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  - 2023 (Manipur)
- Chapter-wise and Topic-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 Topic-wise

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PREFACE

Target's '**NEET Chemistry: PSP (Previous Solved Papers)**' is a compilation of questions asked in the past 37 years (1988-2024) in the National Eligibility cum Entrance Test (NEET), formerly known as the All India Pre-Medical Test (AIPMT). The book is updated as per the latest syllabus of NEET (UG) examination.

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

A graphical (% wise) analysis of the topics for the past 37 years as well as 12 years (2013 onwards) has been provided at the onset of every chapter. Both the graphs will help the students to understand and analyse each topic's distribution for NEET/AIPMT (37 years) and NEET (UG) (12 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.
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A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

Publisher

Edition: Sixth

Frequently Asked Questions

Why this book?

- This book acts as a go-to tool to find all the AIPMT/NEET questions since the past 37 years at one place.
- The topic 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 topic 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 topic having the most weightage for AIPMT may not necessarily be the topic with the most weightage for NEET.

How are the two graphs beneficial to the students?

- The two graphs provide a topic’s weightage distribution over the past 37 years (for NEET/AIPMT) and over the past 12 years (for NEET-UG).
- The students can use these graphs as a self-evaluation tool by analyzing and comparing a particular topic’s weightage with their preparation of the topic. This exercise would help the students to get a clear picture about their strength and weakness based on the topics.
- Students can also use the graphs as a source to know the most important as well as least important topics 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 topics is solely for the knowledge of students and does not guarantee questions from topics having the most weightage, in the future exams. Question classification of a topic is done as per the authors’ discretion and may vary with respect to another individual.)

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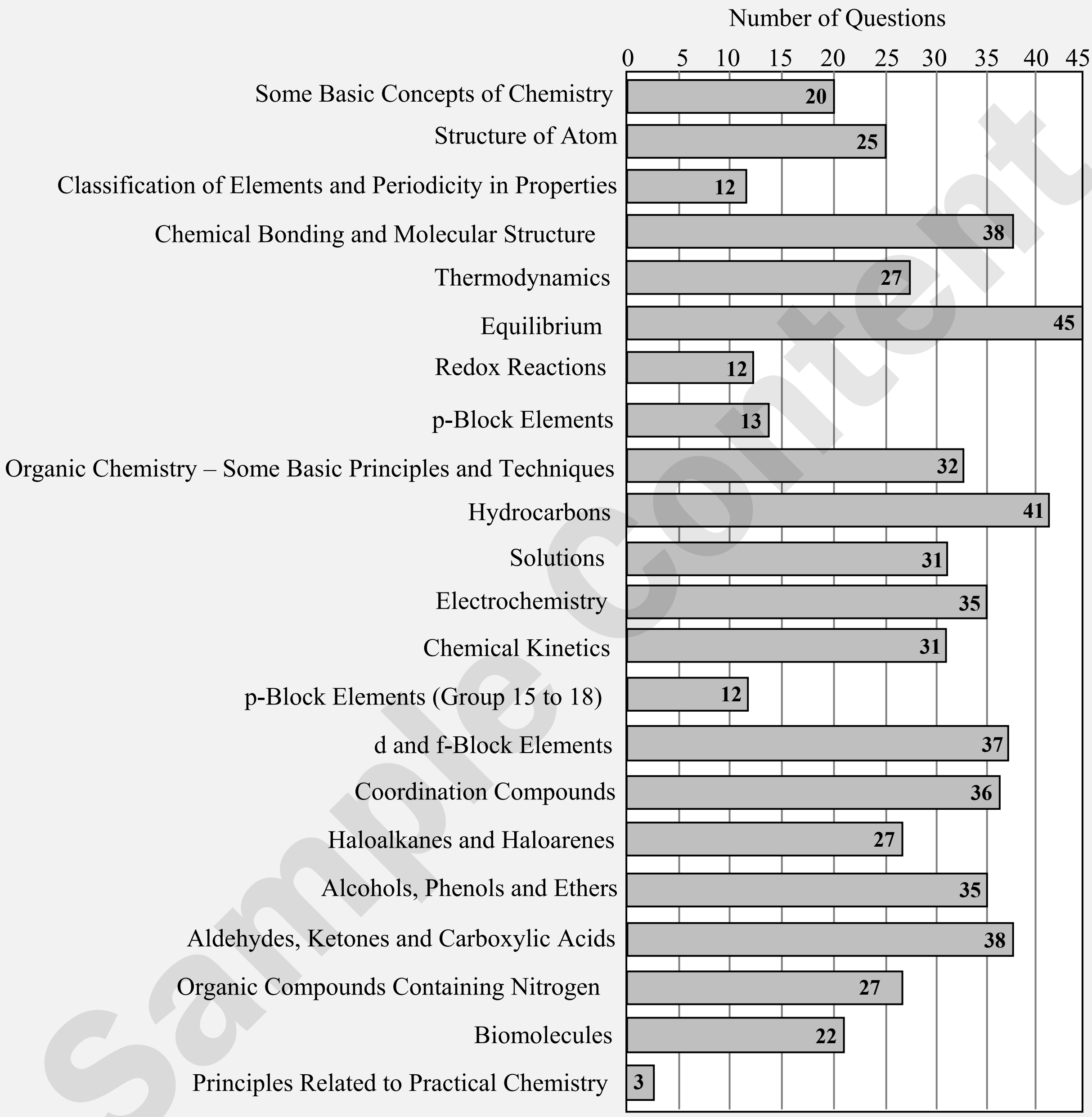
Chapter-wise Weightage Analysis of past 12 Years (2013 Onwards)



