Challenger

SAMPLE CONTENT

NEET-UG & JEE (Main)

CHEMISTRY Vol - II

As per latest syllabus issued by NMC

1500+ MCQs with Hints

For all Medical and Engineering Entrance Examinations held across India.

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Challenger

NEET (UG) & JEE (Main)

Chemistry Vol. II

Now with more study techniques

Salient Features

- Concise theory for every topic
- Eclectic coverage of MCQs under each sub-topic
- Exhaustive coverage of questions including selective questions from previous years' NEET (UG) and JEE (Main) examinations updated upto **year 2024**:
  - **1500+** MCQs
  - **80+** Numerical Value type (NVT)
  - Solutions to the questions are provided for better understanding
- Inclusion of '**Problems To Ponder**' to engage students in scientific enquiry
- Includes Smart Keys: Multiple study techniques to enhance understanding and problem solving:
  - ***Smart code*** - ***Smart tip*** - ***Caution***
  - ***Think out of the box***
- Includes Question Paper and Answer Keys (Solution through Q.R. code) of:
  - JEE (Main) 2024 31st Jan (Shift - I)
  - NEET (UG) 2024
- Q.R. codes provide:
  - Video links for boosting conceptual retention
  - Solution of JEE (Main) 2024 31st Jan (Shift - I) Question Paper
  - Solution of NEET (UG) 2024 Question Paper

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PREFACE

'Challenger Chemistry Vol - II' is a compact guidebook, extremely handy for preparation of various competitive exams like NEET (UG), JEE (Main). This edition provides an unmatched comprehensive amalgamation of theory with MCQs. The chapters are aligned with the latest syllabus for **NEET (UG) and JEE (Main) 2024** examinations. Although the alignment runs parallel to NCERT curriculum, the structure of the chapters prioritizes knowledge building of the students. The book provides the students with scientifically accurate context, several study techniques and skills required to excel in these examinations.

In this book the Theoretical Concepts are presented in the form of pointers, tables, charts and diagrams that form a vital part of preparation of any competitive examination.

Multiple Choice Questions have been specially created and compiled with the following objective in mind – to help students solve complex problems which require strenuous effort and understanding of multiple-concepts. The assortment of MCQs is a beautiful blend of questions based on higher order thinking, theory, and multiple concepts.

MCQs in each chapter are segregated into following sections.

- **Concept Building Problems** section is designed to boost prerequisite understanding of concepts.
- **Practice Problems** section contains questions crafted for thorough revision .
- **Numerical Value Type** section caters to newly added NVT questions in JEE (Main).
- **Problems to Ponder** section offers questions of diverse pattern created to instil the attitude of concentrating on the problems and to understand the application of various concepts in Chemistry.

All the questions included in a chapter have been specially created and compiled to enable students solve complex problems which require strenuous effort with promptness.

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

Exhaustive coverage of questions, including selective questions from previous years' NEET (UG) and JEE (Main) examinations is updated up to the **year 2024.**
Question Papers along with Answers and Solutions (through Q.R. code) of **JEE (Main) 2024 31st Jan (Shift -I)** & **NEET (UG) 2024** have been provided to offer students glimpse of the complexity of questions asked in entrance examination. These papers has been split unit-wise to let the students know which of the units were more relevant as per latest Question papers.

