium and its important compounds		93
	11.9 Allotropes of carbon		94
	11.10 Important compounds of carbon		94
	11.11 Important compounds of silicon		94
14. Environmental Chemistry	Entire chapter is deleted		128
15. The Solid State	Entire chapter is deleted		131
19. Surface Chemistry	Entire chapter is deleted		175
20. General Principles and Processes of Isolation of Elements	Entire chapter is deleted		180
21. p-Block Elements (Group 15 to 18)	21.1 Group 15: Nitrogen family	1, 2, 6, 7, 8, 9, 10, 12, 14, 15, 17, 19-31	185- 187
	21.2 Group 16: Oxygen family	2, 3, 4, 5, 8, 9, 10, 11, 12, 14, 15, 17, 18, 19, 20, 23, 24, 25	187-188

	21.3 Group 17: Halogen family	1-8, 10, 11, 13, 16, 17, 19, 22, 23, 24, 25, 27, 28, 29, 30, 32	188-191
	21.4 Group 18: Noble gases	3, 4, 5, 6, 8	191
29. Polymers	Entire chapter is deleted		292
30. Chemistry in Everyday Life	Entire chapter is deleted		298

Note: *The above table contains the list of chapters/subtopics/question numbers that are excluded from the latest syllabus of NEET (UG) 2024. However, these questions are covered to give an idea about the variety and difficulty levels of questions asked in the examination over the years.*

Chapter-wise Weightage Analysis of past 11 Years (2013 Onwards)

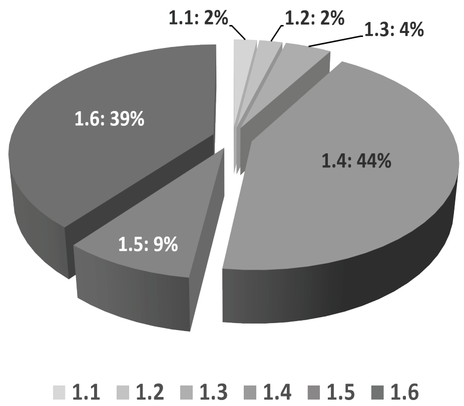


Total No. of Questions: 740

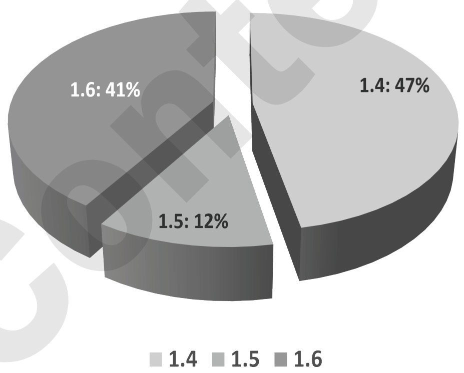
1 Some Basic Concepts of Chemistry

- 1.1 Units of measurement
- 1.2 Uncertainty in measurement
- 1.3 Atomic and molecular masses
- 1.4 Mole concept and molar mass
- 1.5 Percentage composition, empirical and molecular formulae
- 1.6 Chemical reactions, stoichiometry and calculations based on stoichiometry

36 Years NEET/AIPMT Analysis
(Percentage-wise weightage of sub-topics)



11 Years NEET Analysis (2013 Onwards)
(Percentage-wise weightage of sub-topics)



*[**Note:** Till date no questions have been asked from subtopics: General introduction – Importance and scope of chemistry, Laws of chemical combination.]*

1.1 Units of measurement

1. The dimensions of pressure are the same as that of _______. **[1995]**
   (A) force per unit volume
   (B) energy per unit volume
   (C) force
   (D) energy

1.2 Uncertainty in measurement

1. Given the numbers: 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers is _______. **[1998]**
   (A) 3, 3 and 4 respectively
   (B) 3, 4 and 4 respectively
   (C) 3, 4 and 5 respectively
   (D) 3, 3 and 3 respectively

1.3 Atomic and molecular masses

1. Boron has two stable isotopes, ^{10}B (19%) and ^{11}B (81%). Calculate average at.wt. of boron in the periodic table. **[1990]**
   (A) 10.8 (B) 10.2
   (C) 11.2 (D) 10.0