Total No. of Questions: 599

6 Equilibrium

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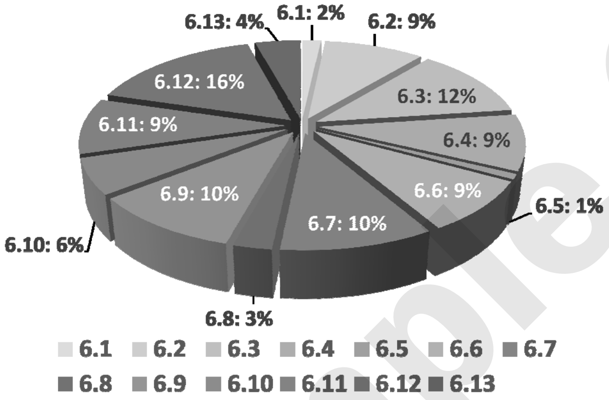
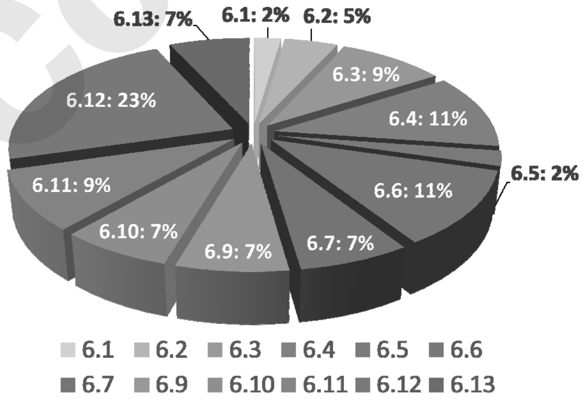
37 Years NEET/AIPMT analysis
(Percentage-wise weightage of topics)



12 Years NEET analysis (2013 onwards)
(Percentage-wise weightage of topics)



6.1 Equilibrium in physical and chemical processes and its dynamic nature

1. In liquid-gas equilibrium, the pressure of vapours above the liquid is constant at _______. **[1995]**

(A) constant temperature
(B) low temperature
(C) high temperature
(D) none of these

2. Consider the following liquid-vapour equilibrium.

Liquid $\rightleftharpoons$ Vapour

Which of the following relation is CORRECT? **[Phase-I 2016]**

(A) $\frac{d\ln P}{dT^2} = \frac{-\Delta H_V}{T^2}$ (B) $\frac{d\ln P}{dT} = \frac{\Delta H_V}{RT^2}$

(C) $\frac{d\ln G}{dT^2} = \frac{\Delta H_V}{RT^2}$ (D) $\frac{d\ln P}{dT^2} = \frac{-\Delta H_V}{RT}$

6.2 Law of chemical equilibrium and equilibrium constant

1. K_1 and K_2 are equilibrium constant for reactions (i) and (ii)

$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ ...(i)

$NO_{(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$ ...(ii) **[1989]**

(A) $K_1 = \left(\frac{1}{K_2}\right)^2$ (B) $K_1 = K_2^2$

(C) $K_1 = \frac{1}{K_2}$ (D) $K_1 = (K_2)^0$

2. The equilibrium constant for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ is K, then the equilibrium constant for the equilibrium $2NH_3 \rightleftharpoons N_2 + 3H_2$ is _______. **[1996]**

(A) $\sqrt{K}$ (B) $\sqrt{\frac{1}{K}}$ (C) $\frac{1}{K}$ (D) $\frac{1}{K^2}$

3. If K_1 and K_2 are the respective equilibrium constant for the two reactions,
$XeF_{6(g)} + H_2O_{(g)} \longrightarrow XeOF_{4(g)} + 2HF_{(g)}$
$XeO_{4(g)} + XeF_{6(g)} \longrightarrow XeOF_{4(g)} + XeO_3F_{2(g)}$, the equilibrium constant of the reaction,
$XeO_{4(g)} + 2HF_{(g)} \longrightarrow XeO_3F_{2(g)} + H_2O_{(g)}$, will be _______. **[1998]**

(A) K_1/K_2 (B) $K_1.K_2$
(C) $K_1/(K_2)^2$ (D) K_2/K_1

4. Equilibrium constant K_1 and K_2 for the following equilibria:
$NO_{(g)} + \frac{1}{2}O_2 \xrightleftharpoons{K_1} NO_{2(g)}$ and
$2NO_{2(g)} \xrightleftharpoons{K_2} 2NO_{(g)} + O_{2(g)}$ are related as _______. **[2005]**

(A) $K_2 = 1/K_1^2$ (B) $K_2 = K_1^2$
(C) $K_2 = 1/K_1$ (D) $K_2 = K_1/2$

5. In which of the following equilibrium, K_c and K_p are NOT equal? **[2010]**

(A) $2C_{(s)} + O_{2(g)} \rightleftharpoons 2CO_{2(g)}$

(B) $2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$

(C) $SO_{2(g)} + NO_{2(g)} \rightleftharpoons SO_{3(g)} + NO_{(g)}$

(D) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

6. For the reaction, $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction, $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$

What is K for the reaction,
$NO_{2(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + O_{2(g)}$? **[2011]**

(A) $\frac{1}{2K_1K_2}$ (B) $\frac{1}{4K_1K_2}$
(C) $\left[\frac{1}{K_1K_2}\right]^{1/2}$ (D) $\frac{1}{K_1K_2}$

7. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound $AB_{(g)}$.
$A_{2(g)} + B_{2(g)} \rightleftharpoons 2AB_{(g)}$
At equilibrium, the concentration of
$A_2 = 3.0 \times 10^{-3}$ M, $B_2 = 4.2 \times 10^{-3}$ M, $AB = 2.8 \times 10^{-3}$ M
If the reaction takes place in a sealed vessel at 527 °C, then the value of K_c will be _______. **[2012]**

(A) 2.0 (B) 1.9 (C) 0.62 (D) 4.5

8. Given that the equilibrium constant for the reaction, $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature?
$SO_{3(g)} \rightleftharpoons SO_{2(g)} + \frac{1}{2}O_{2(g)}$ **[2012]**

(A) 1.8×10^{-3} (B) 3.6×10^{-3}
(C) 6.0×10^{-2} (D) 1.3×10^{-5}

9. If the equilibrium constant for
$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ is K,
the equilibrium constant for
$\frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons NO_{(g)}$
will be _______. **[Re-Test 2015]**

