

Chapter wise Topic wise Solved Paper From (2014 - 2023)

**PREVIOUS YEAR
QUESTION
PAPERS**

CHEMISTRY

CLASS 12

Chapter 1

Solutions

1. WAYS TO EXPRESS CONCENTRATION OF SOLUTIONS

Objective Qs [1 mark]

1. Which of the following is an example of a solid solution?
(a) Sea water
(b) Sugar solution
(c) Smoke
(d) 22 carat gold

[CBSE SQP Term-1 2021]

Question No. 2 and 3 consist of two statements Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.
2. Assertion (A): Molarity of a solution changes with temperature.
Reason (R): Molarity is a colligative property.

[CBSE SQP Term-1 2021]

3. Assertion (A): Molality of a solution changes with temperature.
Reason (R): Volume of a solution changes with temperature.

[Delhi Gov. SQP Term-1 2021]

Very Short & Short Qs 1 - 3 marks

4. Define the following term: Molality (m)
[CBSE 2017, 14]
5. Define the following term:

Mole fraction

[CBSE 2014]

6. (A) What do you understand by a binary aqueous solution?

(B) Define the following term: Molarity (M)

[CBSE 2014]

7. Differentiate between molarity and molality of a solution. How can we change molality value of a solution into molarity value?

[CBSE 2014]

8. Calculate the molarity of 9.8%(w/w) solution of H_2SO_4 if the density of the solution is 1.02 g mL^{-1} .

(Molar mass of H_2SO_4 is 98 g mol^{-1})

[CBSE 2014]

9. A solution of glucose (molar mass = 180 g mol^{-1}) in water is labelled as 10% (by mass). What would be the molality and molarity of the solution?

(Density of solution = 1.2 g mL^{-1}).

[CBSE 2014]

2. SOLUBILITY AND VAPOUR PRESSURE

Objective Qs [1 mark]

10. Solubility of gases in liquids decreases with rise in temperature because dissolution is an: (a) endothermic and reversible process

(b) exothermic and reversible process

(c) endothermic and irreversible process

(d) exothermic and irreversible process.

[CBSE SQP Term-1 2021]

11. On mixing 20 mL of acetone with 30 mL of chloroform, the total volume of the solution is:

(a) $< 50 \text{ mL}$

(b) $= 50 \text{ mL}$

(c) > 50 mL

(d) = 10 mL

[CBSE Term-1 2021]

12. An azeotropic solution of two liquids has a boiling point lower than either of the two when it:

(a) shows a positive deviation from Raoult's law.

(b) shows a negative deviation from Raoult's law.

(c) shows no deviation from Raoult's law.

(d) is saturated.

[CBSE Term-1 2021]

13. Which one of the following pairs will form an ideal solution?

(a) Chloroform and acetone

(b) Ethanol and acetone

(c) *n*-hexane and *n*-heptane

(d) Phenol and aniline [CBSE Term-1 2021]

14. Match the following:

Column I	Column II
(i) Constant boiling solution	(A) $\Delta_{\text{mix}}H > 0$
(ii) Minimum boiling azeotrope	(B) $\text{C}_2\text{H}_5\text{OH}$ (95.4%) + H_2O (4.6%)
(iii) $\text{C}_6\text{H}_6 + \text{C}_6\text{H}_5\text{CH}_3$	(C) $\text{CHCl}_3 + (\text{CH}_3)_2\text{CO}$
(iv) Solute-Solvent interactions are H-bonds	(D) $\Delta_{\text{mix}}H \approx 0$

Which of the following is the best matched options?

(a) (i) - (B), (ii) - (A), (iii) - (D), (iv) - (C)

(b) (i) - (C), (ii) - (B), (iii) - (D), (iv) - (A)

(c) (i) - (B), (ii) - (A), (iii) - (D), (v) - (C)

(d) (i) - (B), (ii) - (D), (iii) - (A), (v) - (C)

[CBSE Term-1 2021]

15. An unknown gas 'X' is dissolved in water at 2.5 bar pressure and has mole fraction 0.04 in solution. The mole fraction of 'X' gas when the pressure of gas is doubled at the same temperature is:
- (a) 0.08
 - (b) 0.04
 - (c) 0.02
 - (d) 0.92

[CBSE Term-1 2021]

16. Which of the following formula represents Raoult's law for a solution containing nonvolatile solute?

- (a) $P_{\text{solute}} = P_{\text{solute}}^{\circ} \cdot X_{\text{solute}}$
- (b) $P = K_H \cdot X$
- (c) $P_{\text{Total}} = P_{\text{Solvent}}$
- (d) $P_{\text{solute}} = P_{\text{solvent}}^{\circ} \cdot X_{\text{solvent}}$

[CBSE Term-1 2021]

Very Short & Short Qs [1 -3 marks]

17. (A) What type of deviation from Raoult's Law is expected when phenol and aniline are mixed with each other? What change in the net volume of the mixture is expected? Graphically represent the deviation.
- (B) The vapour pressure of pure water at a certain temperature is 23.80 mmHg. If 1 mole of a non-volatile non-electrolytic solute is dissolved in 100 g water, Calculate the resultant vapour pressure of the solution.

[CBSE SQP 2023]

18. The vapour pressure of pure liquid X and pure liquid Y at 25°C are 120 mmHg and 160 mm Hg respectively. If equal moles of X and Y are mixed to form an ideal solution, calculate the vapour pressure of the solution.

[CBSE 2023]

19. Answer the following questions:

- (A) State Henry's law and explain why are the tanks used by scuba divers filled with air diluted with helium (11.7% helium, 56.2% nitrogen and 32.1% oxygen)?
- (B) Assume that argon exerts a partial pressure of 6 bar. Calculate the solubility of argon gas in water. (Given: Henry's Law constant for Argon dissolved in water, $K_H = 40\text{kbar}$)

[CBSE SQP 2022]

20. State Raoult's law for the solution containing volatile components. What is the similarity between Raoult's law and Henry's law?

[CBSE 2020]

21. State Henry's law. Calculate the solubility of CO₂ in water at 298 K under 760mmHg.

(K_H for CO₂ in water at 298 K is 1.25×10^6 mmHg)

[CBSE 2020]

22. Identify which liquid will have a higher vapour pressure at 90°C if the boiling points of two liquids *A* and *B* are 140°C and 180°C, respectively.

[CBSE 2020]

23. What happens when acetone is added to pure ethanol?

[CBSE 2020]

24. Give reasons for the following:

(A) Aquatic species are more comfortable in cold water than in warm water.

(B) At higher altitudes people suffer from anoxia resulting in inability to think.

[CBSE 2019]

25. Write two differences between ideal solutions and non-ideal solutions.

[CBSE 2019, 17]

26. What type of azeotropic mixture will be formed by a solution of acetone and chloroform? Justify on the basis of strength of intermolecular interactions that develop in the solution.

[CBSE 2019]

27. Give reason for the following.

Aquatic animals are more comfortable in cold water than in warm water. [CBSE 2018]

28. "The main application of Henry's law in respiratory physiology is to predict how gases will dissolve in the alveoli and bloodstream during gas exchange. The partial pressure of oxygen is greater in alveolar air than in deoxygenated blood, so oxygen has a high tendency to dissolve into deoxygenated blood."

State Henry's law about partial pressure of a gas in a mixture.

[CBSE 2017]

29. In non-ideal solution, what type of deviation shows the formation of maximum boiling azeotropes?

[CBSE 2016]

30. Gas (A) is more soluble in water than gas (B) at the same temperature. Which one of the two gases will have the higher value of K_H (Henry's constant) and why? [CBSE 2016]
31. What is meant by positive deviations from Raoult's law? Give an example. What is the sign of $\Delta_{\text{mix}} H$ for positive deviation?

[CBSE 2015]

32. Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law? Give an example.

[CBSE 2015]

33. Define Raoult's law.

[CBSE 2014]

34. Define the following terms: Azeotropes

[CBSE 2014]

35. What type of deviation is shown by a mixture of ethanol and acetone? Give reason.

[CBSE 2014]

3. COLLIGATIVE PROPERTIES

Objective Qs [1 mark]

36. An azeotropic mixture of two liquids will have a boiling point lower than either of the two liquids when it:
- (a) shows a negative deviation from Raoult's law
 - (b) forms an ideal solution
 - (c) shows a positive deviation from Raoult's law
 - (d) is saturated

[CBSE 2023]

37. In which of the following cases blood cells will shrink?

- (a) When placed in water containing more than 0.9% (mass/ volume) NaCl solution.
- (b) When placed in water containing less than 0.9% (mass /volume) NaCl solution.

(c) When placed in water containing 0.9% (mass/volume) NaCl solution.

(d) When placed in distilled water.

[CBSE SQP Term-1 2021]

38. How much ethyl alcohol must be added to 1 litre of water so that the solution will freeze at -14°C ? (K_f for water = $1.86^{\circ}\text{C}/\text{mol}$)

- (a) 7.5 mol
- (b) 8.5 mol
- (c) 9.5 mol
- (d) 10.5 mol

[CBSE SQP Term-1 2021]

39. A 5% solution of cane sugar (molar mass = 342) is isotonic with 1% solution of a substance X. The molar mass of X is:

- (a) 171.2 g mol^{-1}
- (b) 68.4 g mol^{-1}
- (c) 34.2 g mol^{-1}
- (d) 136.2 g mol^{-1}

[Delhi Gov. SQP Term-1 2021]

40. The boiling point of a 0.2 m solution of a non-electrolyte in water is (K_b for water = $0.52 \text{ K kg mol}^{-1}$):

- (a) 100°C
- (b) 100.52°C
- (c) 100.104°C
- (d) 100.26°C

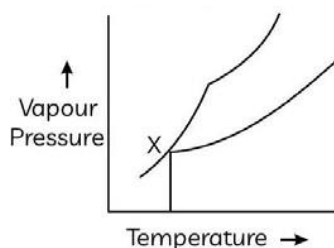
[CBSE Term-1 2021]

41. The osmotic pressure of a solution containing 0.3 mol of solute per litre at Temperature T is:

- (a) $0.3RT$
- (b) $0.03RT$
- (c) $0.003RT$
- (d) $3RT$

[Delhi Gov. SQP Term-1 2021]

42. In the following diagram point, 'X' represents:



- (a) Boiling point of solution
- (b) Freezing point of solvent
- (c) Boiling point of solvent
- (d) Freezing point of solution

[CBSE Term-1 2021]

43. Water retention or puffiness due to high salt intake occurs due to:

- (a) diffusion
- (b) vapour pressure difference
- (c) osmosis
- (d) reverse osmosis

[CBSE SQP Term-1 2021]

In the following question (Q. No. 44-46) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

44. Assertion (A): Elevation in boiling point is a colligative property.

Reason (R): The lowering of vapour pressure of solution causes elevation in boiling point.

[CBSE 2023]

45. Assertion (A): Osmotic pressure is a colligative property.

Reason (R): Osmotic pressure is directly proportional to molarity.

[CBSE 2023]

46. Assertion (A): Cryoscopic constant depends on nature of solvent.

Reason (R): Cryoscopic constant is a universal constant.

[CBSE SQP Term-1 2021]

Case Based Qs [4 - 5 marks]

Read the following passages and answer the questions that follow:

47. Henna is investigating the melting point of different salt solutions.

She makes a salt solution using 10 mL of water with a known mass of NaCl salt.

She puts the salt solution into a freezer and leaves it to freeze.

She takes the frozen salt solution out of the freezer and measures the temperature when the frozen salt solution melts.

She repeats each experiment.

S.No	Mass of the salt used in g	Melting point in °C	
		Readings Set 1	Reading Set 2
1	0.3	-1.9	-1.9
2	0.4	-2.5	-2.6
3	0.5	-3.0	-5.5
4	0.6	-3.8	-3.8
5	0.8	-5.1	-5.0
6	1.0	-6.4	-6.3

Assuming the melting point of pure water as 0°C, answer the following questions:

(A) One temperature in the second set of results does not fit the pattern. Which temperature is that? Justify your answer.

(B) Why did Henna collect two sets of results?

(C) In place of NaCl, if Henna had used glucose, what would have been the melting point of the solution with 0.6 g glucose in it?

OR

(C) What is the predicted melting point if 1.2 g of salt is added to 10ml of water? Justify your answer.

[CBSE SQP 2022]

48. Boiling point or freezing point of liquid solution would be affected by the dissolved solids in the liquid phase. A soluble solid in solution has the effect of raising its boiling point and depressing its freezing point. The addition of non-volatile substances to a solvent decreases the vapor pressure and

the added solute particles affect the formation of pure solvent crystals. According to many researches the decrease in freezing point directly correlated to the concentration of solutes dissolved in the solvent. This phenomenon is expressed as freezing point depression and it is useful for several applications such as freeze concentration of liquid food and to find the molar mass of an unknown solute in the solution. Freeze concentration is a high quality liquid food concentration method where water is removed by forming ice crystals. This is done by cooling the liquid food below the freezing point of the solution. The freezing point depression is referred as a colligative property and it is proportional to the molar concentration of the solution (m), along with vapor pressure lowering, boiling point elevation, and osmotic pressure. These are physical characteristics of solutions that depend only on the identity of the solvent and the concentration of the solute. The characters are not depending on the solute's identity.

(A) When a non volatile solid is added to pure water it will:

- (a) boil above 100°C and freeze above 0°C
- (b) boil below 100°C and freeze above 0°C
- (c) boil above 100°C and freeze below 0°C
- (d) boil below 100°C and freeze below 0°C

(B) Colligative properties are:

- (a) dependent only on the concentration of the solute and independent of the solvent's and solute's identity.
- (b) dependent only on the identity of the solute and the concentration of the solute and independent of the solvent's identity.
- (c) dependent on the identity of the solvent and solute and not on the concentration of the solute.
- (d) dependent only on the identity of the solvent and the concentration of the solute and independent of the solute's identity.

(C) Assume three samples of juices A, B and C have glucose as the only sugar present in them. The concentration of sample A, B and C are 0.1M, 0.5M and 0.2M respectively. Freezing point will be highest for the fruit juice:

- (a) A
- (b) B
- (c) C
- (d) All have same freezing point

(D) Elevation of boiling point is inversely proportional to: (a) molal elevation constant (K_b)

(b) molality (m)

(c) molar mass of solute (M)

(d) weight of solute (W)

[CBSE Term-1 2021]

\section*{

Very Short & Short Qs	1 -3 marks
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Very Short & Short Qs [1 – 3 marks]

49. (A) What is the effect of temperature on the solubility of glucose in water?

(B) Ibrahim collected a 10 mL each of fresh water and ocean water. He observed that one sample labeled " P " froze at 0°C while the other " Q " at -1.3°C . Ibrahim forgot which of the two, "P" or "Q" was ocean water. Help him identify which container contains ocean water, giving rationalization for your answer.

[CBSE SQP 2023]

50. When 19.5 g of $\text{F} - \text{CH}_2 - \text{COOH}$ (Molar mass = 78 g mol^{-1}), is dissolved in 500 g of water, the depression in freezing point is observed to be 1°C . Calculate the degree of dissociation of $\text{F} - \text{CH}_2 - \text{COOH}$.