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

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

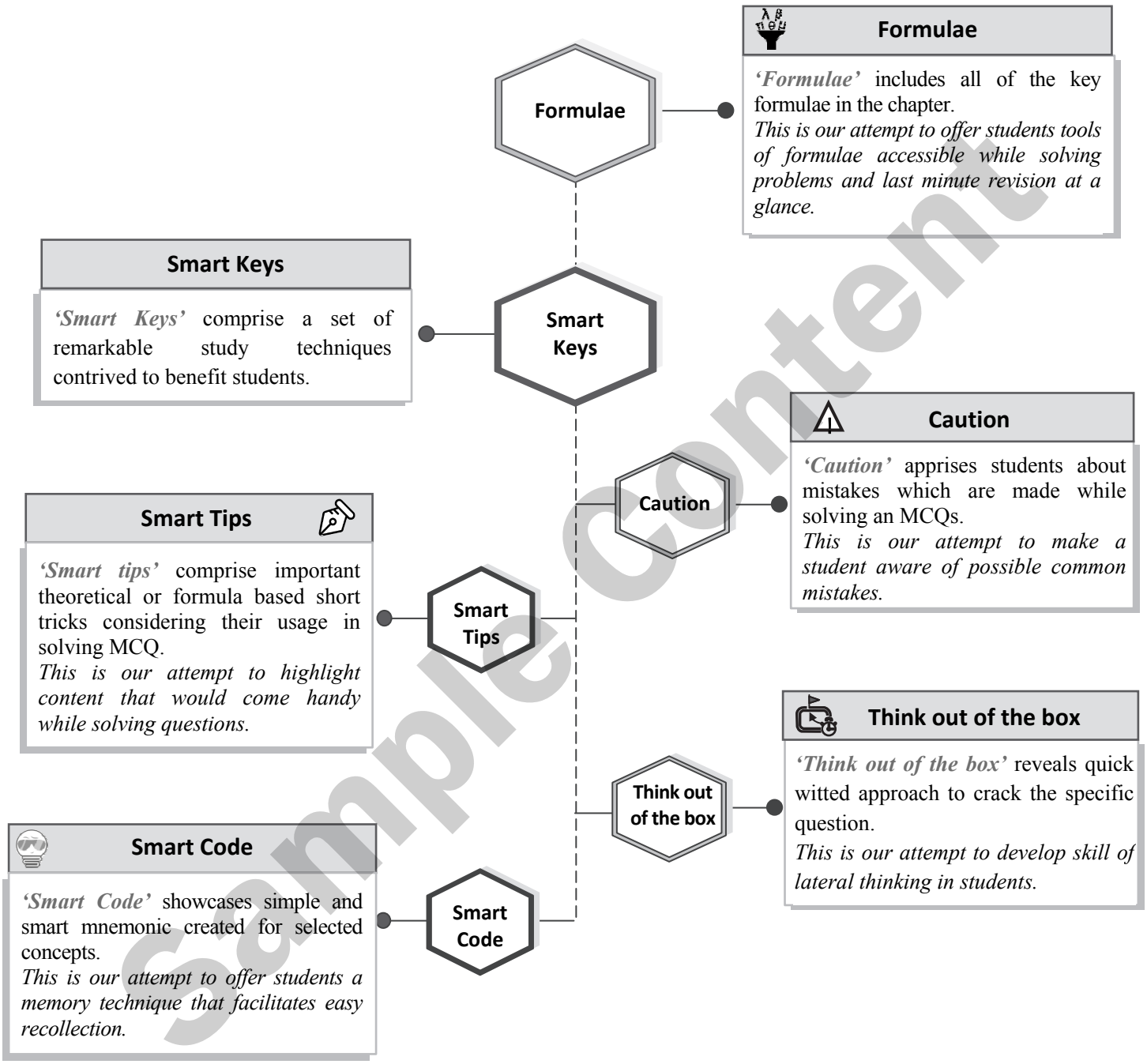
Publisher

Edition: Fifth

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

KEY FEATURES



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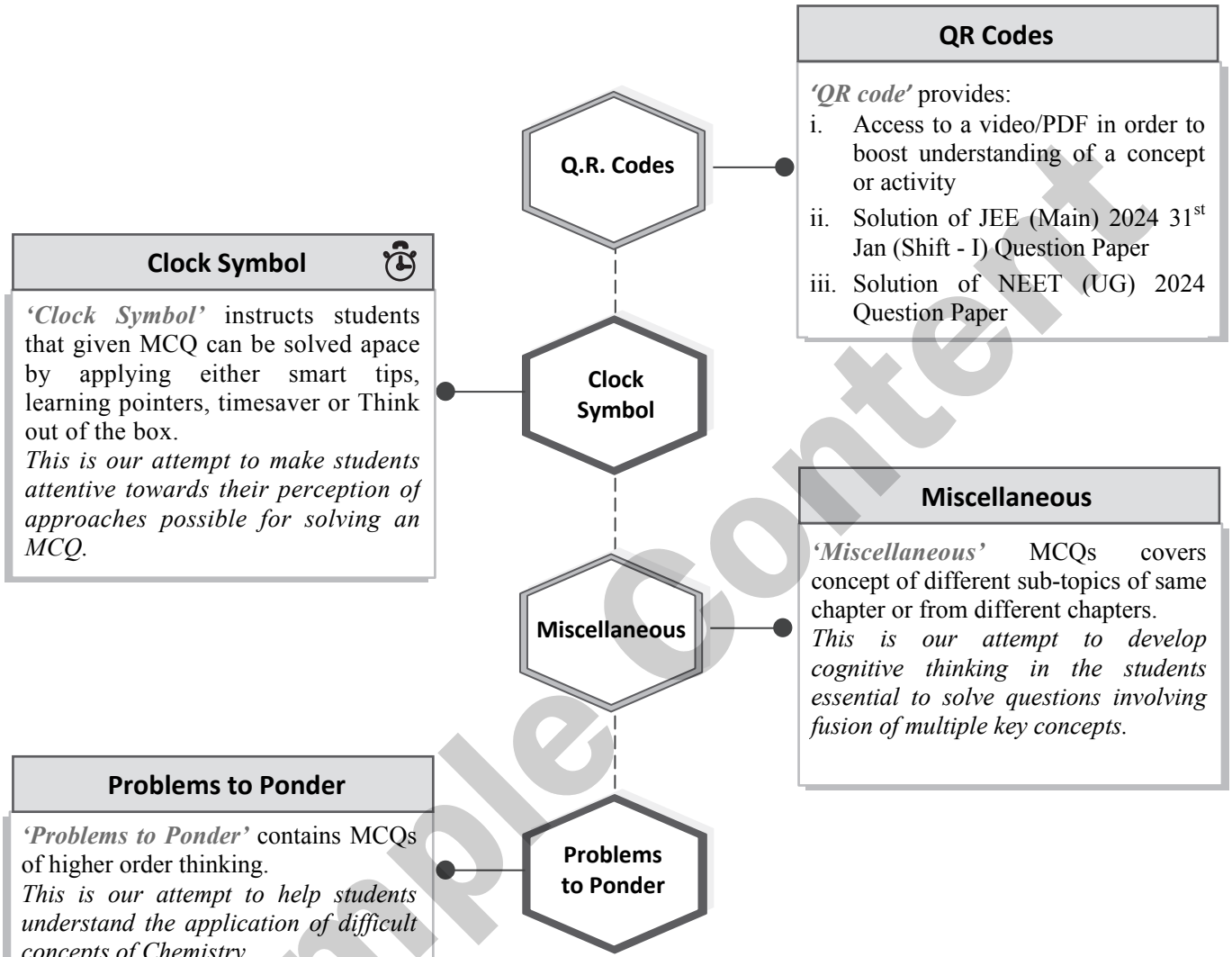

QR Codes

'QR code' provides:

i. Access to a video/PDF in order to boost understanding of a concept or activity

ii. Solution of JEE (Main) 2024 31st Jan (Shift - I) Question Paper

iii. Solution of NEET (UG) 2024 Question Paper

Clock Symbol

'Clock Symbol' instructs students that given MCQ can be solved apace by applying either smart tips, learning pointers, timesaver or Think out of the box.

This is our attempt to make students attentive towards their perception of approaches possible for solving an MCQ.

Miscellaneous

'Miscellaneous' MCQs covers concept of different sub-topics of same chapter or from different chapters.

This is our attempt to develop cognitive thinking in the students essential to solve questions involving fusion of multiple key concepts.

Problems to Ponder

'Problems to Ponder' contains MCQs of higher order thinking.

This is our attempt to help students understand the application of difficult concepts of Chemistry.

Frequently Asked Questions

➢ **Why Challenger Series?**

Gradually, every year the nature of competitive entrance exams is inching towards conceptual understanding of topics. Moreover, it is time to bid adieu to the stereotypical approach of solving a problem using a single conventional method.

To be able to successfully crack the NEET examinations, it is imperative to develop skills such as data interpretation, appropriate time management, knowing various methods to solve a problem, etc. With *Challenger Series,* we are sure, you'd develop all the aforementioned skills and take a more holistic approach towards problem solving. The way you'd tackle advanced level MCQs with the help of solutions, Smart tips, Smart codes and Think out of the box section would give you the necessary practice that would be a game changer in your preparation for the competitive entrance examinations.

➢ **What is the intention behind the launch of Challenger Series?**

The sole objective behind the introduction of Challenger Series is to severely test the student's preparedness to take competitive entrance examinations. With an eclectic range of critical and advanced level MCQs, we intend to test a student's MCQ solving skills within a stipulated time period.

➢ **What do I gain out of Challenger Series?**

After using Challenger Series, students would be able to:

a. Assimilate the given data and apply relevant concepts with utmost ease.
b. Tackle MCQs of different pattern such as match the columns, diagram based questions, multiple concepts and assertion-reason efficiently.
c. Garner the much needed confidence to appear for competitive exams.
d. Easy and time saving methods to tackle tricky questions will help ensure that time consuming questions do not occupy more time than you can allot per question.