(A) K (B) K^2 (C) $K^{1/2}$ (D) $\frac{1}{2}K$

10. The equilibrium constants of the following are:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$; K_1
$N_2 + O_2 \rightleftharpoons 2NO$; K_2
$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$; K_3
The equilibrium constant (K) of the reaction:
$2NH_3 + \frac{5}{2}O_2 \xrightleftharpoons{K} 2NO + 3H_2O$, will be _______. **[2017, 2007, 2003]**

(A) $K_1K_3^3/K_2$ (B) $K_2K_3^3/K_1$
(C) K_2K_3/K_1 (D) $K_2^3K_3/K_1$

11. In which of the following equilibria, K_p and K_c are **NOT** equal? **[2024]**

(A) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

(B) $2BrCl_{(g)} \rightleftharpoons Br_{2(g)} + Cl_{2(g)}$

(C) $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

(D) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

6.3 Applications of equilibrium constant

1. If α is dissociation constant, then the total number of moles for the reaction,
$2HI \longrightarrow H_2 + I_2$ will be _______. **[1996]**

(A) 1 (B) 1 – α
(C) 2 (D) 2 – α

2. Equilibrium constant K_p for following reaction
$MgCO_{3(g)} \rightleftharpoons MgO_{(g)} + CO_{2(g)}$ **[2000]**

(A) $K_p = p_{CO_2}$

(B) $K_p = p_{CO_2} \times \frac{p_{CO_2} \times p_{MgO}}{p_{MgCO_3}}$

(C) $K_p = \frac{p_{CO_2} + p_{MgO}}{p_{MgCO_3}}$

(D) $K_p = \frac{p_{MgCO_3}}{p_{CO_2} \times p_{MgO}}$

3. For any reversible reaction, if we increase concentration of the reactants, then effect on equilibrium constant _______. **[2000]**
(A) depends on amount of concentration
(B) remains unchanged
(C) decreases
(D) increases

4. The reaction quotient (Q) for the reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$. The reaction will proceed from right to left if _______. **[2003]**
(A) $Q = K_c$ (B) $Q < K_c$
(C) $Q > K_c$ (D) $Q = 0$

5. In Haber's process, 30 litres of dihydrogen and 30 litres of dinitrogen were taken for reaction, which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the aforesaid condition at the end? **[2003]**
(A) 20 litres ammonia, 25 litres nitrogen, 15 litres hydrogen
(B) 20 litres ammonia, 20 litres nitrogen, 20 litres hydrogen
(C) 10 litres ammonia, 25 litres nitrogen, 15 litres hydrogen
(D) 20 litres ammonia, 10 litres nitrogen, 30 litres hydrogen

6. The values of K_{p_1} and K_{p_2} for the reactions,

$X \rightleftharpoons Y + Z$ ...(i)

$A \rightleftharpoons 2B$ ...(ii)

are in the ratio 9:1. If degree of dissociation of X and A be equal, then total pressure at equilibrium (i) and (ii) are in the ratio _______. **[2008]**
(A) 36:1 (B) 1:1 (C) 3:1 (D) 1:9

7. The value of equilibrium constant of the reaction,
$HI_{(g)} \rightleftharpoons \frac{1}{2}H_{2(g)} + \frac{1}{2}I_{2(g)}$ is 8.0.
The equilibrium constant of the reaction $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ will be _______. **[2008]**
(A) 16 (B) 1/8
(C) 1/16 (D) 1/64

8. If the concentration of OH^- ions in the reaction $Fe(OH)_{3(s)} \rightleftharpoons Fe^{3+}_{(aq)} + 3OH^-_{(aq)}$ is decreased by 1/4 times, then equilibrium concentration of Fe^{3+} will increase by _______. **[2008]**
(A) 64 times (B) 4 times
(C) 8 times (D) 16 times

9. The dissociation equilibrium of a gas AB_2 can be represented as:
$2AB_{2(g)} \rightleftharpoons 2AB_{(g)} + B_{2(g)}$
The degree of dissociation is x and is small compared to 1. The expression relating the degree of dissociation (x) with equilibrium constant K_p and total pressure P is _______. **[2008]**
(A) $(2K_p/P)^{1/2}$ (B) (K_p/P)
(C) $(2K_p/P)$ (D) $(2K_p/P)^{1/3}$

10. The reaction $2A_{(g)} + B_{(g)} \rightleftharpoons 3C_{(g)} + D_{(g)}$ is begun with the concentration of A and B both at an initial value of 1.00 M. When equilibrium is reached, the concentration of D is measured and found to be 0.25 M. The value for the equilibrium constant for this reaction is given by the expression _______. **[2010]**
(A) $[(0.75)^3 (0.25)] \div [(1.00)^2 (1.00)]$
(B) $[(0.75)^3 (0.25)] \div [(0.50)^2 (0.75)]$
(C) $[(0.75)^3 (0.25)] \div [(0.50)^2 (0.25)]$
(D) $[(0.75)^3 (0.25)] \div [(0.75)^2 (0.25)]$

11. If the value of an equilibrium constant for a particular reaction is 1.6×10^{12}, then at equilibrium the system will contain _______. **[2015]**
(A) all reactants
(B) mostly reactants
(C) mostly products
(D) similar amounts of reactants and products

12. $3O_{2(g)} \rightleftharpoons 2O_{3(g)}$
for the above reaction at 298 K, K_c is found to be 3.0×10^{-59}. If the concentration of O_2 at equilibrium is 0.040 M, then concentration of O_3 in M is ________. **[2022]**
(A) 2.4×10^{31} (B) 1.2×10^{21}
(C) 4.38×10^{-32} (D) 1.9×10^{-63}

13. The equilibrium concentrations of the species in the reaction $A + B \rightleftharpoons C + D$ are 2, 3, 10 and 6 mol L^{-1}, respectively at 300 K. ΔG^o for the reaction is (R = 2 cal/mol K) **[2023]**
(A) –137.26 cal (B) –1381.80 cal
(C) –13.73 cal (D) 1372.60 cal

14. For the reaction $2A \rightleftharpoons B + C$, $K_c = 4 \times 10^{-3}$. At a given time, the composition of reaction mixture is: $[A] = [B] = [C] = 2 \times 10^{-3}$ M.
Then, which of the following is correct? **[2024]**
(A) Reaction has a tendency to go in backward direction.
(B) Reaction has gone to completion in forward direction.
(C) Reaction is at equilibrium.
(D) Reaction has a tendency to go in forward direction.