2. 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 _______. **[2007]**
   (A) 201 amu (B) 202 amu
   (C) 199 amu (D) 200 amu

1.4 Mole concept and molar mass

1. 1 cc N_2O at NTP contains _______. **[1988]**
   (A) $\frac{1.8}{224} \times 10^{22}$ atoms
   (B) $\frac{6.02}{22400} \times 10^{23}$ molecules
   (C) $\frac{1.32}{224} \times 10^{23}$ electrons
   (D) all the above

2. The number of oxygen atoms in 4.4 g of CO_2 is approximately _______. **[1990]**
   (A) 1.2×10^{23}
   (B) 6×10^{22}
   (C) 6×10^{23}
   (D) 12×10^{23}

3. The molecular weight of O_2 and SO_2 are 32 and 64 respectively. At 15 °C and 150 mmHg pressure, one litre of O_2 contains 'N' molecules. The number of molecules in two litres of SO_2 under the same conditions of temperature and pressure will be _______. **[1990]**
(A) N/2 (B) N
(C) 2N (D) 4N

4. The number of moles of oxygen in 1 L of air containing 21 % oxygen by volume, in standard conditions, is _______. **[1995]**
(A) 0.186 mol (B) 0.21 mol
(C) 2.10 mol (D) 0.0093 mol

5. 0.24 g of a volatile gas, upon vaporisation, gives 45 mL vapour at NTP. What will be the vapour density of the substance? (Density of H_2 = 0.089) **[1996]**
(A) 95.93 (B) 59.93
(C) 95.39 (D) 5.993

6. Haemoglobin contains 0.334 % of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (Atomic weight of Fe is 56) present in one molecule of haemoglobin is _______. **[1998]**
(A) 4 (B) 6 (C) 3 (D) 2

7. The number of atoms in 4.25 g of NH_3 is approximately _______. **[1999]**
(A) 4×10^{23} (B) 2×10^{23}
(C) 1×10^{23} (D) 6×10^{23}

8. Specific volume of cylindrical virus particle is 6.02×10^{-2} cc/g whose radius and length are 7 Å and 10 Å respectively.
If $N_A = 6.02 \times 10^{23}$, find molecular weight of virus. **[2001]**
(A) 15.4 kg/mol
(B) 1.54×10^4 kg/mol
(C) 3.08×10^4 kg/mol
(D) 3.08×10^3 kg/mol

9. Which has maximum molecules? **[2002]**
(A) 7 g N_2 (B) 2 g H_2
(C) 16 g NO_2 (D) 16 g O_2

10. The maximum number of molecules is present in _______. **[2004]**
(A) 15 L of H_2 gas at STP
(B) 5 L of N_2 gas at STP
(C) 0.5 g of H_2 gas
(D) 10 g of O_2 gas

11. The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23}$ mol^{-1}) _______. **[2010]**
(A) 6.026×10^{22} (B) 1.806×10^{23}
(C) 3.600×10^{23} (D) 1.800×10^{22}

12. Which has the maximum number of molecules among the following? **[2011]**
(A) 44 g CO_2 (B) 48 g O_3
(C) 8 g H_2 (D) 64 g SO_2

13. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27°C in identical conditions. The ratio of the volume of gases $H_2 : O_2$: methane would be _______. **[2014]**
(A) 8 : 16 : 1 (B) 16 : 8 : 1
(C) 16 : 1 : 2 (D) 8 : 1 : 2

14. A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture? **[2015]**
(A) 16 : 1 (B) 2 : 1
(C) 1 : 4 (D) 4 : 1

15. The number of water molecules is maximum in _______. **[Re-Test 2015]**
(A) 18 g of water
(B) 18 moles of water
(C) 18 molecules of water
(D) 1.8 g of water

16. If Avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change _______. **[Re-Test 2015]**
(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

17. At S.T.P. the density of CCl_4 vapour in g/L will be nearest to _______. **[2016]**
(A) 6.87 (B) 3.42
(C) 10.26 (D) 4.57