➢ **How to derive the best advantage of the book?**

To get the maximum benefit of the book, we recommend :

a. Go through brief theory given at the beginning of a chapter for a quick revision. Commit Smart Tips into memory and pay attention to Caution.
b. Know all the Formulae compiled at the end of theory by heart.
c. Using subtopic wise segregation as a leverage, complete the Concept Building Problems at your own pace. Questions from JEE (Main), NEET (UG) examinations are tagged and placed along the flow of subtopic. Mark these questions specially to gauge the trends of questions in various exams.
d. Be extra receptive to Think out of the box, Alternate Method and application of Smart Tips. Assimilate them into your thinking.
e. After mastering stimulating questions, take up Practice Problems as self-assessment and verify answers as well as methods. Check if you could apply smart tips, alternate method, etc., as mentioned in hint. Find out if you have invented ingenious solution mapping to Think out of the box explicated in hints.
f. Watch the linked video for an efficient revision of chapter theory.
g. Ruminate over questions from Problems To Ponder and appreciate aesthetics of the concepts.

➢ ***Can the Questions presented in Problems to Ponder section be a part of the NEET Examination?***

No, the questions would not appear as it is in the NEET Examination. However, there are fair chances that these questions could be covered in parts or with a novel question construction.

Best of luck to all the aspirants!

CONTENTS

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Introduction

Most of the substances dealt with in day-to-day life are mixtures containing two or more pure substances. The mixtures are either homogeneous in which mixing of components is uniform or heterogeneous which have non-uniform mixing of components. Homogeneous mixtures in which one substance dissolves completely in another substance are known as true solutions. True solutions can be solid solutions, liquid solutions, or gaseous solutions.

Solutions and types of solutions

➢ **Solutions:**

*A **solution** is a homogeneous mixture of two or more substances, the composition of which is not fixed and may be varied within certain limits.*

E.g. Salt and water, sugar in water, milk and water, iodine in CCl_4, etc.

i. In preparation of a solution, a minimum of two different components are involved.

ii. The phase, which is present in smaller amount, is called **solute**.
E.g. In aqueous solution of glucose, the solute is glucose.

iii. The phase, which is present in larger amount, is called **solvent.**
E.g. In aqueous solution of glucose, the solvent is water.

➢ **Types of solutions:**

i. Solutions can also be classified based on the phase of the solute and solvent.

Classification of solutions	Solvent	Solute	Examples
Solid solutions	solid	solid	alloys like bronze, brass, copper in gold
	solid	liquid	mercury based alloys i.e., amalgams such as Zn-Hg, Ag-Hg
	solid	gas	hydrogen gas in palladium metal, pumice stone
Liquid solutions	liquid	solid	salt in water, benzoic acid in benzene, iodine in CCl_4
	liquid	liquid	ethanol in water
	liquid	gas	aerated drinks (CO_2 in water)
Gaseous solutions	gas	solid	iodine in air
	gas	liquid	chloroform in nitrogen, moisture in air
	gas	gas	air

ii. Another way of classifying solutions is based on the number of components present in it.
   a. A solution composed of only two components is called a **binary solution**.
   b. A solution composed of three components is called a **ternary solution**.
   c. A solution composed of four components is called a **quaternary solution**.

EXPRESSION OF CONCENTRATION OF SOLUTIONS

➢ **Concentration:**

Concentration *is defined as the amount of solute dissolved in a specific amount of solvent.*

Qualitatively, concentration of a solution can be expressed either as concentrated or dilute.

i. A **concentrated solution** is one in which, relatively large amount of solute is present.

ii. A **dilute solution** is one in which, the quantity of solute present is very small as compared to that of solvent.

➢ **Expression of concentration of solutions:**

Quantitatively, concentration of solutions can be expressed in the following ways:

- **Mass percentage (w/w):**

Mass percentage *is defined as the mass of solute dissolved per 100 g of the solution.*

$$\text{Percentage (of solute) by mass} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$\therefore \quad \text{Percentage of solute by mass} = \frac{W_B}{(W_A + W_B)} \times 100 \qquad \begin{bmatrix} W_A = \text{mass of solvent} \\ W_B = \text{mass of solute} \end{bmatrix}$$

E.g. In 63 % (w/w) HNO_3 solution;
Mass of solution = 100 g, Mass of HNO_3 = 63 g, mass of water = 37 g
It is independent of the temperature of solution as mass does not vary with change in temperature.

- **Volume percentage (V/V):**

Volume percentage *is defined as the ratio of number of parts by volume of the solute to one hundred parts by volume of the solution.*

$$\text{Percentage (of solute) by volume of} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

E.g. 10 % (V/V) aqueous ethanol solution means that 10 mL of ethanol is dissolved in water such that total volume of the solution is 100 mL.

i. Volume of a solution may not necessarily be the sum of volume of solvent and volume of solute. It may be more than or less than the sum of individual volumes. Also, this form of expressing concentration is only applicable to those solutions where the solute is a liquid.

ii. Volume percentage is a temperature dependent quantity as volume varies with change in temperature.

- **Mass by volume percentage (w/V):** It is the mass of solute dissolved in 100 mL of solution.
E.g. If % w/V = 10; then, mass of solute = 10 g and volume of solution = 100 mL

- **Parts per million (ppm):**

Parts per million *is defined as the parts of a component per million parts of the solution.*

$$\text{Parts per million (ppm)} = \frac{\text{Number of parts of the component}}{\text{Total number of parts of all components of the solution}} \times 10^6$$

i. It is used for expressing concentration when solute is present in very small amounts.

ii. It can be expressed as mass to mass, volume to volume or mass to volume.

E.g. 6×10^{-3} g of dissolved oxygen in 1 litre of sea water (that weighs 1030 g) is expressed as 5.8 g per 10^6 g (i.e., 5.8 ppm) of sea water. Pollutant concentrations in water or atmosphere are usually expressed in $\mu g\ mL^{-1}$ or ppm.

- **Mole fraction (x):**

Mole fraction *of any component of a solution is defined as the ratio of the number of moles of that component to the total number of moles of all components present in the solution.*

$$\text{Mole fraction of a component} = \frac{\text{Number of moles of the component}}{\text{Total number of moles of all components}}$$

i. For a solution containing i number of components,

$$x_i = \frac{n_i}{(n_1 + n_2 + ... + n_i)} = \frac{n_i}{\sum n_i}$$

ii. For a two component solution, x_A denotes mole fraction of solvent and x_B denotes mole fraction of solute.

Thus, $x_A = \frac{n_A}{n_A + n_B}$ and $x_B = \frac{n_B}{n_A + n_B}$

iii. Sum of mole fractions of each component is equal to 1.
i.e., $x_A + x_B + x_C + \ldots\ldots + x_i = 1$

iv. It is a temperature independent quantity and is unitless.

- **Molarity (M):**

Molarity *of a solution is defined as the number of moles of solute dissolved in one litre or 1 dm^3 of the solution.*

$$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in dm}^3}$$

E.g. 0.25 M solution of NaOH means,
Moles of NaOH = 0.25 and
Volume of solution = 1000 mL or 1 L or 1 dm^3

i. Molarity is expressed in mol dm^{-3} or mol L^{-1} or M.

ii. Molarity is inversely proportional to volume of solution if number of moles of solute is constant.

iii. Molarity is a temperature dependent quantity as it is dependent on volume of the solution which varies with change in temperature.