6.4 Factors affecting equilibrium: Le-Chatelier's principle

1. Which one of the following information can be obtained on the basis of Le Chatelier's principle? **[1992]**
   (A) Dissociation constant of a weak acid.
   (B) Entropy change in a reaction.
   (C) Equilibrium constant of a chemical reaction.
   (D) Shift in equilibrium position on changing value of a constraint.

2. According to Le Chatelier's principle, adding heat to a solid and liquid in equilibrium will cause the _______. **[1993]**
   (A) temperature to increase
   (B) temperature to decrease
   (C) amount of liquid to decrease
   (D) amount of solid to decrease

3. Standard state Gibbs free energy change for isomerisation reaction,
   cis-2-Pentene $\rightleftharpoons$ trans-2-Pentene
   is – 3.67 kJ/mol at 400 K. If more trans-2-pentene is added to the reaction vessel then ______. **[1995]**
   (A) equilibrium remains unaffected
   (B) equilibrium is shifted in the forward direction
   (C) more cis-2-pentene is formed
   (D) additional trans-2-pentene is formed

4. Reaction $BaO_{2(s)} \rightleftharpoons BaO_{(s)} + O_{2(g)}$;
   $\Delta H = +$ ve. In equilibrium condition, pressure of O_2 depends on _______. **[2002]**
   (A) increase mass of BaO_2
   (B) increase mass of BaO
   (C) increase temperature on equilibrium
   (D) increase mass of BaO_2 and BaO both

5. For the reaction:
   $CH_{4(g)} + 2O_{2(g)} \rightleftharpoons CO_{2(g)} + 2H_2O_{(l)}$,
   $\Delta H_r = -\ 170.8\ kJ\ mol^{-1}$. Which of the following statements is INCORRECT? **[2006]**
   (A) The reaction is exothermic.
   (B) At equilibrium the concentrations of $CO_{2(g)}$ and $H_2O_{(l)}$ are not equal.
   (C) The equilibrium constant for the reaction is given by $K_p = \frac{[CO_2]}{[CH_4].[O_2]}$
   (D) Addition of $CH_{4(g)}$ or $O_{2(g)}$ at equilibrium will cause a shift to the right.

6. The value of ΔH for the reaction
   $X_{2(g)} + 4Y_{2(g)} \rightleftharpoons 2XY_{4(g)}$ is less than zero. Formation of $XY_{4(g)}$ will be favoured at _______. **[2011]**
   (A) high temperature and high pressure
   (B) low pressure and low temperature
   (C) high temperature and low pressure
   (D) high pressure and low temperature

7. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction,
   $3MnO_4^{2-} + 2H_2O \rightleftharpoons 2MnO_4^{-} + MnO_2 + 4OH^{-}$
   The reaction can go to completion by removing OH^{-} ions by adding _______. **[2013]**
   (A) CO_2 (B) SO_2
   (C) HCl (D) KOH

8. For a given exothermic reaction, K_p and K_p' are the equilibrium constants at temperatures T_1 and T_2, respectively. Assuming that heat of reaction is constant in temperature range between T_1 and T_2, it is readily observed that _______. **[2014]**
   (A) $K_p > K_p'$ (B) $K_p < K_p'$
   (C) $K_p = K_p'$ (D) $K_p = \frac{1}{K_p'}$

9. For the reversible reaction,
   $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} + \text{Heat}$
   The equilibrium shifts in forward direction _______. **[2014]**
   (A) by increasing the concentration of $NH_{3(g)}$
   (B) by decreasing the pressure
   (C) by decreasing the concentration of $N_{2(g)}$ and $H_{2(g)}$
   (D) by increasing pressure and decreasing temperature

10. A 20 litre container at 400 K contains $CO_{2(g)}$ at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the container is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains its maximum value, will be _______.
    (Given that: $SrCO_{3(s)} \rightleftharpoons SrO_{(s)} + CO_{2(g)}$, $K_p = 1.6$ atm) **[2017]**
    (A) 5 litre (B) 10 litre
    (C) 4 litre (D) 2 litre

11. Which one of the following conditions will favour maximum formation of the product in the reaction?
    $A_{2(g)} + B_{2(g)} \rightleftharpoons X_{2(g)}$; $\Delta_r H = -\,x$ kJ **[2018]**
    (A) Low temperature and high pressure
    (B) Low temperature and low pressure
    (C) High temperature and high pressure
    (D) High temperature and low pressure

6.5 Ionic equilibrium

1. Aqueous solution of which of the following compounds is the best conductor of electric current? **[2015]**
(A) Hydrochloric acid, HCl
(B) Ammonia, NH_3
(C) Fructose, $C_6H_{12}O_6$
(D) Acetic acid, $C_2H_4O_2$

6.6 Acids and bases: Various concepts

1. Which of the following is NOT a Lewis acid? **[1996]**
(A) SiF_4 (B) C_2H_4
(C) BF_3 (D) $FeCl_3$

2. The strongest conjugate base is _______. **[1999]**
(A) SO_4^{2-} (B) Cl^-
(C) NO_3^- (D) CH_3COO^-

3. Conjugate acid of NH_2^- is _______. **[2000]**
(A) NH (B) NH_4^+ (C) NH_2 (D) NH_3

4. Which of the following molecules acts as a Lewis acid? **[2009]**
(A) $(CH_3)_3B$ (B) $(CH_3)_2O$
(C) $(CH_3)_3P$ (D) $(CH_3)_3N$

5. Which of the following is least likely to behave as Lewis base? **[2011]**
(A) OH^- (B) H_2O (C) NH_3 (D) BF_3

6. Which of these is least likely to act as a Lewis base? **[2013]**
(A) BF_3 (B) PF_3 (C) CO (D) F^-

7. Which of the following fluoro compounds is most likely to behave as a Lewis base? **[Phase-II 2016]**
(A) SiF_4 (B) BF_3 (C) PF_3 (D) CF_4