18. In which case is the number of molecules of water maximum? **[2018]**
(A) 18 mL of water
(B) 0.18 g of water
(C) 0.00224 L of water vapours at 1 atm and 273 K
(D) 10^{-3} mol of water

19. Which one of the followings has maximum number of atoms? **[Phase-I 2020]**
(A) 1 g of $Mg_{(s)}$ [Atomic mass of Mg = 24]
(B) 1 g of $O_{2(g)}$ [Atomic mass of O = 16]
(C) 1 g of $Li_{(s)}$ [Atomic mass of Li = 7]
(D) 1 g of $Ag_{(s)}$ [Atomic mass of Ag = 108]

20. One mole of carbon atom weighs 12 g, the number of atoms in it is equal to _______. (Mass of carbon-12 is 1.9926×10^{-23} g) **[Phase-II 2020]**
(A) 6.022×10^{23} (B) 1.2×10^{23}
(C) 6.022×10^{22} (D) 12×10^{22}

1.5 Percentage composition, empirical and molecular formulae

1. Which of the following fertilizers has the highest nitrogen percentage? **[1993]**
   (A) Ammonium sulphate
   (B) Calcium cyanamide
   (C) Urea
   (D) Ammonium nitrate

2. Percentage of Se in peroxidase anhydrous enzyme is 0.5 % by weight (at. Wt. = 78.4) then minimum molecular weight of peroxidase anhydrous enzyme is _______. **[2001]**
   (A) 1.568×10^4 (B) 1.568×10^3
   (C) 15.68 (D) 2.136×10^4

3. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weighs 10 g and 0.05 mole of X_3Y_2 weighs 9 g, the atomic weights of X and Y are _______. **[Phase-II 2016]**
   (A) 30, 20 (B) 40, 30
   (C) 60, 40 (D) 20, 30

4. 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] **[2021]**
   (A) CH_2 (B) CH_3 (C) CH_4 (D) CH

1.6 Chemical reactions, stoichiometry and calculations based on stoichiometry

1. A metal oxide has the formula Z_2O_3. It can be reduced by hydrogen to give free metal and water. 0.1596 g of the metal oxide requires 6 mg of hydrogen for complete reduction. The atomic weight of the metal is _______. **[1989]**
   (A) 27.9 (B) 159.6
   (C) 79.8 (D) 55.8

2. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene? **[1989]**
   (A) 2.8 kg (B) 6.4 kg
   (C) 9.6 kg (D) 96 kg

3. The number of gram molecules of oxygen in 6.02×10^{24} CO molecules is _______. **[1990]**
   (A) 10 g molecules (B) 5 g molecules
   (C) 1 g molecules (D) 0.5 g molecules

4. A 5 molar solution of H_2SO_4 is diluted from 1 litre to a volume of 10 litres, the normality of the solution will be _______. **[1991]**
   (A) 1 N (B) 0.1 N (C) 5 N (D) 0.5 N

5. The amount of zinc required to produced 224 mL of H_2 at STP on treatment with dilute H_2SO_4 will be _______. **[1996]**
   (A) 65 g (B) 0.065 g
   (C) 0.65 g (D) 6.5 g

6. In the reaction,
   $4NH_{3(g)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O_{(l)}$
   when 1 mole of ammonia and 1 mole of O_2 are made to react to completion _______. **[1998]**
   (A) all the oxygen will be consumed
   (B) 1.0 mole of NO will be produced
   (C) 1.0 mole of H_2O is produced
   (D) all the ammonia will be consumed

7. Volume of CO_2 obtained by the complete decomposition of 9.85 g of $BaCO_3$ is _______. **[2000]**
   (A) 2.24 L (B) 1.12 L
   (C) 0.84 L (D) 0.56 L

8. Molarity of liquid HCl, if density of solution is 1.17 g/cc is _______. **[2001]**
   (A) 36.5 (B) 18.25
   (C) 32.05 (D) 42.10

9. 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? **[2008]**
   (A) 5 L (B) 10 L (C) 7 L (D) 6 L

10. How many moles of lead (II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g HCl? **[2008]**
    (A) 0.011 (B) 0.029
    (C) 0.044 (D) 0.333