Smart tip - 1

i. For dilution, $\underset{\text{(Initial)}}{M_1V_1} = \underset{\text{(Final)}}{M_2V_2}$

ii. Resulting molarity of the two mixtures (solutions), $M = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

- **Molality (m):**

Molality *of a solution is defined as the number of moles of solute dissolved in 1 kg of solvent.*

$$\text{Molality (m)} = \frac{\text{Number of moles of solute}}{\text{Mass of solvent in kg}} = \frac{n_B}{W_A(\text{in kg})} = \frac{W_B}{M_B.W_A}$$

where, W_B is the mass of solute in solution, M_B is the molar mass of solute,
W_A is the mass of solvent in solution.

E.g. 1.00 mol kg^{-1} (or 1.00 m) solution of KCl means that 1 mol (74.5 g) of KCl is dissolved in 1 kg of water.

i. Molality is expressed in mol kg^{-1} or m.

ii. Molality is independent of temperature as it is dependent on mass of solvent which does not vary with temperature.

Note: i. Normality (N):

a. **Normality** of a solution is defined as the number of gram equivalents of the solute dissolved per litre of the solution.

$$\text{Normality (N)} = \frac{\text{Number of gram equivalents of solute}}{\text{Volume of solution in litres}}$$

b. It is expressed in gram equivalents per litre or g eq/L and is a temperature dependent quantity.

c. Gram equivalents of solute = $\frac{\text{Mass of solute}}{\text{Equivalent mass}}$

d. Normality is related to molarity as,

1. N = M × 'n' factor

$$\text{Normality} = \text{Molarity} \times \frac{\text{Molar mass}}{\text{Equivalent mass}}$$

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To see complete chapter buy **Target Notes** or **Target E-Notes**

iv. K_b, also called **ebullioscopic constant** or **molal elevation constant** or **boiling point elevation constant.**

> ***Ebullioscopic constant*** *is defined as the elevation of boiling point for 1 molal solution i.e., a solution containing 1 mole of solute dissolved in 1 kg of solvent.*

Each solvent has its characteristic K_b value which is expressed in K kg mol^{-1} or °C kg mol^{-1}.

v. Molality (m) = $\frac{W_B}{M_B W_A}$ ….(2) $\begin{bmatrix} W_B = \text{mass of solute} \\ W_A = \text{mass of solvent} \\ M_B = \text{molar mass of solute} \end{bmatrix}$

Substituting (2) in equation (1),

$$\Delta T_b = K_b . \frac{W_B}{M_B W_A} \quad \text{….(3)}$$

➢ **Determination of molar mass of solute from elevation of boiling point:**

i. From equation (3),

Molar mass of non-volatile solute (M_B) = $\frac{K_b . W_B}{\Delta T_b W_A}$

ii. The experimental method to determine molecular mass of non-volatile solute by determining boiling points of pure solvent and solution of known concentration is called **ebullioscopy**.

Students can scan the adjacent Q.R. code in *Quill - The Padhai App* to get further conceptual clarity on boiling point elevation.

DEPRESSION OF FREEZING POINT

➢ **Freezing point:**

> ***Freezing point*** *of a liquid is that temperature at which the vapour pressure of the solid is equal to the vapour pressure of liquid.*

➢ **Depression of Freezing point:**

i. In the presence of a non-volatile solute, the vapour pressure of a solution decreases. Thus, the solution freezes at a lower temperature compared to the solvent.

$T_f < T_f^o$ where T_f = freezing point of solution and T_f^o = freezing point of solvent.

ii. $\Delta T_f = T_f^o - T_f$ = Depression of freezing point

iii. Experimental evidence shows that the depression of freezing point of any solution is directly proportional to the molality of the solution.

i.e., $\Delta T_f \propto m$

where m = molality of solution

and, $\Delta T_f = K_f m$ ….(1)

where K_f = proportionality constant (unit = K kg mol^{-1})

iv. K_f, also called **cryoscopic constant** or **freezing point depression constant** or **molal depression constant.**

> ***Cryoscopic constant*** *is defined as depression of freezing point for a 1 molal solution which is a solution containing 1 mole of solute dissolved in 1 kg of solvent.*

v. Further, molality (m) = $\frac{W_B}{M_B W_A}$ ....(2)

Substituting equation (2) in equation (1),

$$\Delta T_f = K_f \frac{W_B}{M_B \times W_A} \quad \text{....(3)}$$

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To see complete chapter buy **Target Notes** or **Target E-Notes**

Formulae

1. **Percentage by mass (w/w) =** $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100 = \frac{W_B}{W_A + W_B} \times 100$

   where, W_A = mass of solvent, W_B = mass of solute.

2. **Percentage by volume (V/V) =** $\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100 = \frac{V_B}{V_A + V_B} \times 100$

   where, V_A = volume of solvent, V_B = volume of solute.

3. **Mole fraction:** For a solution containing i number of components, mole fraction, x_i, will be

   $x_i = \frac{n_i}{(n_1 + n_2 + ... + n_i)} = \frac{n_i}{\sum n_i}$

   For a binary solution, $x_B = \frac{n_B}{n_A + n_B}$

   where, n_A = number of moles of solvent, n_B = number of moles of solute.

4. **Molarity (M) =** $\frac{\text{Number of moles of solute}}{\text{Volume of solution in dm}^3} = \frac{n_B}{V(\text{in L or dm}^3)}$ or $\frac{n_B}{V(\text{in mL})} \times 1000$

   $$M = \frac{\text{Mass of solute (in kg)}}{\text{Molar mass of solute (in kg mol}^{-1}) \times \text{Volume of solution (in dm}^3 \text{ or L)}} = \frac{W_B}{M_B V}$$

   where, W_B = mass of solute , M_B = molar mass of solute, V = volume of solution.

5. **Molality (m)** $= \frac{\text{Number of moles of solute}}{\text{Mass of solvent in kg}} = \frac{n_B}{\text{Mass of solvent (in kg)}}$ or $\frac{n_B}{\text{Mass of solvent (in g)}} \times 1000$

   $$= \frac{\text{Mass of solute in kg}}{\text{Molar mass of solute (in kg mol}^{-1}) \times \text{Mass of solvent (in kg)}} = \frac{W_B}{M_B W_A \text{ (in kg)}}$$

6. **Parts per million (ppm) =** $\frac{\text{Mass or volume of solute}}{\text{Total mass or volume of solution}} \times 10^6$

7. **Number of moles (n) =** $\frac{\text{Mass in grams}}{\text{Molecular mass in grams}}$

8. **Henry's law:** $p = K_H x$

   where, p = pressure of the gas in equilibrium with the solution,
   x = mole fraction of the gas in solution,
   K_H = Henry's law constant.