8. Conjugate bases for Bronsted acids H_2O and HF are _______. **[2019]**
(A) H_3O^+ and F^-, respectively
(B) OH^- and F^-, respectively
(C) H_3O^+ and H_2F^+, respectively
(D) OH^- and H_2F^+, respectively

9. Which of the following CANNOT act both as Bronsted acid and as Bronsted base? **[Odisha 2019]**
(A) HSO_4^- (B) HCO_3^-
(C) NH_3 (D) HCl

10. Amongst the given options which of the following molecules/ ion acts as a Lewis acid? **[2023]**
(A) H_2O (B) BF_3 (C) OH^- (D) NH_3

6.7 Ionization of acids and bases

1. Aqueous solution of acetic acid contains _______. **[1991]**
(A) CH_3COO^- and H^+
(B) CH_3COO^-, H_3O^+ and CH_3COOH
(C) CH_3COO^-, H_3O^+ and H^+
(D) CH_3COOH, CH_3COO^- and H^+

2. At 80°C, distilled water has $[H_3O^+]$ concentration equal to 1×10^{-6} mole/litre. The value of K_w at this temperature will be _______. **[1994]**
(A) 1×10^{-12} (B) 1×10^{-15}
(C) 1×10^{-6} (D) 1×10^{-9}

3. The ionic product of water at 25 °C is 10^{-14}. Its ionic product at 90 °C will be, _______. **[1996]**
(A) 1×10^{-14} (B) 1×10^{-16}
(C) 1×10^{-20} (D) 1×10^{-12}

4. Correct relation between dissociation constants of a dibasic acid is _______. **[2000]**
(A) $K_{a_1} = K_{a_2}$ (B) $K_{a_1} > K_{a_2}$
(C) $K_{a_1} < K_{a_2}$ (D) $K_{a_1} = \frac{1}{K_{a_2}}$

5. Ionisation constant of CH_3COOH is 1.7×10^{-5} and concentration of H^+ ions is 3.4×10^{-4}. Then find out initial concentration of CH_3COOH molecules. **[2001]**
(A) 3.4×10^{-4} (B) 3.4×10^{-3}
(C) 6.8×10^{-4} (D) 6.8×10^{-3}

6. At 25°C, the dissociation constant of a base, BOH, is 1.0×10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be _______. **[2005]**
(A) 1.0×10^{-5} mol L^{-1}
(B) 1.0×10^{-6} mol L^{-1}
(C) 2.0×10^{-6} mol L^{-1}
(D) 1.0×10^{-7} mol L^{-1}

7. A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mol of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium is closet to _______. **[2007]**
(A) 1.00 % (B) 99.9 %
(C) 0.100 % (D) 99.0 %

8. The dissociation constant for acetic acid and HCN at 25°C are 1.5×10^{-5} and 4.5×10^{-10} respectively. The equilibrium constant for the equilibrium,
$CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$
would be _______. **[2009]**
(A) 3.0×10^{-5} (B) 3.0×10^{-4}
(C) 3.0×10^{4} (D) 3.0×10^{5}

9. What is $[H^+]$ in mol/L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH? (K_a for $CH_3COOH = 1.8 \times 10^{-5}$) **[2010]**
   (A) 3.5×10^{-4} (B) 1.1×10^{-5}
   (C) 1.8×10^{-5} (D) 9.0×10^{-6}

10. The percentage of pyridine (C_5H_5N) that forms pyridinium ion $C_5H_5\overset{+}{N}H$ in a 0.10 M aqueous pyridine solution is _______. (K_b for $C_5H_5N = 1.7 \times 10^{-9}$) **[Phase-II 2016]**
   (A) 1.6 % (B) 0.0060 %
   (C) 0.013 % (D) 0.77 %

11. For a weak acid HA, the percentage of dissociation is nearly 1% at equilibrium. If the concentration of acid is 0.1 mol L^{-1}, then the CORRECT option for its K_a at the same temperature is: **[Manipur 2023]**
   (A) 1×10^{-5} (B) 1×10^{-3}
   (C) 1×10^{-4} (D) 1×10^{-6}

12. Consider the following reaction in a sealed vessel at equilibrium with concentrations of $N_2 = 3.0 \times 10^{-3}$ M, $O_2 = 4.2 \times 10^{-3}$ M and $NO = 2.8 \times 10^{-3}$ M.

    $2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$

    If 0.1 mol L^{-1} of $NO_{(g)}$ is taken in a closed vessel, what will be degree of dissociation (α) of $NO_{(g)}$ at equilibrium? **[2024]**
   (A) 0.8889 (B) 0.717
   (C) 0.00889 (D) 0.0889

6.8 Relative strength of acids and bases

1. The hydride ion H^- is a stronger base than its hydroxide ion OH^-. Which of the following reactions will occur if sodium hydride (NaH) is dissolved in water? **[1997]**
   (A) $H^-_{(aq)} + H_2O \longrightarrow H_3O^-_{(aq)}$
   (B) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow OH^-_{(aq)} + H_{2(g)}$
   (C) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow$ No reaction
   (D) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow H^+ + H_3O^+$

2. In HS^-, I^-, $R - NH_2$, NH_3 order of proton accepting tendency will be _______. **[2001]**
   (A) $I^- > NH_3 > R - NH_2 > HS^-$
   (B) $NH_3 > R - NH_2 > HS^- > I^-$
   (C) $R - NH_2 > NH_3 > HS^- > I^-$
   (D) $HS^- > R - NH_2 > NH_3 > I^-$

3. Which one of the following statements is not true? **[2003]**
   (A) Among halide ions, iodide is the most powerful reducing agent.
   (B) Fluorine is the only halogen that does not show a variable oxidation state.
   (C) HOCl is a stronger acid than HOBr.
   (D) HF is a stronger acid than HCl.