[Given: K_f for water = $1.86 \text{ K kg mol}^{-1}$]

[CBSE 2023]

51. Calculate the mass of ascorbic acid (Molar mass = 176 g mol^{-1}) to be dissolved in 75 g of acetic acid, to lower its freezing point by 1.5°C . $\diamond K_f = 3.9 \text{ K kg mol}^{-1} \diamond$

[CBSE 2020]

52. For a 5% solution of urea (Molar mass = 60 g/mol), calculate the osmotic pressure at 300 K. [$R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$]

[CBSE 2020]

53. What happens when a pressure greater than the osmotic pressure is applied on the solution side separated from solvent by a semipermeable membrane?

[CBSE 2020]

54. Define the following term: Osmotic pressure

[CBSE 2017]

55. Define the following term: Colligative properties

[CBSE 2017]

56. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if freezing point of pure water is 273.15 K.

(Given: molar mass of sucrose = 342 g mol^{-1} , molar mass of glucose = 180 g mol^{-1})

[CBSE 2017]

57. Calculate the boiling point elevation for a solution prepared by adding 10 g of CaCl_2 to 200 g of water. (K_b for water = $0.512 \text{ K kg mol}^{-1}$, Molar mass of CaCl_2 = 111 g mol^{-1})

[CBSE 2017, 14]

58. Blood cells are isotonic with 0.9% sodium chloride solution. What happens if we place blood cells in a solution containing:

(A) 1.2% sodium chloride solution?

(B) 0.4% sodium chloride solution?

[CBSE 2016]

59. Derive the relationship between relative lowering of vapour pressure and molar mass of the solute.

[CBSE 2015]

60. Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K $\diamond K_f = 5.12 \text{ K kg mol}^{-1}$.

[CBSE 2014]

61. A solution containing 15 g urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution.

[CBSE 2014]

62. How is the vapour pressure of a solvent affected when a non-volatile solute is dissolved in it?

[CBSE 2014]

63. What are isotonic solutions?

[CBSE 2014]

64. Define the following term: Molal elevation constant (K_b)

[CBSE 2014]

4. ABNORMAL MOLECULAR MASS

Objective Qs [1 mark]

65. 0.5M aqueous solution of glucose is isotonic with:

- (a) 0.5MKCl solution
- (b) 0.5M CaCl_2 solution
- (c) 0.5M urea solution
- (d) 1M solution of sucrose

[Delhi Gov. SQP Term-1 2021]

66. Which pair of solutions is isotonic at same temperature?

- (a) 0.1M urea and 0.1MNaCl
- (b) 0.1MNaCl and 0.1M Na_2SO_4
- (c) 0.1M urea and 0.2MMgCl₂
- (d) 0.1M Na_2SO_4 and 0.1M $\text{Ca}(\text{NO}_3)_2$

[Delhi Gov. SQP Term-1 2021]

Very Short & Short Qs [1 - 3 marks]

67. A 5% solution of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ ($M \cdot W = 322 \text{ g}$) is isotonic with 2% solution of nonelectrolytic, non volatile substance X. Find out the molecular weight of X.

[CBSE SQP 2023]

68. Calculate Van't Hoff factor for an aqueous solution of $\text{K}_3[\text{Fe}(\text{CN})_6]$ if the degree of dissociation (α) is 0.852. What will be boiling point of this solution if its concentration is 1 molal? ($K_b = 0.52 \text{ K kg/mol}$)

[CBSE SQP 2023]

69. The freezing point of a solution containing 5 g of benzoic acid ($M = 122 \text{ g mol}^{-1}$) in 35 g of benzene is depressed by 2.94 K. What is the percentage association of benzoic acid if it forms a dimer in solution? [K_f for benzene = $4.9 \text{ K kg mol}^{-1}$]

70. Define the following term:

Abnormal molar mass

[CBSE 2020]

71. Define the following term:

Van't Hoff factor

[CBSE 2017, 12]

72. Calculate the boiling point of solution when 4 g of MgSO_4 ($M = 120 \text{ g mol}^{-1}$) was dissolved in 100 g of water, assuming MgSO_4 undergoes complete ionisation. [CBSE 2016]

73. Calculate the freezing point of solution when 1.9 g of MgCl_2 ($M = 95 \text{ g mol}^{-1}$) was dissolved in 50 g of water, assuming MgCl_2 undergoes complete ionization. (K_f for water = $1.86 \text{ K kg mol}^{-1}$)

[CBSE 2016]

74. When 2.56 g of sulphur was dissolved in 100 g of CS_2 , the freezing point lowered by 0.383 K. Calculate the formula of sulphur (S_x). [K_f for $\text{CS}_2 = 3.83 \text{ K kg mol}^{-1}$, Atomic mass of sulphur = 32 g mol^{-1}]

[CBSE 2016]

75. 3.9 g of benzoic acid dissolved in 49 g of benzen shows a depression in freezing point of 1.62 K. Calculate the Van't Hoff factor and predict the nature of solute (associated or dissociated).

(Given: Molar mass of benzoic acid = 122 g mol^{-1} , K_f for benzene = $4.9 \text{ K kg mol}^{-1}$)

[CBSE 2015]

76. Calculate the mass of NaCl (molar mass = 58.5 g mol^{-1}) to be dissolved in 37.2 g of water to lower the freezing point by 2°C assuming that NaCl undergoes complete dissociation.

(K_f for water = $1.86 \text{ K kg mol}^{-1}$)

[CBSE 2015]

PYQ
WITH SOLUTIONS
CHEMISTRY
CLASS 12

Chapter-1

SOLUTIONS

1. WAYS TO EXPRESS CONCENTRATION OF SOLUTIONS

1. (d) 22 carat gold

Explanation: Gold is an alloy so it is a solid in solid solution. A solid solution is a uniform mixture of two crystalline solids that share a common crystal lattice. Among the given options, 22 carat gold is an example of solid solutions.

2. (c) (A) is true but (R) is false.

Explanation: Molarity is a means to express concentration. It is not a physical property. Molarity depends on temperature but molarity is not a colligative property.

3. (d) (A) is false but (R) is true.

Explanation: Molality = $\frac{\text{Moles of solute}}{\text{Mass of solvent (kg)}}$

As molality has only mass terms thus it does not depend on temperature.

4. Molality (m) is defined as the number of moles of the solute per kilogram (kg) of the solvent and is expressed as:

$$\text{Molality } (m) = \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$$

5. Commonly used symbol for mole fraction is X and subscript used on the right hand side of X denotes the component. It is defined as:

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

6. (A) Binary solution means solution containing two components solute and solvent as it is aqueous solution hence solvent is water.

Thus, binary aqueous solution contains solute and water as its components.

(B) Molarity (M) is defined as number of moles of solute dissolved in one litre (or one cubic decimeter) of solution.

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution in litre}}$$

- 7.

Molarity	Molality
Number of moles of solute dissolved in one litre solution is called molarity.	Number of moles of solute dissolved in one kg solvent is called molality.
$M = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litre}}$	$m = \frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$
Molarity depends on temperature as volume depends on temperature. Molarity decreases with rise in temperature.	Molality is independent of temperature as mass does not change with temperature.

If M_g is the molar mass of solute, d is the density of solution then molality (m) of a solutions can be converted to molarity (M) by using the formula

$$M = \frac{1000 \times d}{m + M_g}$$

8. Mass of solute = 9.8 g

Mass of solution = 100 g

Density of solution = 1.02 g mL⁻¹

∴ Volume of solution

$$\begin{aligned}
 &= \frac{\text{Mass of solution}}{\text{Density of solution}} \\
 &= \frac{100 \text{ g}}{1.02 \text{ g mL}^{-1}} \\
 &= 98.039 \text{ mL} = 0.098 \text{ L}
 \end{aligned}$$

Number of moles of solute,

$$\begin{aligned}
 n &= \frac{9.8}{98} = 0.1 \text{ mol} \\
 \text{Molarity} &= \frac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}} \\
 &= \frac{0.1 \text{ mol}}{0.098 \text{ L}} = 1.02 \text{ M}
 \end{aligned}$$

9. Given: Mass of solute, $W_2 = 10 \text{ g}$

Mass of solvent,

$$W_1 = 90 \text{ g}$$

Molar mass of solute,

$$M_2 = 180 \text{ g mol}^{-1}$$

Density of solution = 1.2 g mL^{-1}

(i)

$$\begin{aligned} \text{Molality} &= \frac{W_2 \times 1000}{M_2 \times W_1} \\ &= \frac{10 \times 1000}{180 \times 90} \\ &= 0.62 \text{ m} \end{aligned}$$

(ii) Volume of solution

$$\begin{aligned} &= \frac{\text{mass}}{\text{density}} \\ &= \frac{100 \text{ g}}{1.2 \text{ g mL}^{-1}} \\ \text{Molarity} &= \frac{W_2 \times 1000}{M_2 \times V} \\ M &= \frac{10 \times 1000}{180 \times \frac{100}{1.2}} \\ &= \frac{10 \times 1000 \times 1.2}{180 \times 100} = 0.67 \text{ M} \end{aligned}$$

2. SOLUBILITY AND VAPOUR PRESSURE

10. (b) exothermic and reversible process

Explanation: Solubility of gases in liquids decreases with rise in temperature. As dissolution is an exothermic and reversible process hence according to Le Chatelier's principle, solubility of gases in liquids decreases with rise in temperature.

11. (a) $< 50 \text{ mL}$

Explanation: Acetone and chloroform form a solution showing negative deviation from ideal behaviour due to intermolecular H - bonding between the two. So, volume after mixing decreases.

12. (a) shows a positive deviation from Raoult's law.

Explanation: Interactions are weaker after mixing the two liquids so vapour pressure increases that decreases the boiling point and forms minimum boiling point azeotrope.

13. (c) n-hexane and n-heptane

Explanation: n-hexane and n-heptane have almost similar intermolecular forces so interactions after mixing remain same so these form an ideal solution.

14. (a) (i) - (B), (ii) - (A), (iii) - (D), (iv) - (C)

15. (a) 0.08

Explanation: Mole fraction of gas in the solution is proportional to the partial pressure of the gas.

$$\begin{aligned} \text{Or} \quad & \frac{X}{P} \propto P \\ \text{Or,} \quad & \frac{P_1}{X_1} = \frac{P_2}{X_2} \end{aligned}$$

Where,

X_1 = Initial mole fraction of gas

P_1 = Partial pressure of gas

X_2 = Final mole fraction of gas

P_2 = Final partial pressure of gas

∴ Here only one gas

∴ Partial pressure of gas = Pressure of gas.

Therefore,

$$\begin{aligned} \frac{0.04}{2.5} &= \frac{x_2}{2 \times (2.5)} \\ \Rightarrow x_2 &= \frac{0.04 \times 2 \times 2.5}{2.5} \\ \Rightarrow x_2 &= 0.08 \end{aligned}$$

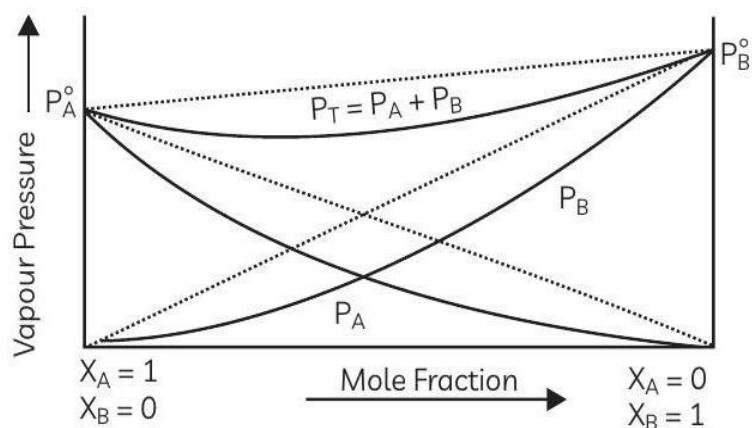
16. (c) $P_{\text{Total}} = P_{\text{Solvent}}$

Explanation: When a non-volatile solute is added to the volatile liquid, then partial pressure of solution is only due to volatile component.

So,

$$P_{\text{Total}} = P_{\text{Solvent}}$$

17. (A) Negative deviation is expected when phenol and aniline are mixed with each other. The net volume of the mixture will decrease, $\Delta V < 0$ due to stronger intermolecular interactions.



P-X Diagram for solutions showing Negative Deviation from Raoult's Law

- (B) Relative lowering of vapour pressure

$$\begin{aligned} X_2 &= \frac{(P^\circ - P)}{P^\circ} = X_2 \\ X_2 &= \frac{n_2}{n_1} \\ n_2 &= \frac{0.1}{100} \\ n_1 &= \frac{0.1}{18} \\ X_2 &= \frac{0.1}{5.55 + 0.1} \\ &= \frac{0.1}{5.65} = 0.018 \\ P^\circ &= 23.8 \text{ mmHg} \end{aligned}$$

Relative lowering of vapour pressure

$$\begin{aligned} &= \frac{(23.80 - P)}{23.80} = 0.018 \\ 23.80 - P &= 0.428 \\ P &= 23.80 - 0.428 \\ &= 23.37 \text{ mmHg} \end{aligned}$$

18. $P_X^0 = 120 \text{ mmHg}$, $P_F^0 = 160 \text{ mmHg}$ $n_X = n_F$ (given)

So, Mole fraction of X $X = \frac{n_x}{n_x + n_y} = \frac{n_x}{2n_x} = \frac{1}{2}$

$$\text{Mole fraction of } Y(X) = \frac{n_y}{n_x + n_y} = \frac{n_y}{2n_y} = \frac{1}{2}$$

According to Raoult's law,

$$\begin{aligned} \frac{P_A}{P_X} &= \frac{P_A^0 X_A}{P_X^0 X_X} \text{ and } P_F = P_F^0 X_F \\ P_X &= 120 \times \frac{1}{2} \text{ and } P_F = 160 \times \frac{1}{2} \\ \text{So, } P_X &= 60 \text{ mmHg and } P_F = 80 \text{ mmHg} \\ P_{\text{Total}} &= P_X + P_F \\ &= (60 + 80) \text{ mmHg} \\ &= 140 \text{ mm Hg} \end{aligned}$$

19. (A) Henry's law: The partial pressure of the gas in vapour phase (P) is proportional to the mole fraction of the gas (X) in the solution. The pressure underwater is high, so the solubility of gases in blood increases. When the diver comes to surface the pressure decreases so does the solubility causing bubbles of nitrogen in blood, to avoid this situation and maintain the same partial pressure of nitrogen underwater too, the dilution is done.

$$(B) P = K_H X$$

Mole fraction of Argon in water

$$\begin{aligned} X &= \frac{P}{K_H} \\ &= \frac{6}{40 \times 10^3} = 1.5 \times 10^{-4} \end{aligned}$$

20. Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction.

Thus, if there is a solution of two liquid components (1 and 2), then for component 1:

For components 2:

$$p_1 = p_1^0 X_1$$

$$p_2 = p_2^0 X_2$$

Here:

p_1, p_2 = Partial vapour pressure of two volatile components (1 and 2) of the solution

p_1^0, p_2^0 = Vapour pressure of pure components (1 and 2)

X_1, X_2 = Mole fractions of the components (1 and 2)

Similarity between Raoult's law and Henry's law:

According to both rules, partial pressure of the volatile component or gas is directly proportional to its mole fraction in the solution.