9. **Raoult's Law:**

   $p_T = p_A^o x_A + p_B^o x_B$ (for an ideal binary solution of two liquids)

   where, p_T = total vapour pressure of the solution,
   p_A^o = vapour pressure of pure component A, p_B^o = vapour pressure of pure component B,
   x_A = mole fraction of component A, x_B = mole fraction of component B.

10. **Vapour pressure:** Vapour pressure of a solution containing non-volatile solute, $p_A = p_A^o x_A$

    where, p_A^o = vapour pressure of pure component A, x_A = mole fraction of component A.

11. **Lowering of vapour pressure:**

    $\Delta p_A = p_A^o - p_A$ OR

    $\Delta p_A = p_A^o x_B$

    where, p_A^o = vapour pressure of pure solvent A,
    p_A = total vapour pressure of solution,
    x_B = mole fraction of solute B.

12. Relative lowering of vapour pressure:

$$\frac{\Delta p_A}{p_A^o} = x_B = \frac{W_B\, M_A}{M_B . W_A}$$

where, W_A and M_A are mass and molecular mass of solvent A, respectively,
W_B and M_B are mass and molecular mass of solute B, respectively.

13. Elevation of boiling point (ΔT_b):

$\Delta T_b = K_b . m = K_b \frac{W_B}{M_B . W_A}$ [when the masses and molar mass are expressed in kg and kg mol^{-1}, respectively.]

where, ΔT_b = elevation of boiling point due to addition of non-volatile solute,
K_b = ebullioscopic constant,
m = molality of the solution.

$\Delta T_b = \frac{K_b \times W_B \times 1000}{M_B \times W_A}$ [When the masses and molar mass are expressed in g and g mol^{-1}, respectively]

14. Depression of freezing point (ΔT_f):

$\Delta T_f = K_f\, m = K_f \frac{W_B}{M_B W_A}$ [when the masses and molar mass are expressed in kg and kg mol^{-1}, respectively.]

where, ΔT_f = depression of freezing point,
K_f = cryoscopic constant, m = molality of the solution.

$\Delta T_f = \frac{K_f \times W_B \times 1000}{M_B \times W_A}$ [When the masses and molar mass are expressed in g and g mol^{-1}, respectively]

15. Osmotic pressure (π):

$$\pi = CRT = \frac{n_B}{V} RT$$

$$\pi = \frac{W_B}{M_B . V} RT$$

$$M_B = \frac{W_B}{\pi V} RT$$

where, M_B = molar mass of solute, C = concentration of the solution,
R = gas constant, T = temperature.

16. van't Hoff factor, i = $\frac{\text{observed colligative property}}{\text{theoretical colligative property}}$

$$= \frac{\text{normal molar mass}}{\text{observed molar mass}}$$

17. Degree of dissociation (α):

$$\alpha = \frac{i-1}{n'-1}$$

$$= \frac{M_B\,(\text{theoretical}) - M_B\,(\text{observed})}{M_B\,(\text{observed})(n'-1)}$$

where, i = van't Hoff factor, α = degree of dissociation,
M_B (observed) = observed molecular mass of solute,
M_B (theoretical) = theoretical molecular mass of solute.

18. Degree of association (α):

$$\alpha = \frac{i-1}{\frac{1}{x}-1} = \frac{M_B\,(\text{theoretical}) - M_B\,(\text{observed})}{M_B\,(\text{observed})\left(\frac{1}{x}-1\right)}$$

where, i = van't Hoff factor, α = degree of association,
M_B (observed) = observed molecular mass of solute,
M_B (theoretical) = theoretical molecular mass of solute,
x = the number of simple molecules which combine to give associated molecule.

Concept Building Problems

Solutions and Types of Solutions

1. Choose the CORRECT sentence from the following.
   (A) A heterogeneous solution is the one which has uniform composition throughout the body of solution.
   (B) A homogeneous solution is a mixture in which solute and solvent are present in two or more phases.
   (C) In a solution, component present in smaller proportion is called solvent.
   (D) In the aqueous solution of salt, salt is the solute and water is the solvent.

2. Which of the following is INCORRECT?
   (A) A mixture of ethanol, water and acetone is an example of ternary solution.
   (B) A mixture of quaternary ammonium salt in water is an example of quaternary solution.
   (C) Oil and water form a heterogeneous solution.
   (D) Binary solutions contain two components.

Expression of Concentration of Solutions

1. When 10 g of solute is dissolved in 950 mL of water, the mass percent of solute in the solution is _____.
   (A) 1.04 (B) 2.5 (C) 8.3 (D) 19.1

2. What is the mass of the precipitate formed when 50 mL of 16.9 % (w/v) solution of $AgNO_3$ is mixed with 50 mL of 5.8 % (w/v) NaCl solution?
   (Ag = 107.3, N = 14, O = 16, Na = 23, Cl = 35.5)
   [AIPMT Re-Test 2015]
   (A) 7 g (B) 14 g (C) 28 g (D) 3.5g

3. What is the mole fraction of the solute in a 1.00 m aqueous solution?
   [AIPMT Re-Test 2015]
   (A) 0.0354 (B) 0.0177
   (C) 0.177 (D) 1.770

4. Calculate the mole fraction of ethanol, in a sample of rectified spirit which contains 95 % of ethanol by weight.
   (A) 0.50 (B) 0.60 (C) 0.75 (D) 0.88

5. The density of 2 M aqueous solution of NaOH is 1.28 g/cm^3. The molality of the solution is _____. [Given that molecular mass of NaOH = 40 g mol^{-1}] **[NEET (UG) Odisha 2019]**
   (A) 1.32 m (B) 1.20 m
   (C) 1.56 m (D) 1.67 m

6. If molality of an aqueous solution is 0.0025m, then molarity of the same solution is _____ M.
   (A) 0.025 (B) 0.0025
   (C) 0.25 (D) 2.5

7. 2 L of 0.01 M aqueous solution of KCl was diluted by adding 0.5 litre of water. The molality of the resultant solution is _____ .
   (A) 0.004 m (B) 0.008 m
   (C) 0.012 m (D) 0.016 m

8. Calculate molarity of 10 % (w/w) H_2SO_4 solution. (Density of solution is 1.02 g/mL.)
   (A) 0.42 M (B) 1.04 M
   (C) 2.08 M (D) 3.78 M

9. Calculate molality of solution when 2 g of acetic acid is dissolved in 100 g of water.
   (A) 0.33 m (B) 3.3 m
   (C) 0.033 m (D) 0.0033 m

10. 100 mL of hard water sample contain 12 mg of Ca^{2+} ions. Calculate the concentration of Ca^{2+} ions in parts per million (ppm).
    (A) 12 ppm (B) 30 ppm
    (C) 120 ppm (D) 240 ppm