6.9 Hydrogen ion concentration: Concept of pH

1. The compound whose water solution has the highest pH is _______. **[1988]**
   (A) NaCl (B) $NaHCO_3$
   (C) Na_2CO_3 (D) NH_4Cl

2. The pH value of a 10 M solution of HCl is _______. **[1995]**
   (A) equal to 1 (B) equal to 2
   (C) less than 0 (D) equal to 0

3. The pH value of N/10 NaOH solution is _______. **[1996]**
   (A) 12 (B) 13 (C) 10 (D) 11

4. The concentration of H^+ and concentration of OH^- of a 0.1 M aqueous solution of 2% ionized weak acid is _______.
   [Ionic product of water $= 1 \times 10^{-14}$] **[1999]**
   (A) 2×10^{-3} M and 5×10^{-12} M
   (B) 1×10^{3} M and 3×10^{-11} M
   (C) 0.02×10^{-3} M and 5×10^{-11} M
   (D) 3×10^{-2} M and 4×10^{-13} M

5. Which statement is INCORRECT about pH and H^+? **[2000]**
   (A) pH of neutral water is not zero.
   (B) Adding 1 N solution of CH_3COOH and 1 N solution of NaOH, pH will be seven.
   (C) $[H^+]$ of dilute and hot H_2SO_4 is more than concentrated and cold H_2SO_4.
   (D) Mixing solution of CH_3COOH and HCl, pH will be less than 7.

6. The hydrogen ion concentration of a 10^{-8} M HCl aqueous solution at 298 K ($K_w = 10^{-14}$) is ________. **[2006]**
   (A) 1.0×10^{-8} M (B) 1.0×10^{-6} M
   (C) 1.0525×10^{-7} M (D) 9.525×10^{-8} M

7. Calculate the pOH of a solution at 25°C that contains 1×10^{-10} M of hydronium ions, i.e., H_3O^+. **[2007]**
   (A) 4.000 (B) 9.000
   (C) 1.000 (D) 7.000

8. Equal volumes of three acid solutions of pH 3, 4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture? **[2008]**
   (A) 3.7×10^{-3} M (B) 1.11×10^{-3} M
   (C) 1.11×10^{-4} M (D) 3.7×10^{-4} M

9. Equimolar solutions of the following substances were prepared separately. Which one of these will record the highest pH value? **[2012]**
   (A) $BaCl_2$ (B) $AlCl_3$
   (C) LiCl (D) $BeCl_2$

10. What is the pH of the resulting solution when equal volumes of 0.1 M NaOH and 0.01 M HCl are mixed? **[Re-Test 2015]**
   (A) 7.0 (B) 1.04 (C) 12.65 (D) 2.0

11. Following solutions were prepared by mixing different volumes of NaOH and HCl of different concentrations:
    i. 60 mL $\frac{M}{10}$ HCl + 40 mL $\frac{M}{10}$ NaOH
    ii. 55 mL $\frac{M}{10}$ HCl + 45 mL $\frac{M}{10}$ NaOH
    iii. 75 mL $\frac{M}{5}$ HCl + 25 mL $\frac{M}{5}$ NaOH
    iv. 100 mL $\frac{M}{10}$ HCl + 100 mL $\frac{M}{10}$ NaOH

    pH of which one of them will be equal to 1? **[2018]**

    (A) ii. (B) i. (C) iv. (D) iii.

12. The pH of 0.01 M $NaOH_{(aq)}$ solution will be _______. **[Odisha 2019]**

    (A) 9 (B) 7.01 (C) 2 (D) 12

6.10 Hydrolysis of salts

1. 0.1 M solution of which one of these substances will act basic? **[1992]**
   (A) Sodium borate
   (B) Ammonium chloride
   (C) Calcium nitrate
   (D) Sodium sulphate

2. Which has the highest pH? **[2002]**
   (A) CH_3COOK (B) Na_2CO_3
   (D) NH_4Cl (D) $NaNO_3$

3. The rapid change of pH near the stoichiometric point of an acid-base titration is the basis of indicator detection. pH of the solution is related to ratio of the concentrations of the conjugate acid (HIn) and base (In^-) forms of the indicator by the expression _______. **[2004]**
   (A) $\log\frac{[In^-]}{[HIn]} = pK_{In} - pH$
   (B) $\log\frac{[HIn]}{[In^-]} = pH_{In} - pH$
   (C) $\log\frac{[HIn]}{[In^-]} = pH - pK_{In}$
   (D) $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$

4. The ionization constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is _______. **[2009]**
   (A) 6.50×10^{-12} (B) 5.65×10^{-13}
   (C) 5.65×10^{-12} (D) 5.65×10^{-10}

5. Which of the following salts will give the highest pH in water? **[2014]**
   (A) KCl (B) NaCl
   (C) Na_2CO_3 (D) $CuSO_4$

6. Which among the following salt solutions is basic in nature? **[Phase-II 2020]**
   (A) Sodium acetate
   (B) Ammonium chloride
   (C) Ammonium sulphate
   (D) Ammonium nitrate

7. The pK_b of dimethylamine and pK_a of acetic acid are 3.27 and 4.77 respectively at T (K). The CORRECT option for the pH of dimethylammonium acetate solution is _______. **[2021]**

   (A) 5.50 (B) 7.75 (C) 6.25 (D) 8.50

6.11 Buffer solutions

1. The pH value of blood does not appreciably change by a small addition of an acid or a base, because the blood _______. **[1995]**
   (A) can be easily coagulated
   (B) contains iron as a part of the molecule
   (C) is a body fluid
   (D) contains serum protein which acts as buffer

2. Solution of 0.1 N NH_4OH and 0.1 N NH_4Cl has pH 9.25. Then find out pK_b of NH_4OH. **[2002]**

   (A) 9.25 (B) 4.75 (C) 3.75 (D) 8.25

3. Which of the following pairs constitutes a buffer? **[2006]**
   (A) HCl and KCl
   (B) HNO_2 and $NaNO_2$
   (C) NaOH and NaCl
   (D) HNO_3 and NH_4NO_3

4. What is the $[OH^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $Ba(OH)_2$? **[2009]**
   (A) 0.40 M (B) 0.0050 M
   (C) 0.12 M (D) 0.10 M