11. 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 _______. **[2009]**
    (A) 3 mol (B) 4 mol
    (C) 1 mol (D) 2 mol

12. 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) **[2014]**
    (A) Mg, 0.16 g (B) O_2, 0.16 g
    (C) Mg, 0.44 g (D) O_2, 0.28 g

13. 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 _______. **[2014]**
    (A) 1 mol of $HCl_{(g)}$ (B) 2 mol if $HCl_{(g)}$
    (C) 0.5 mol of $HCl_{(g)}$ (D) 1.5 mol of $HCl_{(g)}$

14. 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 u) **[Re-Test 2015]**
    (A) 60 (B) 84 (C) 75 (D) 96

15. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be _______. **[2018]**
    (A) 1.4 (B) 3.0 (C) 2.8 (D) 4.4

16. The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is _______. **[2019]**
(A) 20 (B) 30 (C) 40 (D) 10

17. 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] **[2022]**
(A) 3.65 g (B) 9.50 g
(C) 1.25 g (D) 1.32 g

18. The **right** option for the mass of CO_2 produced by heating 20 g of 20% pure limestone is (Atomic mass of Ca = 40)
$[CaCO_3 \xrightarrow{1200\,K} CaO + CO_2]$ **[2023]**
(A) 1.76 g (B) 2.64 g
(C) 1.32 g (D) 1.12 g

Answers to MCQs

1.1 :	1.	(B)																		
1.2 :	1.	(D)																		
1.3 :	1.	(A)	2.	(D)																
1.4 :	1.	(D)	2.	(A)	3.	(C)	4.	(D)	5.	(B)	6.	(A)	7.	(D)	8.	(A)	9.	(B)	10.	(A)
	11.	(B)	12.	(C)	13.	(C)	14.	(D)	15.	(B)	16.	(D)	17.	(A)	18.	(A)	19.	(C)	20.	(A)
1.5 :	1.	(C)	2.	(B)	3.	(A)	4.	(B)												
1.6 :	1.	(D)	2	(C)	3.	(B)	4.	(A)	5.	(C)	6.	(A)	7.	(B)	8.	(C)	9.	(A)	10.	(B)
	11.	(B)	12.	(A)	13.	(A)	14.	(B)	15.	(C)	16.	(B)	17	(D)	18.	(A)				

Solutions to MCQs

1.1 Units of measurement

1.

Quantity	Dimensions
Pressure	$[M L^{-1} T^{-2}]$
Force per unit volume	$[M L^{-2} T^{-2}]$
Energy per unit volume	$[M L^{-1} T^{-2}]$
Force	$[M L T^{-2}]$
Energy	$[M L^2 T^{-2}]$

1.2 Uncertainty in measurement

1. 161 has three significant figures as all are non-zero digits.
0.161 has three significant figures as zero on the left of the first non-zero digit is not significant.
0.0161 also has three significant figures as zeros on the left of the first non-zero digit are not significant.

1.3 Atomic and molecular masses

1. Average atomic mass
$= \dfrac{\text{Sum of (Isotopic mass} \times \text{its abundance)}}{100}$
Average atomic mass $= \dfrac{(19 \times 10) + (81 \times 11)}{100}$
$= 10.81 \approx 10.8$

2. Average atomic mass
$= \dfrac{\text{Sum of (Isotopic mass} \times \text{its abundance)}}{100}$
Average isotopic mass of X
$= \dfrac{(200 \times 90) + (199 \times 8) + (202 \times 2)}{100}$
= 200 a.m.u.

1.4 Mole concept and molar mass

1. At NTP,
1 mol N_2O = 22400 cc N_2O = 6.02×10^{23} N_2O molecules
$\therefore$ 1 cc of $N_2O = \dfrac{6.02 \times 10^{23}}{22400}$ molecules
Each N_2O molecule contains 3 atoms,
Hence,
$\therefore$ 1 cc $N_2O = \dfrac{3 \times 6.02 \times 10^{23}}{22400} = \dfrac{1.8 \times 10^{22}}{22400}$
Nitrogen contains 7 electrons while O contains 8 electrons. Hence, the number of electrons in one molecule of N_2O is 22.
Hence,
Number of electrons in 1 cc N_2O
$= \dfrac{6.02 \times 10^{23}}{22400} \times 22 = \dfrac{1.32}{224} \times 10^{23}$ electrons

2. 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
$= 2 \times N_A$

∴ Number of oxygen atoms in 0.1 mole of CO_2
$= 0.1 \times 2 \times N_A$
$= 0.2 \times 6.022 \times 10^{23}$
$= 1.20 \times 10^{23}$

3. One litre of O_2 contains N molecules at 15 °C and 150 mmHg pressure. If 1 L of one gas contains N molecules then 2 L of any gas under the same conditions will contain 2N molecules.