11. The density of 1 M solution of a compound 'X' is 1.25 g mL^{-1}. The CORRECT option for the molality of solution is _____.
    (Molar mass of compound X = 85 g)
    [NEET (UG) Manipur 2023]
    (A) 1.165 m (B) 0.858 m
    (C) 0.705 m (D) 1.208 m

12. The density of 2 % (w/w) aqueous NaCl solution is 1.049 g mL^{-1}. What is the approximate molality?
    (A) 0.52 m (B) 0.16 m
    (C) 0.29 m (D) 0.35 m

13. Which of the following is dependent on temperature? **[NEET (UG) 2017]**
    (A) Molarity (B) Mole fraction
    (C) Weight percentage (D) Molality

Solubility of Solute in Solvent

1. At dynamic equilibrium, the rate of dissolution of a solute in a solvent is _____.
   (A) less than the rate of crystallization
   (B) greater than the rate of crystallization
   (C) equal to the rate of crystallization
   (D) double than the rate of crystallization

2. Which of the following statements is CORRECT?
   (A) Iodine is more soluble in water than in carbon tetrachloride.
   (B) NaCl is more soluble in benzene than in water.
   (C) Anthracene is more soluble in benzene than in water.
   (D) Naphthalene is more soluble in water than in ether.

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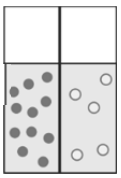
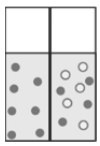
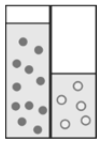
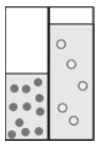
To see complete chapter buy **Target Notes** or **Target E-Notes**

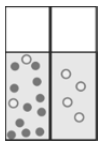
4. Diagram 'X' represents a system in which two aqueous sucrose solutions are separated by a semi-permeable membrane. Which of the following represents the system after a certain amount of time has passed?

X =  Sucrose molecules

(A) 

(B) 

(C) 

(D) 

Numerical Value Type Questions

1. The number of units, which are used to express concentration of solutions from the following is _____.
Mass percent, Mole, Mole fraction, Molarity, ppm, Molality **[JEE (Main) Jan 2023]**

2. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$. The value of x is _____. (Rounded off to the nearest integer) **[JEE (Main) Feb 2021]**

3. The total pressure observed by mixing two liquids A and B is 350 mm Hg when their mole fractions are 0.7 and 0.3 respectively.
The total pressure becomes 410 mm Hg if the mole fractions are changed to 0.2 and 0.8 respectively for A and B. The vapour pressure of pure A is _____ mm Hg. (Nearest integer) Consider the liquids and solutions behave ideally. **[JEE (Main) Jan 2023]**

4. A 500 g toothpaste sample has 0.2 g fluoride concentration. The concentration of F^- in ppm is 4×10^x. The value of 'x' is _____.

5. The vapour pressure of benzene at a certain temperature is 640 mm Hg. A non-volatile and non-electrolyte solid weighing 2.175 g is added to 39.08 g of benzene. The vapour pressure of the solution is 600 mm Hg. What is the molecular weight (g mol^{-1}) of solid substance?

6. When 9.45 g of $ClCH_2COOH$ is added to 500 mL of water, its freezing point drops by 0.5 °C. The dissociation constant of $ClCH_2COOH$ is $x \times 10^{-3}$. The value of x is _____. (Rounded off to the nearest integer) [$K_{f(H_2O)}$ = 1.86 K kg mol^{-1}] **[JEE (Main) Feb 2021]**

Problems To Ponder

1. The vapour pressure of pure benzene at 298 K is 639.7 mm Hg. What is the difference in vapour pressure between 2 molal and 5 molal solutions of non-volatile solute in benzene (Assume very dilute solution)?
(A) 27.1 mm Hg (B) 39.2 mm Hg
(C) 67.3 mm Hg (D) 149.7 mm Hg

2. A bar of chocolate dissolves in water. It forms an aqueous solution of 4 % by mass of caffeine ($C_8H_{10}N_4O_2$), 7 % by mass of theobromine ($C_7H_8N_4O_2$) and 11 % by mass of sucrose ($C_{12}H_{22}O_{11}$). What will be the freezing point of aqueous solution?
$K_{f(H_2O)}$ = 1.86 K kg mol^{-1}.
(A) – 0.932 °C (B) – 1.182 °C
(C) – 2.186 °C (D) – 3.367 °C

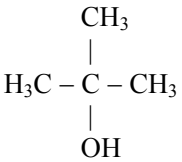
3. Two different solutions contain 2.96 g and 2.88 g of compound x and y dissolved in 100 g of organic solvent. Both solutions gave a freezing point lowering of 0.78 K. What is the formula of x and y?
(K_f for organic solvent = 7.8 K kg mol^{-1})
[Atomic mass of x = 37 and that of y = 48 g/mol]
(A) x_4, y_6 (B) x_6, y_8
(C) x_8, y_6 (D) x_8, y_{10}

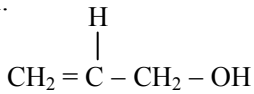
4. An unknown substance 'X' contains 66.66 % carbon, 3.73 % hydrogen and 29.62 % oxygen. Molar mass of 'X' is the same as its empirical molar mass. If 3.15 grams of the unknown substance is dissolved in 25 grams of benzene, what is the freezing point of the resulting solution?
Normal freezing point of benzene is 5.50 °C and the molal freezing-point depression constant, K_f, for benzene is 5.12 K kg mol^{-1}.
(A) –2.9 °C (B) –6.5 °C
(C) –8.2 °C (D) –11.9 °C

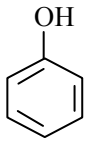
5. Calculate the amount of ice that will separate out upon cooling 1000 g of 1 molal aqueous solution of sucrose to –3.124 °C.
(A) 444 g (B) 302 g
(C) 745 g (D) 152

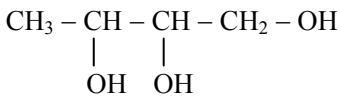
2. Total number of ions per molecule produced by dissociation of Mohr's salt is _____.

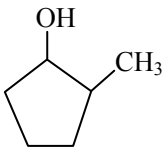
3. How many of the following compounds will give ceric ammonium nitrate iodoform tests positive?

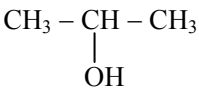
i. 

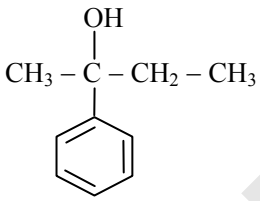
ii. 

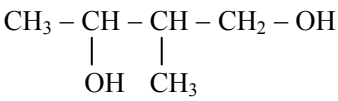
iii. 