21. Henry's law: This law states that the partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.

i.e.,

$$P \propto X$$

X = mole fraction of gas

$$P = K_H X$$

K_H = Henry's constant

It can also be given in terms of solubility.

$$\text{Solubility} = \frac{P}{K_H}$$

$$\begin{aligned} \text{For CO}_2; \text{ solubility} &= \frac{760}{1.25 \times 10^6} \\ &= 6.08 \times 10^{-4} \end{aligned}$$

22. Those liquids which have lower boiling point will vapourise first and have higher vapour pressure. Hence, liquid A will have a high vapour pressure.
23. A mixture of ethanol and acetone shows the positive deviation from the Raoult's law. The vapour pressure of such a solution is higher than that predicted by Raoult's law due to weak intermolecular interactions between ethanol and acetone, the solution exhibits positive deviation.
24. (A) Solubility of gases in liquid decreases on increasing the temperature. Hence the availability of dissolved oxygen in water is more at lower temperatures hence; the aquatic animals feel more comfortable at lower temperatures than at the higher temperatures because oxygen is more soluble in cold water or at low temperature.
- (B) At the higher altitudes, the partial pressure of oxygen is less than at the ground level, thus the concentration of the oxygen in the blood decrease in the tissues thus at the higher altitudes people suffer more from anoxia resulting in the inability to think.
25. The difference between ideal and non-ideal solutions are as follows:

Ideal solution	Non-ideal solution
It obeys Raoult's law to the furthest extent possible.	Does not obey Raoult's law.
The molecular attractions between solute and solvent particles are the same as that between solvent-solvent particles.	The molecular attraction is different between solute-solvent particles and the between solvent-solvent particles.
The proportion of solvent particles that change into their vapour forms remains unchanged even when solute particles are added.	The vapour pressure of solvent significantly decreases when solute particles are added to the solvent.
The liquid and vapour form of the solvent always remain in a dynamic equilibrium.	The equilibrium is quite disturbed because of the various forces of nature at play.

(Any two)

26. When mixture of chloroform and acetone are mixed it shows negative deviation from Raoult's law because hydrogen bonding between acetone and chloroform reduces the possibility of molecules of the mixture escaping which leads to a decrease in vapour pressure.
27. Cold water is more comfortable for aquatic species than warm water. This is because a reduction in temperature causes oxygen to become more soluble in water. Cold water has more dissolved oxygen per unit volume than warm water. Hence, aquatic species can breathe easily in cold water but struggle to do so in warm water.
28. The mole fraction of a gas in the solution is directly proportional to the partial pressure of the gas over the solution.

$$\text{i.e., } P \propto X$$

$$P = K_H \cdot X$$

Where P = partial pressure of the gas

X = mole fraction of the gas

K_H = Henry's law constant

29. Negative deviation from Raoult's law shows the formation of maximum boiling azeotropes.

30. The solubility of a gas in a liquid depends on various factors like temperature, the partial pressure of the gas over the liquid, the nature of the solvent and the nature of the gas. By Henry's law, solubility of a gas is inversely proportional to Henry's constant for that gas. So, gas (B) will show a higher K_H value as it is less soluble.
31. Positive deviation from Raoult's law means that the observed vapour pressure is greater than expected value. Example- The mixture of ethanol and acetone shows a positive deviation. Heat absorption occurs when solutions have positive deviation, hence $\Delta_{\text{mix}} H$ has a positive (+) sign.
32. Azeotropes are binary solution mixtures with same chemical composition in the liquid and vapour phases and have constant boiling points throughout distillation.
- A minimum boiling azeotrope is formed by solution showing a large positive deviation from Raoult's law. Example: An ethanol-water mixture containing approximately 95% ethanol by volume.
33. According to Raoult's law the vapour pressure of volatile component A in a given solution is given by $P_A = P_A^0 X_A$ hence, vapour pressure of A is proportional to the mole fraction of A .
34. Azeotropes are binary mixtures which have the same composition in liquid and vapour phase and boil at a constant temperature.
35. Raoult's law deviates positively in the case of ethanol and acetone mixture. In pure ethanol, molecules are hydrogen bonded. When acetone is added, its molecules bind to the host molecules and break some of the hydrogen bonds between them. Due to weakening of interactions, the solution shows positive deviation from Raoult's law.

3. COLLIGATIVE PROPERTIES

36. (c) shows a positive deviation from Raoult's law

Explanation: When a solution shows positive deviation from Raoult's law, the intermolecular forces of solute-solvent are weaker than solute and solvent-solvent interactions.

The vapour pressure of each component is greater than that predicted from Raoult's law and the total vapour pressure of the solution is greater than the total vapour pressure of an ideal solution.

So, an azeotropic mixture of two liquids will have a boiling point lower than either of the two liquids when it shows a positive deviation from Raoult's law.

37. (a) When placed in water containing more than 0.9% (mass/ volume) NaCl solution.

Explanation: Isotonic solutions are those solutions which have same osmotic pressure at a given temperature.

38. (a) 7.5 mol

Explanation:

$$\Delta T_f = K_f m$$

$$\Delta T_f = K_f \times \frac{n_2 \times 1000}{W_1}$$

$$14 = 1.86 \times \frac{n_2 \times 1000}{1000}$$

$$n_2 = 7.5 \text{ mol}$$

Related Theory

The depression in freezing point can be given as:

$$\Delta T_f = K_f m$$

$$\Delta T_f = \text{Change in freezing point}$$

Where, m = molality

K_f = molal freezing point depression constant

39. (b) 68.4 g mol^{-1}

Explanation: 5% solution means 5 g cane sugar in 100 mL solution.

$$M = \frac{5}{342} \times \frac{1000}{100}$$

$$\pi_1 = C_1 RT$$

$$= \frac{5}{342} \times \frac{1000}{100} \times RT$$

$$\pi_2 = C_2 RT$$

$$= \frac{1}{M_x} \times \frac{1000}{100} \times RT$$

As the solution are isotonic, so

$$\frac{5}{342} \times \frac{1000}{100} \times RT = \frac{1000}{100} \times RT$$

$$\frac{5}{342} = \frac{1}{M_x}$$

$$M_x = \frac{342}{5} = 68.4 \text{ g mol}^{-1}$$

40. (c) 100.104°C

Explanation: Given: Molality of solution = 0.2 m $K_b = 0.52 \text{ K kg mol}^{-1}$

So, 0.2 moles of non-electrolyte solute in 1 kg of water, formula used:

$$\Delta T_b = K_b m$$

($\Delta T_b =$ Elevation in boiling point)

$$= 0.52 \times 0.2$$

$$\frac{\Delta T_b}{\Delta T_b} = \frac{0.104^\circ\text{C}}{T_b - T_b^\circ} \quad (T_b^\circ = 100^\circ\text{C for}$$

but water)

$$\text{So, } T_b = 100^\circ + 0.104^\circ$$

$$= 100.104^\circ\text{C}$$

Boiling point of solution, $T_b = 100.104^\circ\text{C}$.

41. (a) $0.3RT$

Explanation: As we know,

$$\pi V = nRT$$

$$\pi \times 1 = 0.3RT$$

$$= 0.3RT$$

42. (d) Freezing point of solution

Explanation: In presence of a non-volatile solute, vapour pressure of a liquid in solution decreases and so its freezing point also decreases. ' X ' represents depression in freezing point of a liquid in solution.

43. (c) osmosis

Explanation: Water retention or puffiness due to high salt intake occurs due to osmosis. It is a spontaneous process by which a molecule of solvent tends to pass through semipermeable membrane from less concentrated solution into a more concentrated one.

44. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).

Explanation: Elevation in boiling point is a colligative property. It depends on amount of solute present in the solution. So, it is directly proportional to molality.

$$\Delta T_b = K_b \times m$$

Where, $\Delta T_b =$ Elevation in boiling point and $m =$ molality.

45. (a) Both (A) and (R) are true, and (R) is the correct explanation of the (A).

Explanation: Colligative property depends on the no. of solute particles present in the solution. Osmotic pressure depends upon the no. of particles of solute, i.e., molarity of solute. Hence, osmotic pressure is a colligative property.

46. (c) (A) is true but (R) is false.

Explanation: Cryoscopic constant depends on nature of solvent cryoscopic constant varies with the type of solvent.

47. The melting point of ice is the freezing point of water. We can use the depression in freezing point property in this case.

(A) 3rd reading for 0.5 g there has to be an increase in depression of freezing point and therefore decrease in freezing point so also decrease in melting point when amount of salt is increased but the trend is not followed on this case.

(B) Two sets of reading help to avoid error in data collection and give more objective data.

$$\begin{aligned}\Delta T_f(\text{glucose}) &= 1 \times K_f \times \frac{0.6 \times 1000}{180 \times 10} \\ \Delta T_f(\text{NaCl}) &= 2 \times K_f \times \frac{0.6 \times 1000}{58.5 \times 10} \\ 3.8 &= 2 \times K_f \times \frac{0.6 \times 1000}{58.5 \times 10}\end{aligned}$$

Divide equation 1 by 2

$$\begin{aligned}\frac{\Delta T_f(\text{glucose})}{3.8} &= \frac{58.5}{2 \times 180} \\ \Delta T_f(\text{glucose}) &= 0.62\end{aligned}$$

Freezing point or Melting point = -0.62°C

OR

Depression in freezing point is directly proportional to molality (mass of solute when the amount of solvent remains same)

0.3 g depression is 1.9°C

0.6 g depression is 3.8°C

1.2 g depression will be $3.8 \times 2 = 7.6^\circ\text{C}$

48. (A) (c) boil above 100°C and freeze below 0°C Explanation: On addition of a non-volatile solute to pure water, the vapour pressure decreases. This increases the boiling point and decreases the freezing point of water. Therefore, pure water will boil above 100°C and freeze below 0°C .

(B) (a) dependent only on the concentration of the solute and independent of the solvent's and solute's identity.

Explanation: Colligative properties are those properties which depend only on the concentration (number of particles) of the solute and independent of the solvent's and solute's identity.

(C) (a) A

Explanation: As the concentration of solution increases, the freezing point decreases. So, the highest freezing point will be for the solution which has the lowest concentration of solution. Therefore, the freezing point of fruit juice A, with concentration 0.1M, will be the highest.

(D) (c) molar mass of solute (M)

Explanation: According the formula:

$$\Delta T_b = \frac{K_b \times 1000 \times W_2}{M_2 \times W_1}$$

Elevation of boiling point (ΔT_b) is inversely proportional to the molar mass of the solute (M_2).

49. (A) Addition of glucose to water is an endothermic reaction. According to Le Chatelier's principle, on increase in temperature, solubility will increase.

(B) Q is ocean water, due to the presence of salts it freezes at lower temperature (depression in freezing point)

50. $\Delta T_b = 1^\circ\text{C} = 1\text{ F}$

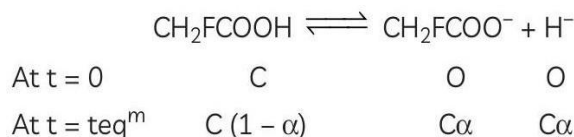
$$K_b = 1.86 \text{ K kg mol}^{-1}$$

Since, $\Delta T_b = iK_b m$

$$1 = i \times 1.86 \times \frac{19.5 \times 1000}{78 \times 500}$$

$$i = \frac{1 \times 78 \times 500}{1.86 \times 19.5 \times 100}$$

$$i = 1.0753$$



$$i = \frac{C(1-\alpha) + C\alpha + C\alpha}{C} = \frac{C - C\alpha + C\alpha + C\alpha}{C}$$

$$i = \frac{C + C\alpha}{C} = \frac{C(1 + \alpha)}{C} = 1 + \alpha$$

$$i = 1 + \alpha$$

$$\alpha = i - 1$$

$$\alpha = 1.0753 - 1$$

$$\alpha = 0.0753$$

So, the required degree of dissociation is 0.0753.

51. Given, $M_2 = 176 \text{ g mol}^{-1}$, $\Delta T_f = 1.5^\circ\text{C}$, $W_1 = 75 \text{ g}$, $K_f = 3.9 \text{ K kg mol}^{-1}$, $W_2 = ?$

$$\Delta T_f = \frac{K_f \times W_2 \times 1000}{M_2 \times W_1}$$

$$W_2 = \frac{\Delta T_f \times M_2 \times W_1}{K_f \times 1000}$$

$$= \frac{1.5 \times 176 \times 75}{3.9 \times 1000} = 5.077 \text{ g}$$

52. Given, 5% urea solution means 5 g urea is present in 100ml of solution. moles of urea present

$$= \frac{\text{weight given}}{\text{molecular weight of urea}}$$

$$= \frac{5 \text{ g}}{60 \text{ g mol}^{-1}}$$

$$= 0.083$$

Hence, Concentration of urea

$$= \frac{\text{moles of urea (n)}}{\text{volume of solution}} \times 1000$$

$$= \frac{112}{100} \times 1000$$

$$= 0.83$$

Hence, Osmotic pressure

$$= 1 \times \frac{10}{20} \times 0.082 \times 300 \text{ atm}$$

$$= 12.45 \text{ atm.}$$

53. When the external pressure applied becomes more than the osmotic pressure of solution then the solvent molecules from the solution will move towards the solvent compartment through semi permeable membrane. This is called reverse osmosis.

54. The pressure that just stops the flow of solvent is called osmotic pressure of the solution.

55. Colligative properties are the one which depends on the number of moles of the solute particles dissolved in the solution.

56.56.

$$\Delta T_f = K_f m$$

Here,

$$m = w_2 \times \frac{1000}{M_2} \times M_1$$

$$273.15 - 269.15 = K_f \times 10 \times \frac{1000}{342} \times 90$$

$$K_f = 12.3 \text{ K kg/mol}$$

$$= K_f m$$

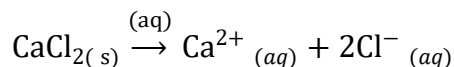
$$= 12.3 \times 10 \times \frac{1000}{180} \times 90$$

$$= 7.6 \text{ K}$$

$$T_f = 273.15 - 7.6$$

$$= 266.55 \text{ K}$$

57. CaCl_2 dissociates in aqueous solution.



$$i = 3, W_B = 10 \text{ g}, W_A = 200 \text{ g} = 0.2 \text{ kg}, K_b = 0.512 \text{ K kg mol}^{-1}$$

$$M_B = 110 \text{ g mol}^{-1}$$

$$\Delta T_b = i \times K_b \times m = \frac{i \times K_b \times W_B}{M_B \times W_A}$$

$$\Delta T_b = \frac{(3) \times (0.512 \text{ K kg mol}^{-1}) \times (10 \text{ g})}{(110 \text{ g mol}^{-1}) \times (0.2 \text{ kg})}$$

$$= 0.69 \text{ K}$$

58. (A) The 1.2% sodium chloride solution is hypertonic in nature thus the cell will shrink due to the exosmosis process taking place in the blood cells.

(B) The 0.4% sodium chloride solution is hypotonic in nature thus the cell will swell due to the endosmosis process taking place in the blood cells.