4. 1 L of air = 1000/0.21 = 210 mL of O_2

∵ 22400 mL = 1 mole

∴ 210 mL $= \frac{1}{22400} \times 210 = 0.0093$ mol

5. Weight of volatile gas = 0.24 g
Volume of gas = 45 mL = 0.045 L
Density $= \frac{\text{Mass}}{\text{Volume}}$
Mass of 45 mL of $H_2 = 0.089 \times 0.045$
$= 4.005 \times 10^{-3}$ g
Vapour density
$= \frac{\text{Mass of certain volume of vapour}}{\text{Mass of same volume of hydrogen}}$
$= \frac{0.24}{4.005 \times 10^{-3}} = 59.93$

6. 100 g of haemoglobin contains 0.334 g of Fe

∴ 67200 g of haemoglobin contains
$= \frac{67200 \times 0.334}{100}$
= 224.448 g of Fe.
Number of atoms of Fe $= \frac{224.448}{56}$
$= 4.008 \approx 4$

7. Molecular mass of $NH_3 = 14 + (3 \times 1) = 17$
Number of moles $= \frac{4.25}{17} = 0.25$ mol
Number of molecules of NH_3
$= 0.25 \times 6.02 \times 10^{23} = 1.506 \times 10^{23}$ molecules
One molecule of NH_3 contains 4 atoms.

∴ 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.

8. Volume of cylindrical virus particle $= \pi r^2 l$
$= 3.14 \times (7 \times 10^{-8})^2 \times 10 \times 10^{-8}$
$= 1.54 \times 10^{-23}$ cc
Weight of one virus particle $= \frac{\text{Volume}}{\text{Specific volume}}$
$= \frac{1.54 \times 10^{-21}}{6.02 \times 10^{-2}}$

∴ Molecular weight of virus particle = weight of N_A particles $= \frac{1.54 \times 10^{-21}}{6.02 \times 10^{-2}} \times 6.02 \times 10^{23}$ g/mol
= 15400 g/mol = 15.4 kg/mol

9. (A) 7 g $N_2 = \frac{7}{28} \times 6.022 \times 10^{23} = 1.51 \times 10^{23}$
(B) 2 g $H_2 = \frac{2}{2} \times 6.022 \times 10^{23} = 6.022 \times 10^{23}$
(C) 16 g $NO_2 = \frac{16}{46} \times 6.022 \times 10^{23} = 2.09 \times 10^{23}$
(D) 16 g $O_2 = \frac{12}{32} \times 6.022 \times 10^{23} = 2.26 \times 10^{23}$

10. (A) 15 L $H_2 = \frac{15}{22.4} \times 6.022 \times 10^{23} = 4.03 \times 10^{23}$
(B) 5 L $N_2 = \frac{5}{22.4} \times 6.022 \times 10^{23} = 1.34 \times 10^{23}$
(C) 0.5 g of $H_2 = \frac{0.5}{2} \times 6.022 \times 10^{23} = 1.51 \times 10^{23}$
(D) 10 g of $O_2 = \frac{10}{32} \times 6.022 \times 10^{23} = 1.88 \times 10^{23}$

11. Total number of atoms in a given amount of substance = n × N_A × Atomicity
$= 0.1 \times 6.02 \times 10^{23} \times 3$
$= 1.806 \times 10^{23}$

12. Option (A): 44 g CO_2 = 1 mole of CO_2
Option (B): 48 g O_3 = 1 mole of O_3
Option (C): 8 g H_2 = 4 moles of H_2
Option (D): 64 g SO_2 = 1 mole of SO_2

13. According to Avogadro's hypothesis, ratio of the volumes of gases will be equal to the ratio of their no. of moles.
$\frac{\text{weight of } H_2}{2} : \frac{\text{weight of } O_2}{32} : \frac{\text{weight of } CH_4}{16}$
$\frac{1}{2} : \frac{1}{32} : \frac{1}{16}$

∴ Ratio is 16 : 1 : 2.