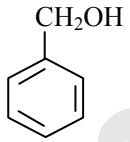
iv. 

v. 

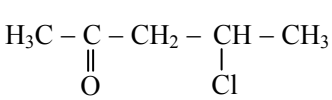
vi. 

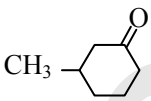
vii. 

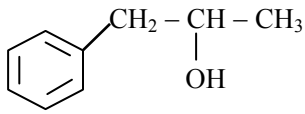
viii. 

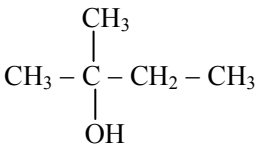
ix. 

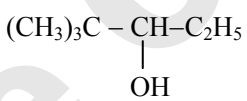
4. The total number ompounds from the following that can be employed for the preparation of iodoform is _____.

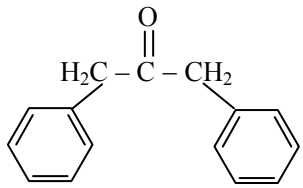
i. 

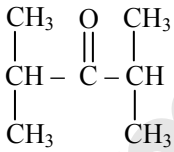
ii. 

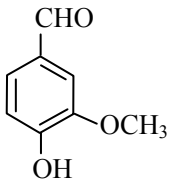
iii. 

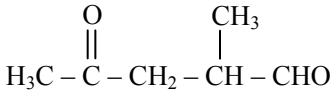
iv. 

v. 

vi. 

vii. 

viii. 

ix. 

5. How many of the following ions will give cobalt nitrate test?
Pb^{2+}, Zn^{2+}, Al^{3+}, Mg^{2+}, Cd^{2+}, Cu^{2+}

Problems To Ponder

1. Tests given by compound 'P' are given below:

i. Flame test $\longrightarrow$ green colour

ii. O.S. of Compound 'P' $\xrightarrow{\text{dil.HCl}}$ No ppt

iii. O.S. of Compound 'P' $\xrightarrow[H_2S\text{gas}]{\text{dil.HCl}}$ No ppt

iv. O.S. of Compound 'P' $\xrightarrow[\text{Solid } (NH_4)_2CO_3]{NH_4OH/NH_4Cl}$ No ppt

v. Compound 'P' + MnO_2 + conc. H_2SO_4 $\xrightarrow{\Delta}$ Greenish yellow gas

Identify Compound 'P'.

(A) $SrCl_2$ (B) $BaCl_2$ (C) $BaBr_2$ (D) $CuSO_4$

2. Aqueous solution of salt 'A' gives white ppt (B) on treatment with dil.HCl. Compound (B) dissolves in hot water and the solution gives yellow ppt. (C) on treatment with K_2CrO_4 solution. Salt (A) gives brown fumes on heating with H_2SO_4.

Identify (A), (B) and (C) respectively.

(A) $Pb(NO_3)_2$, $PbCl_2$, PbO (B) $Pb(NO_3)_2$, $PbCl_2$, $PbCrO_4$

(C) $PbSO_4$, $PbCl_2$, $PbCrO_4$ (D) $PbCl_2$, PbS, $PbCrO_4$

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To see complete chapter buy **Target Notes** or **Target E-Notes**

[Note: The following questions belong to chapters of Absolute Chemistry Vol. II]

Section A

Solutions

1. The Henry's law constant (K_H) values of three gases (A, B, C) in water are 145, 2×10^{-5} and 35 kbar, respectively. The solubility of these gases in water follows the order:
   (A) A > C > B
   (B) A > B > C
   (C) B > A > C
   (D) B > C > A

Electrochemistry

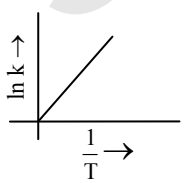
2. Match List I with List II.

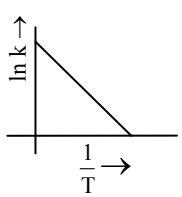
List I (Conversion)		List II (Number of Faraday required)	
i.	1 mol of H_2O to O_2	a.	3F
ii.	1mol of MnO_4^- to Mn^{2+}	b.	2F
iii.	1.5 mol of Ca from molten $CaCl_2$	c.	1F
iv.	1 mol of FeO to Fe_2O_3	d.	5F

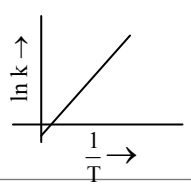
Choose the correct answer from the options given below:
(A) i–b, ii–c, iii–a, iv–d
(B) i–c, ii–d, iii–b, iv–a
(C) i–b, ii–d, iii–a, iv–c
(D) i–c, ii–d, iii–a, iv–b

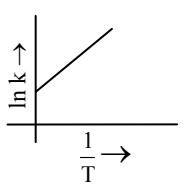
Chemical Kinetics

3. Which plot of ln k vs $\frac{1}{T}$ is consistent with Arrhenius equation?

(A) 

(B) 

(C) 

(D) 

4. Activation energy of any chemical reaction be calculated if one knows the value of
   (A) orientation of reactant molecules during collision
   (B) rate constant at two different temperatures
   (C) rate constant at standard temperature
   (D) probability of collision

p-Block Elements

5. Given below are two statements:
   Statement I: The boiling point of hydrides of Group 16 elements follow the order
   $H_2O > H_2Te > H_2Se > H_2S$
   Statement II: On the basis of molecular mass, H_2O is expected to have lower boiling point than the other members of the group but due to the presence of extensive H-bonding in H_2O, it has higher boiling point.
   In the light of the above statements, choose the *correct* answer from the options given below:
   (A) Statement I is true but Statement II is false.
   (B) Statement I is false but Statement II is true.
   (C) Both Statement I and Statement II are true.
   (D) Both Statement and Statement II are false.

6. Among Group 16 elements, which one does **NOT** show –2 oxidation state?
   (A) Te (B) Po (C) O (D) Se

d- and f- Block Elements

7. The E° value for the Mn^{3+}/Mn^{2+} couple is more positive than that of Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+} due to change of
   (A) d^4 to d^5 configuration
   (B) d^3 to d^5 configuration
   (C) d^5 to d^4 configuration
   (D) d^5 to d^2 configuration

Coordination compounds

8. Match List I with List II.

List I (Complex)		List II (Type of isomerism)	
i.	$[Co(NH_3)_5(NO_2)]Cl_2$	a.	Solvate isomerism
ii.	$[Co(NH_3)_5(SO_4)]Br$	b.	Linkage isomerism
iii.	$[Co(NH_3)_6][Cr(CN)_6]$	c.	Ionization isomerism
iv.	$[Co(H_2O)_6]Cl_3$	d.	Coordination isomerism

Choose the correct answer from the options given below:

(A) i–a, ii–d, iii–c, iv–b
(B) i–b, ii–d, iii–c, iv–a
(C) i–b, ii–c, iii–d, iv–a
(D) i–a, ii–c, iii–d, iv–b

9. 'Spin only' magnetic moment is same for which of the following ions?

i. Ti^{3+} ii. Cr^{2+}
iii. Mn^{2+} iv. Fe^{2+}
v. Sc^{3+}

Choose the most appropriate answer from the options given below:

(A) ii and iii only (B) i and iv only
(C) ii and iv only (D) i and v only

10. Given below are two statements

Statement I: Both $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ complexes are octahedral but differ in magnetic behaviour.