5. In a buffer solution containing equal concentration of B^- and HB, the K_b for B^- is 10^{-10}. The pH of buffer solution is _______. **[2010]**

   (A) 10 (B) 7 (C) 6 (D) 4

6. A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5}, what is the pH of this solution? **[2011]**
   (A) 8.73 (B) 9.08
   (C) 9.43 (D) 11.72

7. Buffer solutions have constant acidity and alkalinity because _______. **[2012]**
(A) these give unionized acid or base on reaction with added acid or alkali
(B) acids and alkalies in these solutions are shielded from attack by other ions
(C) they have large excess of H^+ or OH^- ions
(D) they have fixed value of pH

8. Which one of the following pairs of solution is NOT an acidic buffer? **[Re-Test 2015]**
(A) H_2CO_3 and Na_2CO_3
(B) H_3PO_4 and Na_3PO_4
(C) $HClO_4$ and $NaClO_4$
(D) CH_3COOH and CH_3COONa

9. Which will make basic buffer? **[2019]**
(A) 100 mL of 0.1 M CH_3COOH + 100 mL of 0.1 M NaOH
(B) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH
(C) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH
(D) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH_3COOH

10. The pH of the solution containing 50 mL each of 0.10 M sodium acetate and 0.01 M acetic acid is _______.
[Given pK_a of CH_3COOH = 4.57] **[2022]**
(A) 4.57 (B) 2.57
(C) 5.57 (D) 3.57

11. An acidic buffer is prepared by mixing: **[Manipur 2023]**
(A) strong acid and its salt with strong base.
(B) strong acid and its salt with weak base.
(C) weak acid and its salt with strong base.
(D) equal volumes of equimolar solutions of weak acid and weak base. (The pK_a of acid = pK_b of the base)

6.12 Solubility product

1. Which one of the following is most soluble? **[1994]**
(A) Bi_2S_3 ($K_{sp} = 1 \times 10^{-70}$)
(B) Ag_2S ($K_{sp} = 6 \times 10^{-51}$)
(C) CuS ($K_{sp} = 8 \times 10^{-37}$)
(D) MnS ($K_{sp} = 7 \times 10^{-16}$)

2. The solubility product of CuS, Ag_2S and HgS are 10^{-31}, 10^{-44} and 10^{-54} respectively. The solubilities of these sulphides are in the order _______. **[1997]**
(A) HgS > Ag_2S > CuS
(B) CuS > Ag_2S > HgS
(C) Ag_2S > CuS > HgS
(D) AgS > HgS > CuS

3. The solubility of a saturated solution of calcium fluoride is 2×10^{-4} moles per litre. Its solubility product is _______. **[1999]**
(A) 22×10^{-11} (B) 14×10^{-4}
(C) 2×10^{-2} (D) 32×10^{-12}

4. Solubility of M_2S salt is 3.5×10^{-6} then find out solubility product. **[2001]**
(A) 1.7×10^{-6} (B) 1.7×10^{-16}
(C) 1.7×10^{-18} (D) 1.7×10^{-12}

5. Solubility of MX_2 type electrolytes is 0.5×10^{-4} mole/lit., then find out K_{sp} of electrolytes. **[2002]**
(A) 5×10^{-12} (B) 25×10^{-10}
(C) 1×10^{-13} (D) 5×10^{-13}

6. The solubility product of AgI at 25°C is 1.0×10^{-16} mol^2 L^{-2}. The solubility of AgI in 10^{-4} N solution of KI at 25 °C is approximately _______. (in mol L^{-1}) **[2003]**
(A) 1.0×10^{-16} (B) 1.0×10^{-12}
(C) 1.0×10^{-10} (D) 1.0×10^{-8}

7. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in moles/litres) is _______. **[2004]**
(A) 2×10^{-4} (B) 4×10^{-4}
(C) 5.6×10^{-6} (D) 3.1×10^{-4}

8. In qualitative analysis, the metals of group I can be separated from other ions by precipitating them as chloride salts. A solution initially contains Ag^+ and Pb^{2+} at a concentration of 0.10 M. Aqueous HCl is added to this solution until the Cl^- concentration is 0.10 M. What will the concentrations of Ag^+ and Pb^{2+} be at equilibrium?
(K_{sp} for AgCl = 1.8×10^{-10}, K_{sp} for $PbCl_2 = 1.7 \times 10^{-5}$) **[2011]**
(A) $[Ag^+] = 1.8 \times 10^{-7}$ M, $[Pb^{2+}] = 1.7 \times 10^{-6}$ M
(B) $[Ag^+] = 1.8 \times 10^{-11}$ M, $[Pb^{2+}] = 8.5 \times 10^{-5}$ M
(C) $[Ag^+] = 1.8 \times 10^{-9}$ M, $[Pb^{2+}] = 1.7 \times 10^{-3}$ M
(D) $[Ag^+] = 1.8 \times 10^{-11}$ M, $[Pb^{2+}] = 1.7 \times 10^{-4}$ M

9. pH of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product (K_{sp}) of $Ba(OH)_2$ is _______. **[2012, 2010]**
(A) 3.3×10^{-7} (B) 5.0×10^{-7}
(C) 4.0×10^{-6} (D) 5.0×10^{-6}

10. Identify the CORRECT order of solubility in aqueous solution. **[2013]**
(A) Na_2S > ZnS > CuS
(B) CuS > ZnS > Na_2S
(C) ZnS > Na_2S > CuS
(D) Na_2S > CuS > ZnS

11. Using the Gibb's energy change $\Delta G° = +63.3$ kJ, for the following reaction,

$$Ag_2CO_{3(s)} \rightleftharpoons 2Ag^{+}_{(aq)} + CO^{2-}_{3(aq)}$$

The K_{sp} of $Ag_2CO_{3(s)}$ in water at 25°C is _______. ($R = 8.314\ JK^{-1}\ mol^{-1}$) **[2014]**

(A) 3.2×10^{-26} (B) 8.0×10^{-12}
(C) 2.9×10^{-3} (D) 7.9×10^{-2}

12. The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are respectively, 1.1×10^{-12}, 1.8×10^{-10}, 5.0×10^{-13} and 8.3×10^{-17}. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, NaI and Na_2CrO_4? **[2015]**

(A) AgI (B) AgCl
(C) AgBr (D) Ag_2CrO_4

13. MY and NY_3, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be TRUE in regard to MY and NY_3? **[Phase-I 2016]**

(A) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water.
(B) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities.
(C) The molar solubilities of MY and NY_3 in water are identical.
(D) The molar solubility of MY in water is less than that of NY_3.