14. Number of moles of $H_2 = \frac{1}{2}$
Number of moles of $O_2 = \frac{4}{32}$
Hence, molar ration $= \frac{1}{2} : \frac{4}{32} = 4 : 1$

15. 1 mole of water = 18 g of water
$= 6.022 \times 10^{23}$ molecules of water

∴ 18 moles of water
$= 18 \times 6.022 \times 10^{23}$ molecules of water
$= 1.08396 \times 10^{25}$ molecules of water

16. When Avogadro number is 6.022×10^{23} mol^{-1}, the mass of 1 mol of carbon = 12 g

∴ Mass of 1 mol of carbon when Avogadro number is 6.022×10^{20} mol^{-1}

$= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}} = 12 \times 10^{-3}$ g

Thus, the mass of 1 mol of carbon is changed.

17. Volume of 1 mole of a gas at STP = 22.4 L

1 mol CCl_4 vapour = 12 + 4 × 35.5 = 154 g

Therefore, 22.4 L of a gas contains 154 g of CCl_4.

Density $= \frac{\text{Mass}}{\text{Volume}}$

∴ Density of CCl_4 vapour $= \frac{154}{22.4}$ g/L = 6.875 g/L

18. Option (A)

18 mL of water = 18 g of water $= \frac{18}{18}$

= 1 mol of water

Option (B)

0.18 g water $= \frac{0.18}{18}$ = 0.01 mol of water

Option (C)

0.00224 L of water vapours at 1 atm and 273 K (STP conditions) = 2.24 mL of water

$= \frac{2.24}{22.4}$

= 0.1 mol of water

Option (D) has 10^{-3} mol of water.

Hence, 18 mL of water, i.e., option (A) has maximum number of moles of water and hence, it contains maximum number of water molecules.

19. Number of atoms

= Number of moles × Avogadro's constant

$= \frac{\text{Mass of a substance}}{\text{Molar mass of a substance}} \times N_A$

Number of atoms of $Mg_{(s)} = \frac{1}{24} \times N_A$

Number of atoms of $O_{2(g)} = \frac{2 \times 1}{32} \times N_A$

Number of atoms of $Li_{(s)} = \frac{1}{7} \times N_A$

Number of atoms of $Ag_{(s)} = \frac{1}{108} \times N_A$

20. Number of atoms in 1 mole of carbon

$= 6.022 \times 10^{23}$

1.5 Percentage composition, empirical and molecular formulae

1. (A) % of nitrogen in $(NH_4)_2SO_4 = \frac{28}{132} \times 100$

= 21.21%

(B) % of nitrogen in $CaCN_2 = \frac{28}{80} \times 100 = 35$ %

(C) % of nitrogen in $CO(NH_2)_2 = \frac{28}{60} \times 100$

= 46.66 %

(D) % of nitrogen $NH_4NO_3 = \frac{28}{80} \times 100 = 35$ %

2. Since, 0.5 g Se ≡ 100 gm peroxidase anhydrous enzyme

∴ 78.4 g Se $= \frac{100 \times 78.4}{0.5} = 1.568 \times 10^4$

Hence, minimum molecular mass of peroxidase anhydrous enzyme is 1.568×10^4 g/mol.

3. 0.1 mol of XY_2 = 10 g

∴ 1 mol of XY_2 = 100 g

i.e, Molecular weight of XY_2 = 100

0.05 mol of X_3Y_2 = 9 g

∴ 1 mol of X_3Y_2 = 180 g

i.e., Molecular weight of X_3Y_2 = 180

Let atomic weights of X and Y be x and y respectively.