59.59.

$$\Rightarrow \begin{array}{l} P_A = a X_A \\ P_A = P_A^\circ X_A \\ \therefore X_A + X_B = 1 \\ \therefore X_A = 1 - X_B \\ \Rightarrow P_A = P_A^\circ (1 - X_B) \\ \frac{P_A}{P_A^\circ} = 1 - X_B \\ \Rightarrow 1 - \frac{P_A}{P_A^\circ} = X_B \\ \frac{P_A^\circ - P_A}{P_A^\circ} = X_B \end{array}$$

$$\frac{P_{\hat{A}} - P_A}{P_{\hat{A}}} = \frac{\frac{W_B}{M_B}}{\frac{W_A}{M_A} + \frac{W_B}{M_B}} = \frac{W_B}{W_A} \frac{M_A}{M_B}$$

$\because \frac{W_B}{M_B} \ll \frac{W_A}{M_A}$ for dilute solution

$$\Rightarrow \frac{P_{\hat{A}} - P_A}{P_{\hat{A}}} = \frac{W_B}{M_B} \times \frac{M_A}{W_A}$$

$$\Rightarrow M_B = \frac{W_B \times M_A}{W_A} \times \frac{P_{\hat{A}}}{P_{\hat{A}} - P_A}$$

where $P_{\hat{A}}$ = Vapour pressure of pure 'A'
(solvent)

X_A = Mole fraction of 'A'

X_B = Mole fraction of 'B' (solute)

P_A = Vapour pressure of solution

W_B = Mass of solute

W_A = Mass of solvent

M_B = Molar mass of solute

M_A = Molar mass of solvent

60. Given: $W_2 = ?$, $M_2 = 256 \text{ g mol}^{-1}$, $\Delta T_f = 0.48 \text{ K}$, $W_1 = 75 \text{ g}$, $K_f = 5.12 \text{ K kg mol}^{-1}$

$$\Delta T_f = \frac{(3) \times (0.512 \text{ K kg mol}^{-1}) \times (10 \text{ g})}{(110 \text{ g mol}^{-1}) \times (0.2 \text{ kg})}$$

$$0.48 \text{ K} = 5.12 \text{ K kg mol}^{-1}$$

$$\times \frac{W_2}{75 \times 256} \times 1000$$

$$W_2 = \frac{0.48 \times 75 \times 256}{5.12 \times 1000} \text{ g}$$

$$W_2 = 1.8 \text{ g}$$

61. Given: Mass of Urea,

$$W_B = 15 \text{ g}$$

Molar Mass of Urea

$$M_b = 60 \text{ g}$$

The solution of urea in water is isotonic to that of glucose solution.

$$\begin{aligned} \pi_{\text{Urea}} &= \pi_{\text{Glucose}} \\ C_{\text{urea}} RT &= C_{\text{Glucose}} RT \\ \frac{n_{\text{urea}}}{V} RT &= \frac{n_{\text{Glucose}}}{VT} \\ \text{So, } \frac{15}{60} &= \frac{W_{\text{Glucose}}}{180} \\ W_{\text{Glucose}} &= \frac{15 \times 18}{60} \\ &= 4.5 \text{ g} \end{aligned}$$

So, 4.5 g of glucose is present in 1 L of solution.

62. When a non-volatile solute is added to a solvent, then the vapour pressure of the solvent decreases because surface area is partly occupied by non-volatile solute molecules. Due to this rate of evaporation decreases.
63. Two solutions having same osmotic pressure at a given temperature are called isotonic solutions.
64. Molal elevation constant can be defined as the elevation in boiling point produced when one mole of solute is dissolved in 1 kg i.e., 1000 g of the solvent. It is also known as the Ebullioscopic constant.

4. ABNORMAL MOLECULAR MASS

65. (c) 0.5M urea solution

Explanation: Isotonic solutions have same osmotic pressure.

$$\pi = i CRT$$

$$\pi_1 = 1 \times 0.5 \times RT \text{ for glucose, } i = 1$$

$$\pi_2 = 2 \times 0.5 \times RT \text{ for KCl, } i = 2$$

$$\pi_3 = 3 \times 0.5 \times RT \text{ for CaCl}_2, i = 3$$

$$\pi_4 = 0.5 \times 1 \times RT \text{ for urea, } i = 1$$

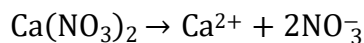
$$\pi_5 = 1 \times 1 \times RT \text{ for sucrose, } i = 1$$

$$\pi_1 = \pi_4 \text{ hence answer is 0.5 urea solution.}$$

66. (d) 0.1MNa₂SO₄ and 0.1MCa(NO₃)₂

Explanation: Na₂SO₄ → 2Na⁺ + SO₄²⁻

Concentration = 0.3M



Concentration = 0.3M

Osmotic pressure a number of particles.

67.67.

$$\begin{aligned}\pi_1 &= \pi_2 \\ iC_1RT &= C_2RT \\ \frac{3 \times 5}{322} &= \frac{2}{M} \\ M &= \frac{2 \times 322}{3 \times 5} \\ M &= 42.9 \text{ g}\end{aligned}$$

68. $K_3[Fe(CN)_6]$ gives 4 ions in aqueous solution

$$\begin{aligned}i &= 1 + (n - 1)\alpha \\ i &= 1 + (4 - 1) \times 0.0852 \\ i &= 3.556 \\ \Delta T_b &= i K_b m = 3.556 \times 0.52 \times 1 \\ &= 1.85 \\ T_b &= 101.85^\circ\text{C}\end{aligned}$$

69. Number of moles of benzoic acid = $\frac{5}{122}$

Molality of benzoic acid solution

$$= \frac{5}{122} \times \frac{1000}{35} = 1.17$$

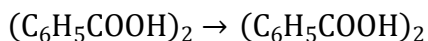
Apply the relation,

$$\Delta T_f = i K_f m$$

Where i is Vant Hoff factor.

$$2.94 \text{ K} = i \times 4.8 \text{ Kgmol}^{-1}$$

$$\text{Or } i = \frac{2.94}{4.9 \times 1.17} \times 1.17 \text{ molkg}^{-1}$$



Total number of moles = $1 - x(x/2)$

$$\begin{aligned}&= 1 - (x/2) \\ i &= \frac{1 - \frac{x}{2}}{1}\end{aligned}$$

From (i) and (ii), we have

$$\begin{aligned}1 - \frac{x}{2} &= \frac{2.94}{4.9 \times 1.17} = 0.5128 \\ \text{Or } \frac{x}{2} &= 1 - 0.5128 = 0.4872 \\ \text{Or } x &= 0.9744 \text{ or } 97.44\%\end{aligned}$$

70. Molar mass that is either lower or higher than the expected or the normal molar mass is known as abnormal molar mass.
71. The Van't Hoff factor is the ratio between the actual concentration of particles produced when the substance is dissolved and the concentration of a substance as calculated from its mass. For most non-electrolytes dissolved in water, the Van't Hoff factor is essentially 1.
72. Apply the relation,

$$\begin{aligned}\Delta T_b &= i \times K_b \times m \\ \text{For MgSO}_4, i &= 2 \\ \text{Molarity of Solution} &= \frac{4/120}{\frac{4}{100}} \times 1000 \\ &= \frac{120}{120} \times 10 \\ &= \frac{1}{3}\end{aligned}$$

Substituting the values in eq. (i), we have

$$\begin{aligned}\Delta T_b &= 2 \times 0.52 \times \frac{1}{3} \\ &= 0.347\end{aligned}$$

Boiling point of the solution

$$\begin{aligned}&= 100 + 0.347 \\ &= 100.347^\circ\text{C} \\ &= 373.347 \text{ K}\end{aligned}$$

73. Given:

$$K_f = 1.86 \text{ K kg mol}^{-1}$$

Mass of solute = 1.9 g

Mass of solvent = 50 g

Therefore,

Molality of the solution,

$$m = \frac{1.9}{95} \times \frac{1000}{50} = 0.4 \text{ m}$$

Also, MgCl_2 undergoes complete ionisation and thereby yielding 3 moles of constituent ions for every mole of MgCl_2 .

$$\therefore i = 3$$

Now, depression in freezing point is given as:

$$\begin{aligned}\Delta T_f &= i K_f m \\ &= 3 \times 1.86 \times 0.4 \\ &= 2.232 \text{ K} \\ T_f &= 273.15 - 2.232 \\ &= 270.918 \text{ K}\end{aligned}$$

Hence, the new freezing point of the solution is 270.92 K.

74. Here, $W_B = 2.56 \text{ g}$, $W_A = 100 \text{ g}$, $\Delta T_f = 0.383 \text{ K}$, $K_f = 3.83 \text{ K kg mol}^{-1}$

Substitution these values in the expression, we get

$$\begin{aligned}M_B &= \frac{K_f \times W_B \times 1000}{\Delta T_f \times W_A} \\ &= \frac{3.83 \text{ K kg mol}^{-1} \times 2.56}{100 \text{ g} \times 0.383 \text{ K}} \\ &= \frac{3.83 \text{ K kg mol}^{-1} \times 2.56 \times 1000 \text{ g kg}^{-1}}{100 \text{ g} \times 0.383 \text{ K}}\end{aligned}$$

Now, molecular mass of $S_x = x \times 32 = 256$

$$x = \frac{256}{32} = 8$$

Therefore, formula of sulphur = S_8 .

75.

$$\begin{aligned}\Delta T_f &= i K_f m \\ m &= \frac{W_B \times 1000}{M_B \times W_B} \\ \Delta T_f &= \text{Depression in freezing point} \\ &= 1.62 \\ i &= \text{Van't Hoff factor} \\ K_f &= \text{constant} = 4.9\end{aligned}$$

$$m = \frac{3.9 \times 1000}{122 \times 49} = 0.65$$

$$i = \frac{\Delta T_f}{K_f m}$$

$$= \frac{1.62}{4.9 \times 0.65} = 0.50$$

$$i = 0.50$$

As the value of $i < 1$, the solute is associated.

76. NaCl undergoes complete dissociation as:



The Van't Hoff factor, i is given as: Number of particles

$$i = \frac{\text{after dissociation}}{\text{Number of particles}}$$

$$\Rightarrow i = \frac{\text{before diss}}{1} = \frac{2}{1} = 2$$

The depression in freezing point of a solution is given by:

Given:

$$\Delta T_f = K_f \frac{W_s \times 1000}{M_s \times W}$$

$$K_f \text{ for water} = 1.86 \text{ K kg mol}^{-1}$$

Molar mass of solute, $M_s = 58.5 \text{ g mol}^{-1}$ Mass of water,

Mass of solute, $W_s = ?$

$$W = 37.2 \text{ g}$$

$$\Delta T_f = 2^\circ\text{C} = 2 \text{ K}$$

Substituting the above values in (i), we get

$$2 = 2 \times 1.86 \times \frac{W_s \times 1000}{58.5 \times 37.2}$$

$$W_s = 1.17 \text{ g}$$

Hence, the required mass of NaCl is 1.17 g.

PREVIOUS YEAR
QUESTION
PAPERS

CHEMISTRY

CLASS 12

CHAPTER - 2
Electrochemistry

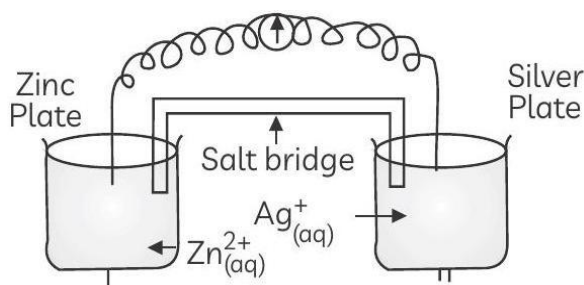
1. ELECTROCHEMICAL CELLS AND ELECTRODE POTENTIAL

Case Based Qs [4 - 5 marks]

Read the following passages and answer the questions that follow:

1. Oxidation-reduction reactions are commonly known as redox reactions. They involve transfer of electrons from one species to another. In a spontaneous reaction, energy is released which can be used to do useful work. The reaction is split into two half reactions. Two different containers are used and a wire is used to drive the electrons from one side to the other and a Voltaic/Galvanic cell is created. It is an electrochemical cell that uses spontaneous redox reactions to generate electricity. A salt bridge also connects to the half cells. The reading of the voltmeter gives the cell voltage or cell potential or electromotive force. If E_{cell}° is positive, the reaction is spontaneous and if it is negative, the reaction is non-spontaneous and is referred to as electrolytic cell. Electrolysis refers to the decomposition of a substance by an electric current. One mole of electric charge when passed through a cell it will discharge half a mole of a divalent metal ion such as Cu^{2+} . This was first formulated by Faraday in the form of laws of electrolysis.

The conductance of material is the property of materials due to which a material allows the flow of ions through itself and thus conducts electricity. Conductivity is represented by κ and it depends upon nature and concentration of electrolyte temperature etc. A more common term molar conductivity of a solution at a given concentration is conductance of the volume of solution containing one mole of electrolyte kept between two electrodes, with the unit area of cross-section and distance of unit length. Limiting molar conductivity of weak electrolytes cannot be obtained graphically.



- (A) Is silver plate act as anode or cathode?
- (B) What will happen if the salt bridge is removed?
- (C) When does electrochemical cell behaves like an electrolytic cell?
- (D) (i) What will happen to the concentration of Zn^{2+} and Ag^{+} when $E_{\text{cell}} = 0$
- (ii) Why does conductivity of a solution decreases with dilution?

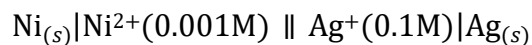
OR

The molar conductivity of a 1.5M solution of an electrolyte is found to be $138.9 \text{ s cm}^2 \text{ mol}^{-1}$. Calculate the conductivity of this solution.

[CBSE Term-2 2020]

Very Short & Short Qs [1 - 3 marks]

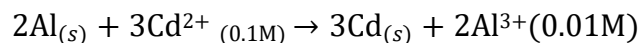
2. Write electrode reactions and calculate the E_{cell} of the following cell at 298 K :



[Given: E° for $\text{Ni}^{2+}/\text{Ni} = 0.25 \text{ V}$, $\text{Ag}^+/\text{Ag} = 0.80 \text{ V}$]

[Delhi Gov. SQP Term-2 2022]

3. Represent the cell in which the following reaction takes place. The value of E° for the cell is 1.260 V. What is the value of E_{cell} ?

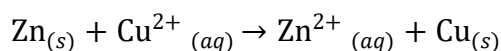


[CBSE SQP Term-2 2022]

4. Give two points of difference between the electrolytic cell and electrochemical cell.

[CBSE 2020]

5. Calculate ΔG° for the reaction.



Given: E° for $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$ and

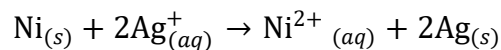
$$E^\circ \text{ for } \text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$$

$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1},$$

$$F = 96500 \text{ C mol}^{-1},$$

[CBSE 2020]

6. Calculate the maximum work and $\log K_c$ for the given reaction at 298 K :



Given:

$$E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V} \quad E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$$

$$1 \text{ F} = 96500 \text{ C mol}^{-1}$$

[CBSE 2020]

7. Calculate e.m.f. of the following cell:



Given: E° for $\text{Zn}^{2+}/\text{Zn} = -0.76\text{ V}$, E° for $\text{Ag}^+/\text{Ag} = +0.80\text{ V}$

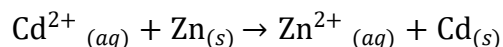
[Given: $\log 10 = 1$]

[CBSE 2020]

8. Define electrochemical cell. What happens if external potential applied becomes greater than E°_{Cell} of electrochemical cell?