14. The solubility of $AgCl_{(s)}$ with solubility product 1.6×10^{-10} in 0.1 M NaCl solution would be _______. **[Phase-II 2016]**

(A) zero (B) 1.26×10^{-5} M
(C) 1.6×10^{-9} M (D) 1.6×10^{-11} M

15. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} mol L^{-1}. Solubility product of $Ag_2C_2O_4$ is _______. **[2017]**

(A) 2.42×10^{-8} (B) 2.66×10^{-12}
(C) 4.25×10^{-11} (D) 5.3×10^{-12}

16. The solubility of $BaSO_4$ in water is 2.42×10^{-3} g L^{-1} at 298 K. The value of its solubility product (K_{sp}) will be _______.
(Given : molar mass of $BaSO_4$ = 233 g mol^{-1}) **[2018]**

(A) 1.08×10^{-10} $mol^2\ L^{-2}$
(B) 1.08×10^{-12} $mol^2\ L^{-2}$
(C) 1.08×10^{-14} $mol^2\ L^{-2}$
(D) 1.08×10^{-8} $mol^2\ L^{-2}$

17. pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is _______. **[2019]**

(A) 0.25×10^{-10} (B) 0.125×10^{-15}
(C) 0.5×10^{-10} (D) 0.5×10^{-15}

18. Find out the solubility of $Ni(OH)_2$ in 0.1 M NaOH. Given that the ionic product of $Ni(OH)_2$ is 2×10^{-15}. **[Phase-I 2020]**

(A) 2×10^{-8} M (B) 1×10^{-13} M
(C) 1×10^{8} M (D) 2×10^{-13} M

19. The solubility product for a salt of the type AB is 4×10^{-8}. What is the molarity of its saturated solution? **[Phase-II 2020]**

(A) 4×10^{-4} mol/L (B) 2×10^{-4} mol/L
(C) 16×10^{-16} mol/L (D) 2×10^{-16} mol/L

6.13 Common ion effect

1. The solubility of AgCl will be minimum in _______. **[1995]**

(A) 0.01 M $CaCl_2$
(B) pure water
(C) 0.001 M $AgNO_3$
(D) 0.01 M NaCl

2. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because _______. **[2005]**

(A) presence of HCl decreases the sulphide ion concentration
(B) solubility product of group II sulphides is more than that of group IV sulphides
(C) presence of HCl increases the sulphide ion concentration
(D) sulphides of group IV cations are unstable in HCl.

3. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be _______. **[Phase-I 2016]**

(A) unchanged (B) doubled
(C) faster (D) slower

4. The molar solubility of CaF_2 ($K_{sp} = 5.3 \times 10^{-11}$) in 0.1 M solution of NaF will be _______. **[Odisha 2019]**

(A) 5.3×10^{-10} mol L^{-1}
(B) 5.3×10^{-11} mol L^{-1}
(C) 5.3×10^{-8} mol L^{-1}
(D) 5.3×10^{-9} mol L^{-1}

5. HCl was passed through a solution of $CaCl_2$, $MgCl_2$ and NaCl. Which of the following compound(s) crystallise(s)? **[Phase-I 2020]**

(A) Only NaCl
(B) Only $MgCl_2$
(C) NaCl, $MgCl_2$ and $CaCl_2$
(D) Both $MgCl_2$ and $CaCl_2$

Answers & Solutions

Std. XI

1. Some Basic Concepts of Chemistry

1.1 Units of measurement

1. **(B)**

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. **(D)**

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. **(A)**

Average atomic mass

$= \frac{\text{Sum of (Isotopic mass} \times \text{its abundance)}}{100}$

Average atomic mass $= \frac{(19 \times 10) + (81 \times 11)}{100}$

$= 10.81 \approx 10.8$

2. **(D)**

Average atomic mass

$= \frac{\text{Sum of (Isotopic mass} \times \text{its abundance)}}{100}$

Average isotopic mass of X

$= \frac{(200 \times 90) + (199 \times 8) + (202 \times 2)}{100}$

= 200 a.m.u.

1.4 Mole concept and molar mass

1. **(D)**

At NTP,

1 mol N_2O = 22400 cc N_2O = 6.02×10^{23} N_2O molecules

$\therefore$ 1 cc of $N_2O = \frac{6.02 \times 10^{23}}{22400}$ molecules

Each N_2O molecule contains 3 atoms,

Hence,

$\therefore$ 1 cc $N_2O = \frac{3 \times 6.02 \times 10^{23}}{22400} = \frac{1.8 \times 10^{22}}{22400}$

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

$= \frac{6.02 \times 10^{23}}{22400} \times 22 = \frac{1.32}{224} \times 10^{23}$ electrons

2. **(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

$= 0.1 \times 2 \times N_A$

$= 0.2 \times 6.022 \times 10^{23}$

$= 1.20 \times 10^{23}$

3. **(C)**

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. **(D)**

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

$\because$ 22400 mL = 1 mole

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

5. **(B)**

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

$= \frac{\text{Mass of certain volume of vapour}}{\text{Mass of same volume of hydrogen}}$

$= \frac{0.24}{4.005 \times 10^{-3}} = 59.93$

1 Which of the following temperature will read the same value on Celsius and Fahrenheit scales?

(A) – 40°

(B) + 40°

(C) – 80°

(D) – 20°

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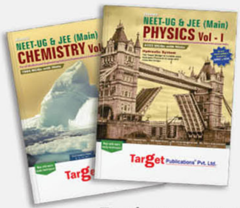

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