Statement II: $[Co(NH_3)_6]^{3+}$ is diamagnetic whereas $[COF_6]^{3-}$ is paramagnetic.

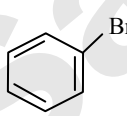
In the light of the above statements, choose *correct* answer from the options given below:

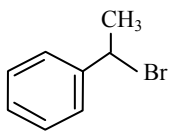
(A) Statement I is true but Statement II is false.
(B) Statement 1 is false but Statement II is true
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

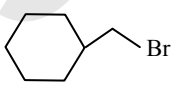
(D) Both Statement I and Statement II are false.

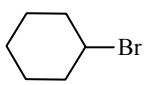
Haloalkanes and Haloarenes

11. The compound that will undergo S_N1 reaction with the fastest rate is

(A) 

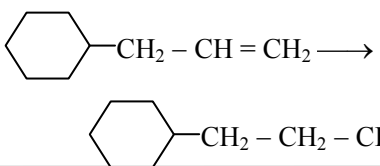
(B) 

(C) 

(D) 

Alcohols, Phenols and Ethers

12. Identify the correct reagents that would bring about the following transformation.



(A) i. BH_3
ii. H_2O_2/OH^-
iii. alk. $KMnO_4$
iv. H_3O^+

(B) i. H_2O/H^+
ii. PCC

(C) i. H_2O/H^+
ii. CrO_3

(D) i. BH_3
ii. H_2O_2/OH^-
iii. PCC

13. Which one of the following alcohols reacts instantaneously with Lucas reagent?

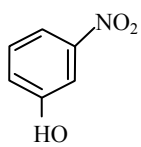
(A) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2OH$

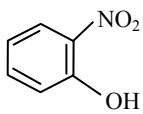
(B) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}} - OH$

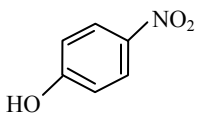
(C) $CH_3 - CH_2 - CH_2 - CH_2OH$

(D) $CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - OH$

14. Intramolecular hydrogen bonding is present in

(A) 

(B) HF
(C) 

(D) 

Organic compounds containing Nitrogen

15. Given below are two statements:

Statement I: Aniline does not undergo Friedel–Crafts alkylation reaction.

Statement II: Aniline cannot be prepared through Gabriel synthesis.

In the light of the above statements, choose the correct answer from the options given below:

(A) Statement I is correct but Statement II is false.
(B) Statement 1 is incorrect but Statement II is true.
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

Biomolecules

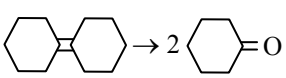
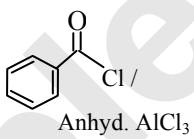
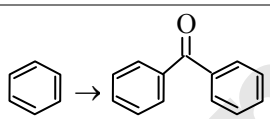
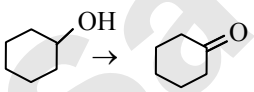
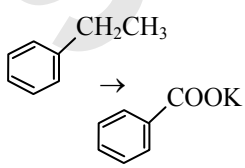
16. The reagents with which glucose does not react to give the corresponding tests/products are
i. Tollen's reagent ii. Schiff's reagent
iii. HCN iv. NH_2OH
v. $NaHSO_3$
Choose the correct options from the given below:
(A) ii and v
(B) v and iv
(C) ii and iii
(D) i and iv

Principles related to practical chemistry

17. Fehling's solution 'A' is
(A) alkaline solution of sodium potassium tartrate (Rochelle's salt)
(B) aqueous sodium citrate
(C) aqueous copper sulphate
(D) alkaline copper sulphate

Aldehydes and ketones

18. Match List I with List II.

List I (Reaction)		List II (Reagents/ Condition)	
i.		a.	
ii.		b.	CrO_3
iii.		c.	$KMnO_4/KOH, \Delta$
iv.		d.	(i) O_3 (ii) ZnH_2O

Choose the correct answer from the options given below:
(A) i–d, ii–a, iii–b, iv–c
(B) i–a, ii–d, iii–b, iv–c
(C) i–d, ii–a, iii–c, iv–b
(D) i–c, ii–a, iii–b, iv–d

Section B

Solutions

19. The plot of osmotic pressure (π) vs concentration (mol L^{-1}) for a solution gives a straight line with slope 25.73 L bar mol^{-1}. The temperature at which the osmotic pressure measurement is done is:
(Use R = 0.083 L bar mol^{-1} K^{-1})
(A) 25.73 °C (B) 12.05 °C
(C) 37 °C (D) 310 °C

Electrochemistry

20. Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is:
(Given: Molar mass of Cu: 63 g mol^{-1}, 1 F = 96487 C)
(A) 31.5 g (B) 0.0315 g
(C) 3.15 g (D) 0.315 g

Chemical Kinetics

21. The rate of a reaction quadruples when temperature changes from 27 °C to 57 °C. Calculate the energy of activation.
Given: R = 8.314 J K^{-1} mol^{-1}, log 4 = 0.6021
(A) 3.80 kJ/mol (B) 3804 kJ/mol
(C) 38.04 kJ/mol (D) 380.4 kJ/mol

p-Block Elements

22. The products A and B obtained in the following reactions, respectively, are
$3ROH + PC1_3 \rightarrow 3RCl + A$
$ROH + PCl_5 \rightarrow RCl + HCl + B$
(A) H_3PO_4 and $POCl_3$
(B) H_3PO_3 and $POCl_3$
(C) $POCl_3$ and H_3PO_3
(D) $POCl_3$ and H_3PO_4

d- and f- Block Elements

23. The pair of lanthanoid ions which are diamagnetic is
(A) Gd^{3+} and Eu^{3+} (B) Pm^{3+} and Sm^{3+}
(C) Ce^{4+} and Yb^{2+} (D) Ce^{3+} and Eu^{2+}

Coordination compounds

24. Given below are two statements:
Statement I: $[Co(NH_3)_6]^{3+}$ is a homoleptic complex whereas $[Co(NH_3)_4Cl_2]^{+}$ is a heteroleptic complex.
Statement II: Complex $[Co(NH_3)_6]^{3+}$ has only one kind of ligands but $[Co(NH_3)_4Cl_2]^{+}$ has more than one kind of ligands.

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