[CBSE 2019, 16]

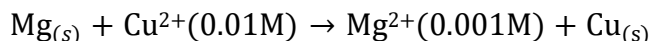
9. Calculate the equilibrium constant for the reaction:



[CBSE 2019]

If $E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.403\text{ V}$; $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.763\text{ V}$

10. E°_{cell} for the given redox reaction is 2.71 V



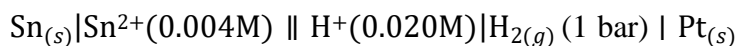
Calculate E_{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is:

(i) less than 2.71 V and

(ii) greater than 2.71 V

[CBSE 2019]

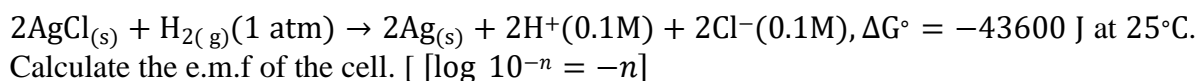
11. Write the cell reaction and calculate the e.m.f. of the following cell at 298 K :



(Given, $E^\circ_{\text{Sn}^{2+}/\text{Sn}} = -0.14\text{ V}$)

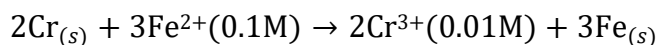
[CBSE 2018]

12. For the reaction.



[CBSE 2018]

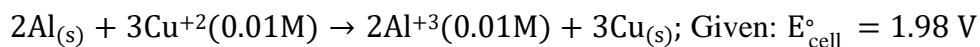
13. Calculate e.m.f of the following cell at 298K:



$$\text{Given: } E_{\text{Cr}^{3+}/\text{Cr}} = -0.74\text{V}, E_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$$

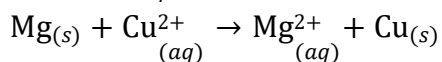
[CBSE 2016]

14. Calculate E_{cell} for the following reaction at 298K.



[CBSE 2016]

15. Calculate $\Delta_r G^{\circ}$ for the reaction:



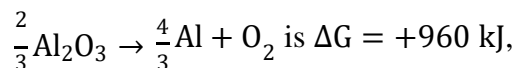
$$\text{Given: } E_{\text{cell}}^{\circ} = +2.71\text{V}, 1\text{F} = 96500\text{Cmol}^{-1}$$

[CBSE 2014]

16. Calculate emf of the following cell at 298K: $\text{Mg}_{(s)}|\text{Mg}^{2+}(0.1\text{M}) \parallel \text{Cu}^{2+}(0.01\text{M})|\text{Cu}_{(s)}$ [Given $E_{\text{cell}}^{\circ} = +2.71\text{V}$, 1 Faraday = 96500C mol⁻¹].

[CBSE 2014]

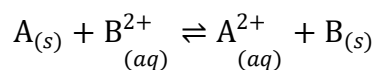
17. Estimate the minimum potential difference needed to reduce Al_2O_3 at 500°C. The free energy change for the decomposition reaction:



$$F = 96500\text{Cmol}^{-1}$$

[CBSE 2014]

18. Equilibrium constant (K_c) for the given reaction is 10. Calculate E_{cell}° .



[CBSE 2014]

2. CONDUCTIVITY OF ELECTROLYTIC SOLUTIONS

Objective Qs [1 mark]

19. Which of the following solutions will have the highest conductivity at 298 K ?

- (a) 0.01M HCl solution
- (b) 0.1M HCl solution
- (c) 0.01M CH₃COOH solution
- (d) 0.1M CH₃COOH solution

[CBSE SQP 2023]

20. Which of the following solutions of KCl will have the highest value of molar conductivity?

- (a) 0.01M
- (b) 1M
- (c) 0.5M
- (d) 0.1M

[CBSE 2023]

In the following question (Q. No. 21) a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

21. Assertion (A): Conductivity decreases with decrease in concentration of electrolyte.

Reason (R): Number of ions per unit volume that carry the current in a solution decreases on dilution.

[CBSE 2023]

22. Which of the following option will be the limiting molar conductivity of CH₃COOH if the limiting molar conductivity of CH₃COONa is 91 S cm² mol⁻¹ ? Limiting molar conductivity for individual ions are given in the following table.

S. No.	Ions	Limiting molar conductivity/ $\text{Scm}^2 \text{mol}^{-1}$
(1)	H^+	349.6
(2)	Na^+	50.1
(3)	K^+	73.5
(4)	OH^-	199.1

- (a) $350 \text{ s cm}^2 \text{ mol}^{-1}$
 (b) $375.3 \text{ s cm}^2 \text{ mol}^{-1}$
 (c) $390.5 \text{ s cm}^2 \text{ mol}^{-1}$
 (d) $340.4 \text{ s cm}^2 \text{ mol}^{-1}$

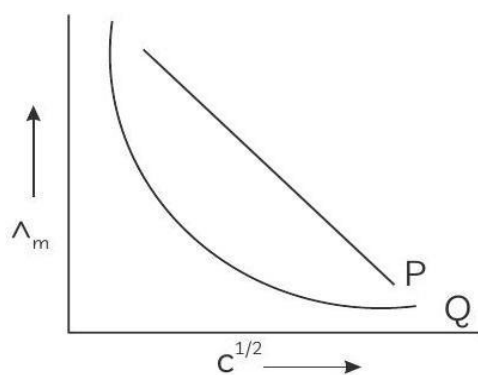
[CBSE SQP 2020]

Very Short & Short Qs [1-3 marks]

23. Solutions of two electrolytes 'A' and 'B' are diluted. The Λ_m of 'B' increases 1.5 times while that of 'A' increases 25 times. Which of the two is a strong electrolyte? Justify your answer. Graphically show the behavior of 'A' and 'B'.

[CBSE SQP Term-2 2022]

24. In the plot of molar conductivity (Λ_m) vs square root of concentration $c^{1/2}$ following curve is obtained for two electrolytes A and B :



Answer the following:

- (i) Predict the nature of electrolytes A and B.
 (ii) What happens on extrapolation of Λ_m to concentration approaching zero for electrolytes A and B?

[CBSE 2019]

25. "Conductivity is a measurement of the ability of an aqueous solution to transfer an electrical current. The current is carried by ions, and therefore, the conductivity increases with the concentration of ions present in solution, their mobility, and temperature of the water. Conductivity measurements are related to ionic strength." It is observed that on dilution, conductivity of CH_3COOH decreases. Support this statement by giving proper explanation.

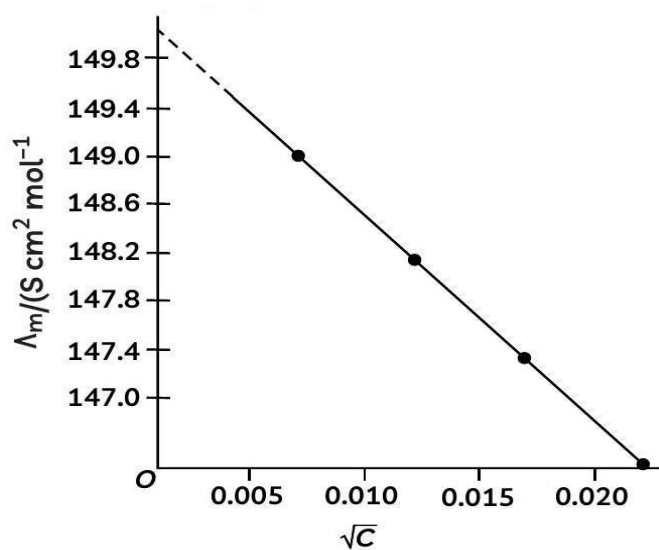
[Mod. CBSE 2018]

26. Give reason:

Conductivity of CH_3COOH decreases on dilution.

[CBSE 2018]

27. Consider the graph:



Observe the graph and identify and define the chemical term when concentration approaches zero. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

[Mod. CBSE 2015]

28. Define the term degree of dissociation. Write an expression that relates the molar conductivity of a weak electrolyte to its degree of dissociation.

[CBSE 2015]

29. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

[CBSE 2015]

30. Define the term degree of dissociation. Write an expression that relates the molar conductivity of a weak electrolyte to its degree of dissociation.

[CBSE 2015]

31. State Kohlrausch law of independent migration of ions. Why does the conductivity of a solution decrease with dilution?

[CBSE 2014]

32. Define the terms conductivity and molar conductivity for the solution of an electrolyte. Comment on their variation with temperature.

[CBSE 2014]

Long Qs [4 - 5 marks]

33. (A) Can we construct an electrochemical cell with two half-cells composed of ZnSO_4 solution and zinc electrodes? Explain your answer.

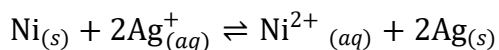
(B) Calculate the λ_m° for Cl^- ion from the data given below: $\lambda_m^\circ \text{MgCl}_2 = 258.6 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda_m^\circ \text{Mg}^{2+} = 106 \text{ S cm}^2 \text{ mol}^{-1}$

(C) The cell constant of a conductivity cell is 0.146 cm^{-1} . What is the conductivity of 0.01M solution of an electrolyte at 298 K , if the resistance of the cell is 1000 Ohm ?

[CBSE SQP 2023]

34. (A) Conductivity of $2 \times 10^{-3}\text{M}$ methanoic acid is $8 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation if Λ_m° for methanoic acid is $404 \text{ S cm}^2 \text{ mol}^{-1}$.

(B) Calculate the $\Delta_r G$ and $\log K_c$, for the given reaction at 298 K :



Given: $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$, $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$

$$1 \text{ F} = 96500 \text{ C mol}^{-1}$$

[CBSE 2023]

35. (A) Why does the cell voltage of a mercury cell remain constant during its lifetime?

(B) Write the reaction occurring at anode and cathode and the products of electrolysis of aq. KCl .

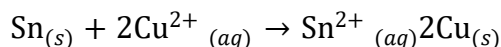
(C) What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.59 V at standard temperature and pressure?

[CBSE SQP 2022]

36. (A) Molar conductivity of substance 'A' is $5.9 \times 10^3 \text{ S/m}$ and 'B' is $1 \times 10^{-16} \text{ S/m}$. Which of the two is most likely to be copper metal and why?

(B) What is the quantity of electricity in Coulombs required to produce 4.8 g of Mg from molten MgCl_2 ? How much Ca will be produced if the same amount of electricity was passed through molten CaCl_2 ? (Atomic mass of Mg = 24u, atomic mass of Ca = 40u).

(C) What is the standard free energy change for the following reaction at room temperature? Is the reaction spontaneous?



[CBSE SQP 2022]

37. Molar conductivity of acetic acid solution is $39.0 \text{ S cm}^2 \text{ mol}^{-1}$. If limiting molar conductivities of NaCl, HCl and CH_3COONa are 126.4, 425.9 and $91.0 \text{ S cm}^2 \text{ mol}^{-1}$ respectively.

(A) Calculate limiting molar conductivity of acetic acid.

(B) How much acetic acid is present in unionized form for given solution?

[Delhi Gov. SQP Term-2 2022]

38. (A) Calculate the degree of dissociation of 0.0024M acetic acid if conductivity of this solution is $8.0 \times 10^{-5} \text{ S cm}^{-1}$.

$$\lambda^{\circ}_{\text{CH}_3\text{COO}^-} = 349.6 \text{ S cm}^2 \text{ mol}^{-1};$$
$$\lambda^{\circ}_{\text{H}^+} = 40.9 \text{ S cm}^2 \text{ mol}^{-1}$$

(B) Solutions of two electrolytes 'A' and 'B' are diluted. The limiting molar conductivity of 'B' increases to a smaller extent while that of 'A' increases to a much larger extent comparatively. Which of the two is a strong electrolyte?

[CBSE SQP 2019]

39. Calculate the degree of dissociation (α) of acetic acid if its molar conductivity is $39.05 \text{ S cm}^2 \text{ mol}^{-1}$. Given: $\lambda^{\circ}_{\text{H}^+} = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda^{\circ}_{(\text{CH}_3\text{COO}^-)} = 40.9 \text{ S cm}^2 \text{ mol}^{-1}$. [CBSE 2017]

Numerical Type Qs [1 - 3 marks]

40. The conductivity of 0.20 mol L^{-1} solution of KCl is $2.48 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation (α).

Given: $\lambda^{\circ}_{\text{K}^+} = 73.5 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda^{\circ}_{(\text{Cl}^-)} = 76.5 \text{ S cm}^2 \text{ mol}^{-1}$.

[CBSE 2015]

41. Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100Ω . If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520Ω , calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution is $1.29 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$.

[CBSE 2014]

3. ELECTROLYTIC CELL AND ELECTROLYSIS

Very Short & Short Qs [1 - 3 marks]

42. How many coulombs are required for the oxidation of 1 mol of H_2O_2 to O_2 ?

[CBSE 2020]

43. Give reason:

On the basis of E° values, O_2 gas should be liberated at anode but Cl_2 gas is liberated at anode in the electrolysis of aqueous NaCl .

[CBSE 2020]

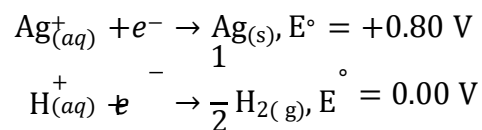
44. How much charge in terms of Faraday is required to reduce one mole of MnO_4^- to Mn^{2+} ?

[CBSE 2020]

45. How many coulombs of electricity are required for the oxidation of 1 mole of H_2O to O_2 ?

[CBSE 2020]

46. Following reactions occur at cathode during electrolysis of aqueous silver chloride solution:



On the basis of standard reduction potential (E° value), which reaction is feasible at cathode and why?

[CBSE 2017, 15]

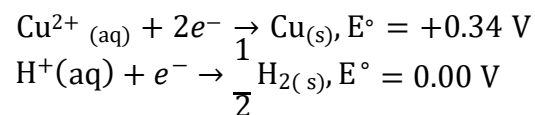
47. How much charge is required for the reduction of 1 mol of Zn^{2+} to Zn ?

[Mod. CBSE 2015]

48. Faraday's laws of electrolysis have quantitative relationships based on the electrochemical research published by Michael Faraday in 1833. State the Faraday's first Law of electrolysis.

[Mod. CBSE 2015]

49. Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution:

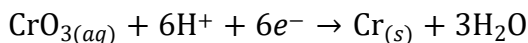


On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why?

[CBSE 2015]

Numerical Type Qs [1 - 3 marks]

50. Chromium metal is electroplated using an acidic solution containing CrO_3 according to the following equations:



Calculate how many grams of chromium will be electroplated by 24,000 coulombs. How long will it take to electroplate 1.5 g chromium using 12.5 A current?

[Atomic mass of Cr = 52 g mol⁻¹, 1 F = 96500 Cmol⁻¹]

[CBSE 2019]

51. A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes FeSO_4 and ZnSO_4 until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y. (Molar mass : Fe = 56 g mol⁻¹, Zn = 65.3 g mol⁻¹, 1 F = 96500 Cmol⁻¹)

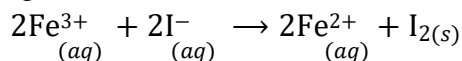
[CBSE 2019]

52. Calculate the mass of Ag deposited at cathode when a current of 2 ampere was passed through a solution of AgNO_3 for 15 minutes.