∴ $x + 2y = 100$ ….(i)

$3x + 2y = 180$ ….(ii)

Subtracting (i) from (ii),

$2x = 180 - 100$

∴ $x = 40$

Substituting $x = 40$ in (i),

$40 + 2y = 100$

∴ $y = 30$

4.

Element	% Composition	Atomic ratio	Simplest ratio
C	78	$\frac{78}{12} = 6.5$	$\frac{6.5}{6.5} = 1$
H	22	$\frac{22}{1} = 22$	$\frac{22}{6.5} = 3.38$

∴ The empirical formula of the compound is CH_3.

1.6 Chemical reactions, stoichiometry and calculations based on stoichiometry

1. The reaction is

$Z_2O_3 + 3H_2 \longrightarrow 2Z + 3H_2O$

Hence, as per reaction stoichiometry, 1 mole H_2 or 6 g H_2 reacts with one mole of Z_2O_3.

Now,

0.1596 g of Z_2O_3 react with 0.006 g of H_2.

∴ 6 g H_2 reacts with $= \frac{0.1596}{0.006} \times 6 = 159.6$ g of Z_2O_3

Therefore, molecular mass of Z_2O_3 is 159.6 g/mol.

∴ Molecular mass of Z_2O_3 = (2 × At. Wt. Z + 3 At. Wt. O)

Atomic mass of Z $= \frac{159.6 - (3 \times 16)}{2} = 55.8$ g

2. $C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$
28 g of ethylene require 96 g of O_2
∴ 2.8×10^3 g of ethylene require $= \frac{2.8 \times 10^3 \times 96}{28}$
$= 9.6 \times 10^3$ g
$= 9.6$ kg

3. 1 mole of CO is equivalent to 6.02×10^{23} molecules
∴ 10 mole CO will correspond to 6.02×10^{24} molecules
6.02×10^{24} CO molecules contain 6.02×10^{24} atoms of oxygen, which is equivalent to 10 g atoms of oxygen
10 g atoms of (O) oxygen = 5 g molecules of O_2 (∵ Oxygen is a diatomic gas.)

4. $M_1V_1 = M_2V_2$
$5 \times 1 = M_2 \times 10$
$M_2 = 0.5$ M
Normality = n × Molarity
$= 2 \times 0.5$ (∵ H_2SO_4 is a diprotic acid)
$= 1$ N

5. $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$
1 Mole of zinc reacts to give 1 mole of hydrogen
1 mole of hydrogen at STP is 22,400 mL.
65 g zinc react to liberate 22400 mL of H_2
∴ Amount of zinc required to produce 224 mL of H_2 at STP $= \frac{224 \times 65}{22400} = 0.65$ g

6. $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$
From above reaction,
4 Moles of NH_3 require 5 moles of O_2.
∴ 1 Moles of $NH_3 = \frac{5}{4}$ moles of $O_2 = 1.25$ mol of O_2
Therefore, 1 mol of NH_3 require 1.25 mol of O_2. In given conditions, 1 mole of NH_3 and 1 mole of O_2 are made to react to completion. Hence, all the oxygen will be consumed.

7. $BaCO_3 \longrightarrow BaO + CO_2$
197.34 g of $BaCO_3$ gives 22.4 L of CO_2
∴ 9.85 g of $BaCO_3$ will give $\frac{22.4 \times 9.85}{197.34}$
$= 1.118 \text{ L} \approx 1.12$ L

8. Density = 1.17 g/cc = 1170 g/L
Hence, volume of the solution = 1 L
Mass of the solute = 1170 g.
Mol of solute = 32.05 mol
Molarity $= \frac{\text{Moles of solute}}{\text{Volume of solution (L)}} = \frac{32.05}{1}$
$= 32.05$ M

9. $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$
(1 mol). (5 mol)
At STP, volume is proportional to mole.
1 L of propane gas will require 5 L of O_2. 1 mol propane gas (C_3H_8) requires 5 mol oxygen gas (O_2). Hence, 1 L propane gas (C_3H_8) requires 5 L oxygen gas (O_2).