[Given: Molar mass of Ag = 108 g mol⁻¹, F = 96500 Cmol⁻¹]

[CBSE 2017]

53. (A) The cell in which the following reaction occurs:



has $E^\circ_{\text{cell}} = 0.236 \text{ V}$ at 298 K. Calculate the standard Gibbs energy of the cell reaction. (Given: 1 F = 96500 Cmol⁻¹)

(B) How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 hours? (Given: 1F = 96500 Cmol⁻¹)

[CBSE 2017]

54. State Faraday's first Law of electrolysis. How much charge in terms of Faraday is required for the reduction of 1 mol of Cu^{2+} to Cu ?

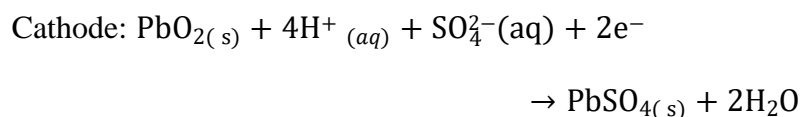
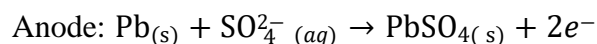
[CBSE 2014]

55. A solution of $\text{Ni}(\text{NO}_3)_2$ is electrolysed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode? [CBSE 2014]

4. COMMERCIAL CELLS/ BATTERIES

Case Based [4 - 5 marks]

56. The lead-acid battery represents the oldest rechargeable battery technology. Lead acid batteries can be found in a wide variety of applications including small-scale power storage such as UPS systems, ignition power sources for automobiles, along with large, grid-scale power systems. The spongy lead act as the anode and lead dioxide as the cathode. Aqueous sulphuric acid is used as an electrolyte. The half-reactions during discharging of lead storage cells are:



There is no safe way of disposal and these batteries end - up in landfills. Lead and sulphuric acid are extremely hazardous and pollute soil, water as well as air. Irrespective of the environmental challenges it poses, lead acid batteries have remained an important source of energy.

Designing green and sustainable battery systems as alternatives to conventional means remains relevant. Fuel cells are seen as the future source of energy. Hydrogen is considered a green fuel. Problem with fuel cells at present is the storage of hydrogen. Currently, ammonia and methanol are being used as a source of hydrogen for fuel cell. These are obtained industrially, so add to the environmental issues.

If the problem of storage of hydrogen is overcome, is it still a "green fuel?" Despite being the most abundant element in the Universe, hydrogen does not exist on its own so needs to be extracted from the water using electrolysis or separated from carbon fossil fuels. Both of these processes require a significant amount of energy which is currently more than that gained from the hydrogen itself. In addition, this extraction typically requires the use of fossil fuels. More research is being conducted in this field to solve these problems. Despite the problem of no good means to extract Hydrogen, it is a uniquely abundant and renewable source of energy, perfect for our future zero-carbon needs.

Answer the following questions:

- (A) How many coulombs have been transferred from anode to cathode in order to consume one mole of sulphuric acid during the discharging of lead storage cell?
- (B) How much work can be extracted by using lead storage cell if each cell delivers about 2.0 V of voltage? ($1 \text{ F} = 96500\text{C}$)
- (C) Do you agree with the statement "Hydrogen is a green fuel.?" Give your comments for and against this statement and justify your views.

OR

Imagine you are a member of an agency funding scientific research. Which of the following projects will you fund and why?

(i) Safe recycling of lead batteries

(ii) Extraction of hydrogen

[CBSE SQP 2023]

Very Short & Short Qs [1-3 marks]

57. Give reasons:

(A) Mercury cell delivers a constant potential during its life time.

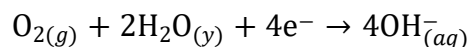
(B) In the experimental determination of electrolytic conductance, Direct Current (DC) is not used.

OR

Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries?

[CBSE 2023]

58. Corrosion is an electrochemical phenomenon. The oxygen in moist air reacts as follows:



Write down the possible reactions for corrosion of zinc occurring at anode, cathode, and overall reaction to form a white layer of zinc hydroxide.

[CBSE SQP 2022]

59. Name the type of cell which was used in Apollo space programme.

[CBSE 2020, 19]

60. Give two advantages of fuel cells.

[CBSE 2020, 18]

61. "Fuel cells work like batteries, but they do not run down or need recharging. A fuel cell consists of a negative electrode (or anode) and a positive electrode (or cathode), sandwiched around an electrolyte." Define fuel cells by writing its working in a sentence.

[Mod. CBSE 2018, 17, 15, 14]

62. Define fuel cell and write its two advantages.

[CBSE 2018]

63. Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.

[CBSE 2017]

64. Write the name of the cell which is generally used in inverters. Write the reactions taking place at the anode and the cathode of this cell.

[CBSE 2017]

65. Using the E° values of A and B , predict which is better for coating the surface of iron to prevent corrosion and why?

$$E^\circ_{\text{Fe}^{2+}/\text{Fe}} = 0.44 \text{ V}$$

$$E^\circ_{\text{A}^{2+}/\text{A}} = -2.37 \text{ V}; E^\circ_{\text{B}^{2+}/\text{B}} = 0.14 \text{ V}$$

[CBSE 2016]

66. "The storage battery, secondary battery, or charge accumulator is a cell or combination of cells in which the cell reactions are reversible." Give a brief insight about the secondary batteries.

[Mod. CBSE 2015]

67. What type of battery is mercury cell? Why it is more advantageous than dry cell?

[CBSE 2015]

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CHAPTER 3

Chemical Kinetics

1. RATE OF A REACTION AND FACTORS AFFECTING THE RATE OF REACTION

Very Short & Short Qs [1 - 3 marks]

- (A) Radioactive decay follows first-order kinetics. The initial amount of two radioactive elements X and Y is 1gm each. What will be the ratio of X and Y after two days if their half-lives are 12 hours and 16 hours respectively?
(B) The hypothetical reaction $P + Q \rightarrow R$ is half order w.r.t ' P ' and zero order w.r.t ' Q '. What is the unit of rate constant for this reaction?

[CBSE SQP 2023]

- How will the rate of reaction be affected when:
(A) surface area of the reactant is reduced,
(B) temperature of the reaction is increased, and
(C) catalyst is added in a reversible reaction?

[CBSE 2020]

- Write units of rate constant for zero order and for the second order reactions if the concentration is expressed in molL^{-1} and time in second.

[CBSE 2015]

- Define rate of reaction. Write two factors that affect the rate of reaction. [CBSE 2015]

Numerical Qs [1 - 5 marks]

- A first order reaction takes 20 minutes for 50% completion. Calculate the time required for 90% completion of this reaction. ($\log 2 = 0.30$)

[Delhi Gov. SQP Term-2 2022]

- For a reaction, $A + 2B \rightarrow 2C + D$

Following data was obtained experimentally:

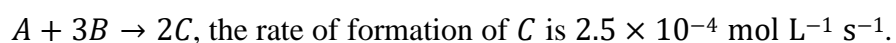
Experiment	[A] / mol L ⁻¹	[B] / mol L ⁻¹	Initial rate of reaction / mol L ⁻¹ s ⁻¹
1	0.30	0.30	0.096
2	0.60	0.30	0.384
3	0.30	0.60	0.192
4	0.60	0.60	0.768

For this reaction,

- (A) Calculate order with respect to each reactant? What is order of reaction?
 (B) Calculate the rate constant. Mention unit also.
 (C) Calculate the rate of reaction when concentration of both *A* and *B* are 0.02M.

[Delhi Gov. SQP Term-2 2022]

7. In the given reaction



Calculate the:

- (A) rate of reaction, and
 (B) rate of disappearance of *B*.

[CBSE 2020]

8. For the reaction, $2 \text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$, the rate of formation of $\text{NO}_2(\text{g})$ is $2.8 \times 10^{-3} \text{ Ms}^{-1}$. Calculate the rate of disappearance of $\text{N}_2\text{O}_5(\text{g})$.

[CBSE 2018]

2. RATE LAW, ORDER & MOLECULARITY

Objective Qs [1 mark]

9. Which of the following statement is true?
 (a) Molecularity of reaction can be zero or a fraction.
 (b) Molecularity has no meaning for complex reactions.

(c) Molecularity of a reaction is an experimental quantity.

(d) Reactions with the molecularity three are very rare but are fast.

[CBSE SQP 2023]

10. If the initial concentration of substance A is 1.5M and after 120 seconds the concentration of substance A is 0.75M , the rate constant for the reaction if it follows zero - order kinetics is:

(a) $0.00625 \text{ mol L}^{-1} \text{ s}^{-1}$

(b) 0.00625 s^{-1}

(c) $0.00578 \text{ mol L}^{-1} \text{ s}^{-1}$

(d) 0.00578 s^{-1}

[CBSE SQP 2023]

11. The slope in the plot of $[R]$ vs. time for a zero order reaction is:

(A) $\frac{+k}{2.303}$

(B) $-k$

(C) $\frac{-k}{2.303}$

(D) $+k$

[CBSE 2023]

12. For the reaction, $A + 2B \rightarrow AB_2$, the order w.r.t. reactant A is 2 and w.r.t. reactant B . What will be change in rate of reaction if the concentration of A is doubled and B is halved?

(a) increases four times

(b) decreases four times

(c) increases two times

(d) no change

[CBSE SQP 2022]

13. Which radioactive isotope would have the longer half-life ^{15}O or ^{19}O ?

(Given rate constants for ^{15}O and ^{19}O are $5.63 \times 10^{-3} \text{ s}^{-1}$ and $k = 2.38 \times 10^{-2} \text{ s}^{-1}$ respectively.)

(a) ^{15}O

(b) ^{19}O

(c) Both will have the same half-life

(d) None of the above, information given is insufficient.

[CBSE SQP 2022]

In the following question, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true

14. Assertion (A): Molecularity of the reaction



Reason (R): Two molecules of the reactants are involved in the given elementary reaction.

[CBSE 2020]

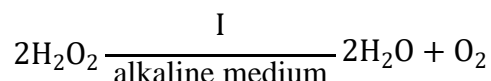
Very Short & Short Qs [1 – 3 marks]

15. (A) The conversion of molecule *A* to *B* followed second order kinetics. If concentration of *A* increased to three times, how will it affect the rate of formation of *B* ?

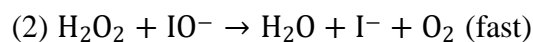
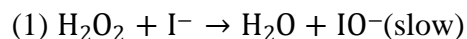
(B) Define Pseudo first order reaction with an example.

[CBSE 2023]

16. For a reaction:



the proposed mechanism is as given below:



(A) Write rate law for the reaction.

(B) Write the overall order of reaction.

(C) Out of steps (1) and (2), which one is rate determining step?

[CBSE 2019]

17. For a reaction: $\text{H}_2 + \text{Cl}_2 \xrightarrow{h\nu} 2\text{HCl}$; Rate = **k**
(A) Write the order and molecularity of this reaction.

(B) Write the unit of k.

[CBSE 2016]

18. For a reaction: $2\text{NH}_3(g) \xrightarrow{\text{Pt}} \text{N}_2(g) + 3\text{H}_2(g)$; Rate = *k*.

(A) Write the order and molecularity of this reaction.

(B) Write the unit of *k*.

[CBSE 2016]

19. "Chemical reactions proceed at vastly different speeds depending on the nature of the reacting substances, the type of chemical transformation, the temperature, and other factors."

Give an insight on the "specific rate" of a reaction.

[Mod. CBSE 2014]

20. (A) For a reaction $2\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$ (in the presence of Pt catalyst at 1130 K),

$$\text{Rate} = k.$$

Write the order of the reaction and unit of the rate constant of the reaction.

(B) Write three differences between order of reaction and molecularity of the reaction.

[Delhi Gov. SQP Term-2 2022]

3. INTEGRATED RATE EQUATION

Objective Qs [1 mark]

21. For a reaction $2\text{A} \rightarrow 3\text{B}$, rate of reaction $\frac{-d[\text{A}]}{dt}$ is equal to:

(A) $\frac{+3}{2} \frac{d[\text{B}]}{dt}$

(B) $\frac{+2}{3} \frac{d[\text{B}]}{dt}$

(C) $\frac{+1}{3} \frac{d[\text{B}]}{dt}$

(D) $+\frac{2d[\text{B}]}{dt}$

[CBSE 2023]

Very Short & Short Qs [1 - 3 marks]

22. Answer the following questions (Do any two)

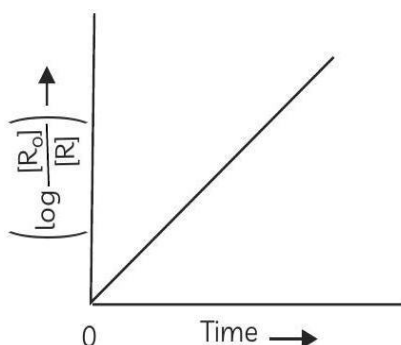
(A) Identify the order of reaction from the following unit for its rate constant: $\text{Lmol}^{-1} \text{s}^{-1}$.

(B) The conversion of molecules A to B follow second order kinetics. If concentration of A is increased to three times, how will it affect the rate of formation of B ?

(C) Write the expression of integrated rate equation for zero order reaction.

[CBSE Term-2 2022]

23. Observe the graph shown in figure and answer the following questions:



(A) What is the order of the reaction?

(B) What is the slope of the curve?

(C) Write the relationship between k and $t_{1/2}$ (half life period)?

[CBSE Term-2 2022]

24. A first-order reaction takes 69.3 min for 50% completion. What is the time needed for 80% of the reaction to get completed? (Given: $\log 5 = 0.6990$, $\log 8 = 0.9030$, $\log 2 = 0.3010$).

[CBSE SQP 2022]

25. A first order reaction is 40% completed in 80 minutes. Calculate the value of rate constant (k). In what time will the reaction be 90% completed?

[Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$, $\log 5 = 0.6771$, $\log 6 = 0.7782$]

[CBSE 2020]

26. Write the slope value obtained in the plot of $\ln [R]$ vs time for a first order reaction.

[CBSE 2020]

27. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3} \text{Ms}^{-1}$, how long will it take to reduce the initial concentration of NH_3 from 0.1M to 0.064M ?

[CBSE 2019]

28. Define half-life of a reaction. Write the expression of half-life for:

(A) zero order reaction and

(B) first order reaction.

[CBSE 2014]

29. Define the type of a reaction in which a bimolecular reaction becomes first order reaction, by stating the condition.

[Mod. CBSE 2014]

30. "The half-life of a radionuclide is important in determining the safety of food that has been radioactively contaminated."

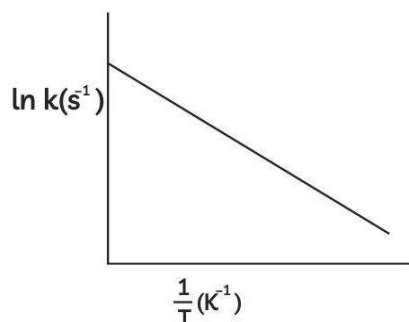
Define "half-life" period of a reaction.

[Mod. CBSE 2014]

4. EFFECT OF TEMPERATURE & CATALYST ON RATE OF THE REACTION

Objective Qs [1 mark]

31. Arrhenius equation can be represented graphically as follows:



The (i) intercept and (ii) slope of the graph are:

(a)	(i) $\ln A$	(i) E_a/R
(b)	(i) A	(ii) E_a
(c)	(i) $\ln A$	(iii) $-E_a/R$
(d)	(i) A	(iv) $-E_a$

[CBSE SQP 2022]

Very Short & Short Qs [1 - 3 marks]

32. The rate constants of a reaction at 200 K and 500 K are 0.02 s^{-1} and 0.20 s^{-1} respectively.

Calculate the value of E_a (Given $2.303R = 19.15 \text{ J K}^{-1} \text{ mol}^{-1}$)

[CBSE SQP 2023]

33. A first order reaction is 50% complete in 30 minutes at 300 K and in 100 minutes at 320K. Calculate activation energy (E_a) for the reaction. [$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$] [Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$]

[CBSE 2023]

34. Explain how and why will the rate of reaction for a given reaction be affected when:

(A) a catalyst is added

(B) the temperature at which the reaction was taking place is decreased.

[CBSE SQP 2022]

35. Draw the plot of $\ln k$ vs $1/T$ for a chemical reaction. What does the intercept represent? What is the relation between slope and E_a ?

[CBSE 2019]

36. A first order reaction is 50% complete in 50 minutes at 300 K and the same reaction is again 50% complete in 25 minutes at 350 K. Calculate activation energy of the reaction.

[CBSE SQP 2019]

37. What is the effect of adding a catalyst on:

(A) Activation energy (E_a), and

(B) Gibbs energy (ΔG) of a reaction?

[CBSE 2017]

38. The rate constant for the first order decomposition of H_2O_2 is given by the following equation:

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T}$$

Calculate E_a for this reaction and rate constant k if its half-life period be 200 minutes. (Given : $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

[CBSE 2016]

39. The rate of a first order reaction increases from 2×10^{-2} to 4×10^{-2} when the temperature changes from 300 K to 310 K. Calculate the activation energy (E_a).

($\log 2 = 0.301, \log 3 = 0.4771, \log 4 = 0.6021$)

[CBSE 2015]

40. The rate constants of a reaction at 500 K and 700 K are 0.02 and 0.07 s^{-1} respectively. Calculate the value of E_a ?

[CBSE 2015]

41. How does a change in temperature affect the rate of a reaction? How can this effect on the rate constant of reaction be represented quantitatively?

[CBSE 2014]

Numerical Qs [1 - 5 marks]

42. The rate constant for the first order decomposition of N_2O_3 is given by the following equation :

$$k = (2.5 \times 10^{14} \text{ s}^{-1})e^{(-25000)/T}$$

Calculate E_a for this reaction and rate constant if its half-life period be 300 minutes.

[CBSE 2020]

43. The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature.

[$R = 8.134 \text{ J K}^{-1} \text{ mol}^{-1}, \log 4 = 0.6021$]

[CBSE 2019]

44. A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the activation energy of the reaction. (Given: $\log 2 = 0.3010, \log 4 = 0.6021, R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

[CBSE 2018]

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CHAPTER 4

The d- and f- block elements

1. TRANSITION & INNER TRANSITION ELEMENTS

Objective Qs [1 mark]

1. Match the properties with the elements of 3d series:

(i) Lowest enthalpy of atomisation	(p) Sc
(ii) Shows maximum number of oxidation states	(q) Mn
(iii) Transition metal that does not form coloured compounds	(r) Zn
	(s) Ti

(a) (i)-(r), (ii)-(q), (iii)-(p)

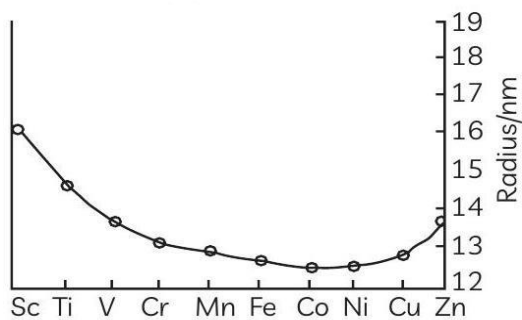
(b) (i)-(r), (ii)-(s), (iii)-(p)

(c) (i)-(p), (ii)-(q), (iii)-(r)

(d) (i)-(s), (ii)-(r), (iii)-(p)

[CBSE SQP 2023]

2. The trend of which property is represented by the following graph?



(a) ionization enthalpy

(b) atomic radii

(c) enthalpy of atomization

(d) melting point

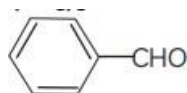
[CBSE SQP 2023]

3. Which of the following does not give Cannizzaro reaction?

(a) $(\text{CH}_3)_3\text{C} - \text{CHO}$

(b) $(\text{CH}_3)_2\text{CH} - \text{CHO}$

(c)



(d) HCHO

[CBSE 2023]

4. Which of the following reactions are feasible?

(a) $\text{CH}_3\text{CH}_2\text{Br} + \text{Na}^+\text{O} - \text{C}(\text{CH}_3)_3 \rightarrow \text{CH}_3\text{CH}_2\text{O} - \text{C}(\text{CH}_3)_3$

(b) $(\text{CH}_3)_3\text{C} - \text{Cl} + \text{Na}^+\text{O} - \text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2 - \text{O} - \text{C}(\text{CH}_3)_3$

(c) Both (a) and (b)

(d) Neither (a) nor (b)

[CBSE 2023]

5. KMnO_4 is coloured due to:

(a) *d* - *d* transitions.

(b) charge transfer from ligand to metal.

(c) unpaired electrons in *d* orbital of Mn.

(d) charge transfer from metal to ligand.

[CBSE SQP 2022]

6. Out of the following transition metals, the maximum number of oxidation states are shown by:

(a) Chromium ($Z = 24$)

(b) Manganese ($Z = 25$)

(c) Iron ($Z = 26$)

(d) Titanium ($Z = 22$)

[CBSE 2020]

In the following question, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

7. Assertion (A): Magnetic moment values of actinides are lesser than the theoretically predicted values.

Reason (R): Actinide elements are strongly paramagnetic.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

[CBSE SQP 2022]

8. Assertion (A): Transition metals have high melting point.

Reason (R): Transition metals have completely filled d -orbitals.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

[CBSE 2020]

Very Short & Short Qs [1 - 3 marks]

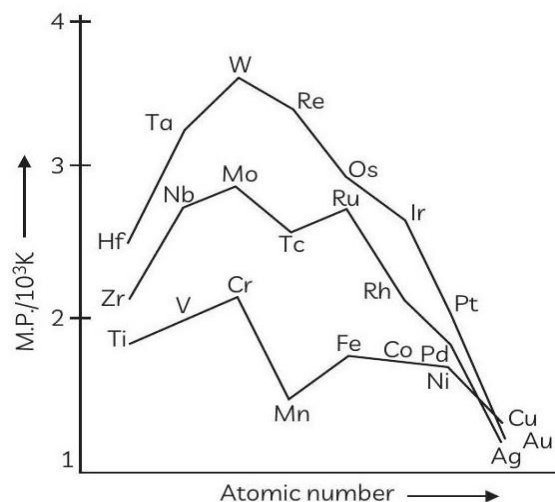
9. (A) Which ion among the following is colourless and why?



(B) Why is Mn^{2+} is much more resistant than Fe^{2+} towards oxidation?

[CBSE SQP Term-2 2022]

10. On the basis of the given figure, answer the following questions:



(source: NCERT)

- (A) Why manganese has lower melting point than chromium?
- (B) Why do transition metals of 3*d* series have lower melting points as compared to 4*d* series?
- (C) In the third transition series, identify and name the metal with the highest melting point.

[CBSE SQP Term-2 2022]

11. Account for the following:

- (A) Ti(IV) is more stable than the Ti(II) or Ti(III).
- (B) In case of transition elements, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number.
- (C) Zinc is a comparatively a soft metal, iron and chromium are typically hard.

[CBSE SQP Term-2 2022]

12. (A) Why are fluorides of transition metals more stable in their higher oxidation state as compared to the lower oxidation state?

(B) Which one of the following would feel attraction when placed in magnetic field:

Co^{2+} , Ag^+ , Ti^{4+} , Zn^{2+}

(C) It has been observed that first ionization energy of 5*d* series of transition elements are higher than that of 3*d* and 4*d* series, explain why? [CBSE SQP Term-2 2022]

13. (A) Write any two consequences of Lanthanoid contraction.

(B) Name the element of 3*d* series which exhibits the largest number of oxidation states. Give reason.

[CBSE Term-2 2022]

14. Give reasons for the following statements:

(A) Copper does not displace hydrogen from acids.

(B) Transition metals and most of their compounds show paramagnetic behaviour.

(C) Zn, Cd and Hg are soft metals.

[CBSE Term-2 2022]

15. Out of zinc and tin, whose coating is better to protect iron objects?

[CBSE 2020]

16. Account for the following:

Copper (I) compounds are white whereas copper (II) compounds are coloured.

[CBSE 2020]

17. Calculate the spin-only moment of Co^{2+} ($Z = 27$) by writing the electronic configuration of Co and Co^{2+} .

[CBSE 2020]

18. Give reason and select one atom/ion which will exhibit asked property:

(A) Sc^{3+} or Cr^{3+} (exhibit diamagnetic behaviour)

(B) Cr or Cu (high melting and boiling point)

[CBSE 2020]

19. Following ions are given:

Cr^{2+} , Cu^{2+} , Cu^{+} , Fe^{2+} , Fe^{3+} , Mn^{3+}

Identify the ion which is:

(A) a strong reducing agent.

(B) unstable in aqueous solution.

(C) a strong oxidising agent.

Give suitable reason in each.

[CBSE 2020]

20. Give reason for the following:

Eu^{2+} is a strong reducing agent.

[CBSE 2019]

21. Write the formula of an oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number.

[CBSE 2017]

22. Write the formula of an oxo-anion of manganese (Mn) in which it shows the oxidation state equal to its group number.

[CBSE 2017]

23. Why do transition elements show variable oxidation states?

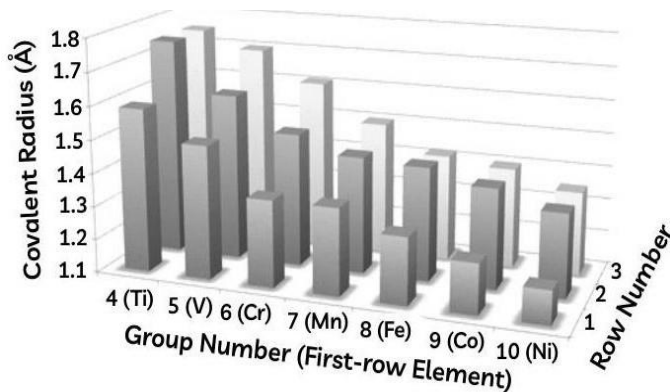
[CBSE 2017]

24. "Color in transition-series metal compounds is generally due to electronic transitions of two major types, namely, charge transfer transitions and $d - d$ transitions. TiO_2 is one of the most efficient photocatalyst materials for the degradation of organic dyes."

Explain, why Zn^{2+} salts are white while Cu^{2+} salts are coloured.

[Mod. CBSE 2015]

25. Observe the bar graph given below illustrating the covalent radii of $3d$, $4d$ and $5d$ series:



Explain why Zr and Hf have almost similar atomic radii.

[Mod. CBSE 2015]

26. How would you account for the following:

Transition elements form coloured compounds.

[CBSE 2015]

27. Give reasons:

Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.

[CBSE 2016]

28. What are the transition elements? Write two characteristics of the transition elements.

[CBSE 2015]

29. Why do transition elements show variable oxidation states? In 3d series (Sc to Zn), which element shows the maximum number of oxidation states and why?

[CBSE 2015]

30. Why do transition elements show variable oxidation states?

[CBSE 2014]

31. Write any two characteristics of transition elements.

[CBSE 2014]

32. Give reason:

Transition metals are much harder than the alkali metals.

[CBSE 2014]

33. Give reason:

Transition metals and many of their compounds act as good catalysts.

[CBSE 2014]

34. Account for the following:

(A) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state?

(B) The enthalpy of atomisation is lowest for Zn in 3d series of the transition elements.

[CBSE 2014]

35. Assign a reason for each of the following observations:

(A) Transition metals (with the exception of Zn, Cd and Hg) are hard and have high melting and boiling points.

(B) The ionization enthalpies (first and second) in the first series of the transition elements are found to vary irregularly.

[CBSE 2014]

Long Qs [4 - 5 marks]

36. (A) Account for the following:

(i) E° value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}

(ii) Sc^{3+} is colourless whereas Ti^{3+} is coloured in an aqueous solution.

(iii) Actinoids show wide range of oxidation states.

(B) Write the chemical equations for the preparation of KMnO_4 from MnO_2 .

OR

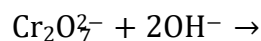
(A) Account for the following:

(i) Transition metals form alloys.

(ii) Ce^{4+} is a strong oxidising agent.

(B) Write one similarity and one difference between chemistry of Lanthanoids and Actinoids.

(C) Complete the following ionic equation:



[CBSE 2023]

37. Answer the following:

(A) Why are all copper halides known except that copper iodide?

(B) Why is the $E^\circ(\text{V}^{3+}/\text{V}^{2+})$ value for vanadium comparatively low?

(C) Why HCl should not be used for potassium permanganate titrations?

(D) Explain the observation, at the end of each period, there is a slight increase in the atomic radius of *d*-block elements.

(E) What is the effect of pH on dichromate ion solution?

[CBSE SQP 2022]

2. IMPORTANT COMPOUNDS OF TRANSITION ELEMENTS

Very Short & Short Qs [1 - 3 marks]

38. Give reasons for following:

(A) Zinc is not considered as transition element.

(B) Cr^{2+} is reducing and Mn^{3+} is oxidising when both have d^4 configuration

(C) Transition metals and their compounds are known for their catalytic activity.

[Delhi Gov. SQP Term-2 2022]

39. Write the balanced chemical equations involved in the preparation of KMnO_4 from pyrolusite ore (MnO_2).

[CBSE 2020]

40. Account for the following:

Chromates change their colour when kept in an acidic solution.

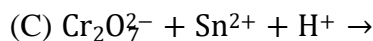
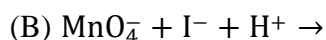
[CBSE 2020]

41. When MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A).

Compound (A) disproportionates in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C) and (D).

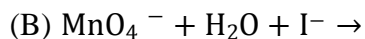
[CBSE 2019]

42. Complete the following equations:



[CBSE 2019]

43. Complete and balance the following chemical equations:

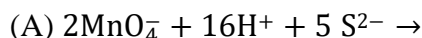


[CBSE 2018]

44. Orange colour of $\text{Cr}_2\text{O}_7^{2-}$ ion changes to yellow when treated with an alkali. Why?

[CBSE 2017]

45. Complete the following equations:



[CBSE 2017]

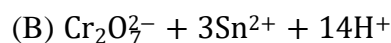
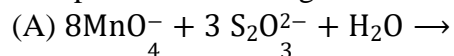
46. When chromite ore FeCr_2O_4 is fused with NaOH in presence of air, a yellow coloured compound (X) is obtained which on acidification with dilute sulphuric acid gives a compound (Y). Compound (Y) on reaction with KCl forms an orange coloured crystalline compound (Z).