10. $PbO + 2HCl \longrightarrow PbCl_2 + H_2O$
Molecular weight of PbO = 207.2 + 16
= 223.2
Moles of PbO $= \frac{6.5}{223.2} = 0.029$ mol
Moles of HCl $= \frac{3.2}{36.5} = 0.088$ mol
0.029 mol of PbO required 0.058 mol of HCl. Hence, HCl is in excess, PbO is limiting reagent.
From stoichiometry, mol of PbO = mol of $PbCl_2$
0.029 mol of PbO = 0.029 mol of $PbCl_2$

11. $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)}$
Ratio of moles of reactants, $H_2 : O_2 = 2 : 1$
Actual amount of reactants: 10 g H_2 and 64 g O_2
Actual moles of reactants: 5 mol H_2 and 2 mol O_2
Ratio of actual moles of reactants,
$H_2 : O_2 = 5 : 2 = 2.5 : 1$
∴ The limiting reactant is O_2.
Now, 1 mole of oxygen gives 2 moles of water. Hence, 2 moles of oxygen will give 4 moles of water.

12. $2Mg + O_2 \longrightarrow 2MgO$
(2×24) (32)
48 g of Mg requires 32 g of O_2
∴ 0.56 g of O_2 requires $= \frac{0.56 \times 48}{32} = 0.84$ g of Mg
∴ Mg left = 1 – 0.84 = 0.16 g

13. 1 mol gas ≡ 22.4 L at S.T.P.
Moles of H_2 = 1 mol
Moles of Cl_2 = 11.2/22.4 = 0.5 mol
The reaction is
$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$
From the reaction, 1 mol of H_2 requires 1 mol of Cl_2 to form 2 mol of HCl. Since, available Cl_2 is 0.5 mol, it is limiting reactant.
Hence, 1 mol Cl_2 = 2 mol HCl
0.5 mol Cl_2 = 1 mol HCl

14. $MgCO_{3(s)} \longrightarrow MgO_{(s)} + CO_{2(g)}$
Molar mass of $MgCO_3 = 84$ g mol^{-1}
∴ Number of moles of $MgCO_3 = \frac{20}{84} = 0.238$ mol
∵ 1 mole $MgCO_3$ gives 1 mole MgO
∴ 0.238 mole $MgCO_3$ will give 0.238 mole MgO.
Molar mass of MgO = 40 g mol^{-1}

∴ 0.238 mole MgO = 40 × 0.238
= 9.52 g MgO

∴ Theoretical yield of MgO = 9.52 g
Practical yield of MgO is 8.0 g

∴ Percentage purity = $\frac{8}{9.52} \times 100 = 84\ \%$

15. $HCOOH \xrightarrow{\text{Conc. } H_2SO_4} CO + H_2O$
0.5 mol   0.5 mol

$(COOH)_2 \xrightarrow{\text{Conc. } H_2SO_4} \underline{CO + CO_2} + H_2O$
0.5 mol   0.5 mol

Gaseous mixture formed is CO and CO_2 When it is passed through KOH, which CO_2 is absorbed. So, the remaining gas is CO.
Weight of remaining gaseous product at STP is
0.5 × 0.5 × 28 = 2.8 g

16. $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$
3 mol H_2 = 2 mol NH_3
∴ 30 mol H_2 = 20 mol NH_3

17. $CaCO_{3(s)} + 2HCl_{(aq)}$
$\rightarrow CaCl_{2(aq)} + CO_{2(g)} + 2H_2O_{(l)}$
From the reaction stoichiometry,
2 mol HCl will neutralise 1 mol $CaCO_3$.
So, 1 mol HCl will neutralise $\frac{1}{2}$ mol $CaCO_3$.
Number of moles = Molarity × Volume (in L)
Number of moles of HCl = 0.5 × 0.05
= 0.025 mol

18. Since the sample of $CaCO_3$ is 20% pure, the amount of actual $CaCO_3$ in the sample is
$\frac{20 \times 20}{100} = 4$ g
The balanced chemical equation is:
$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
1 mol (100 g)   1 mol (44 g)

∴ 1 mol of $CaCO_3$ = 1 mol of CO_2
OR
100 g of $CaCO_3$ = 44 g of CO_2

∴ 4 g of $CaCO_3$ = $\frac{44 \times 4}{100}$ = 1.76 g of CO_2