(A) Write the formulae of the compounds (X), (Y) and (Z).

(B) Write one use of compound (Z).

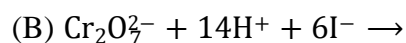
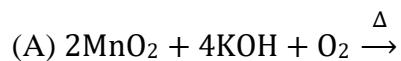
[CBSE 2016]

47. Complete the following chemical equations:



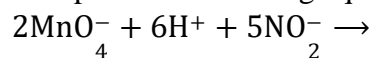
[CBSE 2016]

48. Complete the following equations:



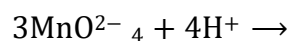
[CBSE 2016]

49. Complete the following equation:



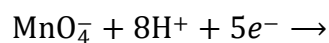
[CBSE 2015]

50. Complete the following equation:



[CBSE 2015]

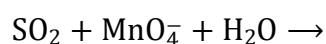
51. Complete the following equation:



[CBSE 2014]

The *d* - and *f*-block elements

52. Complete the following chemical equation:



[CBSE 2014]

53. How do you prepare :

(A) K_2MnO_4 from MnO_2

(B) $Na_2Cr_2O_7$ from Na_2CrO_4 ?

[CBSE 2014]

54. Complete the following equations:

(A) $Cr_2O_7^{2-} + 2OH^- \rightarrow$

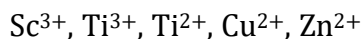
(B) $MnO_4^- + 4H^+ + 3e^- \rightarrow$

[CBSE 2014]

Long Qs [4 - 5 marks]

55. Attempt any five of the following:

(A) Which of the following ions will have a magnetic moment value of 1.73BM.



(B) In order to protect iron from corrosion, which one will you prefer as a sacrificial electrode, Ni or Zn ? Why? (Given standard electrode potentials of Ni, Fe and Zn are -0.25 V, -0.44 V and -0.76 V respectively.)

(C) The second ionization enthalpies of chromium and manganese are 1592 and 1509 kJ/mol respectively. Explain the lower value of Mn.

(D) Give two similarities in the properties of Sc and Zn.

(E) What is actinoid contraction? What causes actinoid contraction?

(F) What is the oxidation state of chromium in chromate ion and dichromate ion?

(G) Write the ionic equation for reaction of KI with acidified $KMnO_4$.

[CBSE SQP 2023]

PREVIOUS YEAR
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CLASS 12

CHAPTER 5
Coordination Compounds

1. NOMENCLATURE & ISOMERISM OF COORDINATION COMPOUNDS

Objective Qs [1 mark]

- The formula of the complex dichloridobis (ethane-1, 2-diamine) platinum (IV) nitrate is:
(a) $[\text{PtCl}_2(\text{en})_2(\text{NO}_3)_2]$
(b) $[\text{PtCl}_2(\text{en})_2](\text{NO}_3)_2$
(c) $[\text{PtCl}_2(\text{en})_2(\text{NO}_3)]\text{NO}_3$
(d) $[\text{Pt}(\text{en})_2(\text{NO}_3)_2]\text{Cl}_2$
[CBSE 2023]
- What is the secondary valency of Cobalt in $[(\text{Co}(\text{en})_2\text{Cl}_2)]^+?$
(a) 6
(b) 4
(c) 2
(d) 8
[CBSE 2023]
- The number of ions formed on dissolving one molecule of $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ in water is:
(a) 3
(b) 4
(c) 5
(d) 6 [CBSE SQP 2022]
- One mole of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ compound reacts with excess AgNO_3 solution to yield two moles of $\text{AgCl}_{(s)}$. The structural formula of the compound is:
(a) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$
(b) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}_3] \cdot 3\text{H}_2\text{O}$
(c) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
(d) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
[CBSE 2020]

5. The coordination number of Co in the complex $[\text{Co}(\text{en})_3]^{3+}$ is:

- (a) 3
- (b) 6
- (c) 4
- (d) 5

[CBSE 2020]

6. The oxidation number of Ni in $[\text{Ni}(\text{CO})_4]$ is:

- (a) 0
- (b) 2
- (c) 3
- (d) 4

[CBSE 2020]

7. Predict the number of ions produced per formula unit in an aqueous solution of $[\text{Co}(\text{en})_3]\text{Cl}_3$:

- (a) 4
- (b) 3
- (c) 6
- (d) 2

[CBSE 2019]

8. Ambidentate ligands like NO_2^- and SCN^- are:

- (a) unidentate
- (b) didentate
- (c) polydentate
- (d) has variable denticity

[CBSE SQP 2019]

In the following question (Q. No. 9-10) a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and R is the correct explanation of A.
- (b) Both (A) and (R) are true and R is not the correct explanation of A.
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

9. Assertion (A): $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ complex is less stable than $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]^{2+}$ complex.

Reason (R): $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ complex shows chelate effect.

[CBSE 2020]

10. Assertion (A): Linkage isomerism arises in coordination compounds because of ambidentate ligand.
Reason (R): Ambidentate ligand like NO_2 has two different donor atoms i.e., N and O.

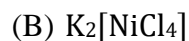
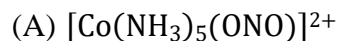
[CBSE 2020]

Very Short & Short Qs [1 - 3 marks]

11. (A) Write the formula for the following coordination compound Bis(ethane-1, 2-diamine) dihydroxidochromium(III) chloride.
(B) Does ionization isomer for the following compound exist? Justify your answer. $\text{Hg}[\text{Co}(\text{SCN})_4]$
(C) Is the central metal atom in coordination complexes a Lewis acid or a Lewis base? Explain.

[CBSE SQP 2023]

12. Write the IUPAC names of the following:



OR

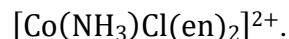
- (A) What is a chelate complex? Give one example.
(B) What are heteroleptic complexes? Give one example.

[CBSE 2023]

13. The formula $\text{Co}(\text{NH}_3)_5\text{CO}_3\text{Cl}$ could represent a carbonate or a chloride. Write the structures and names of possible isomers.

[CBSE SQP 2022]

14. (A) Write the IUPAC name of:



- (B) Discuss bonding, geometry and magnetic property of $[\text{Ni}(\text{CN})_4]^{2-}$.

[Delhi Gov. SQP Term-2 2022]

15. Explain the following giving examples:

- (A) Ambidentate ligand
(B) Coordination number

(C) Chelate complex

[Delhi Gov. SQP Term-2 2022]

16. Give the formulae of the following compounds:

(A) Potassium tetrahydroxidozincate (II)

(B) Hexaammineplatinum (IV) chloride

[CBSE 2020]

17. What is the difference between a complex and a double salt?

[CBSE 2019]

18. Using IUPAC norms write the formulae for the following:

(A) Pentaamminenitrito-o-cobalt (III) chloride

(B) Potassium tetracyanonickelate (II)

[CBSE 2019]

19. Write IUPAC name of the complex $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$. Draw structures of geometrical isomers for this complexes.

[CBSE 2019]

20. Write the coordination number and oxidation state of Platinum in the complex $[\text{Pt}(\text{en})_2\text{Cl}_2]$.

[CBSE 2018]

21. Write the formula of the following coordination compound:

Iron (III) hexacyano ferrate (II)

[CBSE 2018]

22. Write the IUPAC name of the following complex:

$[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$

[CBSE 2018]

23. What type of isomerism is exhibited by the complex $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$?

[CBSE 2018]

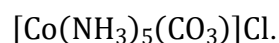
24. What type of isomerism is shown by the complex $[\text{Co}(\text{en})_3\text{Cl}_3]$?

[CBSE 2017]

25. What type of isomerism is shown by the complex $[\text{Co}(\text{NH}_3)_5(\text{SCN})]^{2+}$?

[CBSE 2017]

26. Write the IUPAC name of the following complex:



[CBSE 2017]

27. What type of isomerism is shown by the complex $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$?

[CBSE 2017]

28. Using IUPAC norms write the formulae for the following:

(A) Sodium dicyanidoaurate (I)

(B) Tetraamminechloridonitrito-N-platinum (IV) sulphate

[CBSE 2017]

29. Using IUPAC norms write the formulas for the following:

(A) Tris (ethane- 1, 2, diamine) chromium (III) chloride

(B) Potassium tetrahydrozincate (II)

[CBSE 2017]

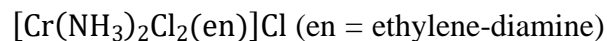
30. When a coordination compound $\text{CoCl}_3 \cdot 6\text{NH}_3$ is mixed with AgNO_3 , 3 moles of AgCl are precipitated per mole of the compound. Write structural formula of the complex.

[CBSE 2016]

31. Draw one of the geometrical isomers of the complex $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$ which is optically active.

[CBSE 2016]

32. (A) Write down the IUPAC name of the following complex:



(B) Write the formula for the following complex:

Pentaamminenitrito-o-cobalt (III)

[CBSE 2015]

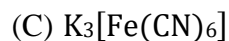
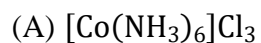
33. (A) Write down the IUPAC name of the following complex: $[\text{Cr}(\text{en})_3]\text{Cl}_3$

(B) Write the formula for the following complex:

Potassium trioxalatochromate (III)

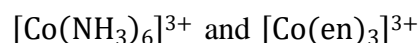
[CBSE 2015]

34. Write the IUPAC name of the following:



[CBSE 2015]

35. Which of the following is more stable complex and why?

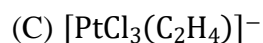
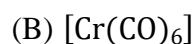
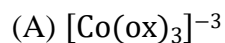


[CBSE 2014]

36. What type of isomerism is exhibited by the complex $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$?

[CBSE 2014]

37. Write the IUPAC name and draw the structure of each of the following complex entities:



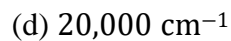
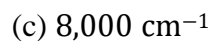
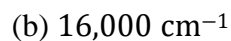
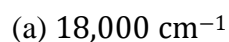
(At. nos. Cr = 24, Co = 27, Pt = 78)

[CBSE 2014]

2. BONDING IN COORDINATION COMPOUNDS

Objective Qs [1 mark]

38. The CFSE for octahedral $[\text{CoCl}_6]^{4-}$ is $18,000 \text{ cm}^{-1}$. The CFSE for tetrahedral $[\text{CoCl}_4]^{2-}$ will be:



[CBSE SQP 2022]

39. The crystal field splitting energy for octahedral (Δ_0) and tetrahedral (Δ_t) complexes are related as:

(a) $\Delta_t = \frac{4}{9} \Delta_0$

(b) $\Delta_t = \frac{1}{2} \Delta_0$

(c) $\Delta_0 = \frac{2}{4} \Delta_t$

(d) $\Delta_0 = \frac{9}{4} \Delta_t$

[CBSE 2020]

Case Based CBQ [4 - 5 marks]

Read the following passage and answer the questions that follow:

40. Crystal field splitting by various ligands

Metal complexes show different colours due to $d-d$ transitions. The complex absorbs light of specific wavelength to promote the electron from t_{2g} to e_g level. The colour of the complex is due to the transmitted light, which is complementary of the colour absorbed.

The wave number of light absorbed by different complexes of Cr ion are given below:

Complex	Wavenumber of light absorbed (cm^{-1})	Energy of light absorbed (kJ/mol)
$[\text{CrA}_6]^{3-}$	13640	163
$[\text{CrB}_6]^{3+}$	17830	213
$[\text{CrC}_6]^{3+}$	21680	259
$[\text{CrD}_6]^{3-}$	26280	314

Answer the following questions:

(A) Out of the ligands " X ", " Y ", " Z " and " W ", which ligand causes maximum crystal field splitting? Why? [1]

OR

Which of the two, " W " or " W " will be a weak field ligand? Why?

(B) Which of the complexes will be violet in colour? $[\text{CrA}_6]^{3-}$ or $[\text{CrB}_6]^{3+}$ and why? (Given: If 560 – 570 nm of light is absorbed, the colour of the complex observed is violet.) [1]

(C) If the ligands attached to Cr^{3+} ion in the complexes given in the table above are water, cyanide ion, chloride ion, and ammonia (not in this order)

Identify the ligand, write the formula and IUPAC name of the following:

(i) $[\text{CrA}_6]^{3-}$

(ii) $[\text{CrC}_6]^{3+}$

[CBSE SQP 2023]

Very Short & Short Qs [1-3 marks]

41. In a coordination entity, the electronic configuration of the central metal ion is $t^3 e^1$.
 $2 g g$

(A) Is the coordination compound a high spin or low spin complex?

(B) Draw the crystal field splitting diagram for the above complex.

[CBSE SQP Term-2 2022]

42. Answer the following questions:

(A) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ (aq) is green in colour whereas $[\text{Ni}(\text{H}_2\text{O})_4(\text{en})]^{2+}$ (aq) is blue in colour. Give reason in support of your answer.

(B) Write the formula and hybridization of the following compound: tris(ethane-1,2-diamine) cobalt(III) sulphate

[CBSE SQP Term-2 2022]

43. Using Valence Bond Theory, explain the following in relation to the paramagnetic complex $[\text{Mn}(\text{CN})_6]^{3-}$:

(A) Type of hybridisation

(B) Magnetic moment value

(C) Type of complex.

[CBSE SQP 2022]

44. (A) Write the IUPAC name of the following complex: $\text{K}_2[\text{PdCl}_4]$

(B) Using crystal field theory, write the electronic configuration of d^5 ion, if $\Delta_0 > P$.

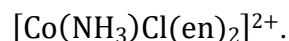
(C) What are Homoleptic complexes?

[CBSE Term-2 2022]

45. (A) Why chelate complexes are more stable than complexes with unidentate ligands?
(B) What is "spectrochemical series"? What is the difference between a weak field ligand and a strong field ligand?

[CBSE Term-2 2022]

46. (A) Write the IUPAC name of:



- (B) Discuss bonding, geometry and magnetic property of $[\text{Ni}(\text{CN})_4]^{2-}$.

[Delhi Gov. SQP Term-2 2022]

47. Write the IUPAC name and hybridisation of the complex $[\text{CoF}_6]^{3-}$

[Given: Atomic number of Co = 27]

[CBSE 2020]

48. Give the formula of each of the following coordination entities:

(A) Co^{3+} ion is bound to one Cl^- , one NH_3 molecule and two bidentate ethylene diamine (en) molecules.

(B) Ni^{2+} ion is bound to two water molecules and two oxalate ions.

Write the name and magnetic behaviour is each of the above coordination entities.

[At. nos. Co = 27, Ni = 28]

[CBSE 2019]

49. Two complex is given as $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, which one complex is:

(A) diamagnetic

(B) more stable

(C) outer orbital complex and

(D) low spin complex?

[Atomic no. of Co = 27]

[CBSE 2019]

50. Write the hybridisation and magnetic character of $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$.

[At. No. of Co = 27]

[CBSE 2017]

51. Why a solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green while a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless?

[CBSE 2017]

52. (A) Why is $[\text{NiCl}_4]^{2-}$ paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic?

[Atomic number of Ni = 28]

(B) Why are low spin tetrahedral complex rarely observed?

[CBSE 2017]

53. For the complex $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$, write the hybridization, magnetic character and spin of the complex.

[At. number of Fe = 26]

[CBSE 2016]

54. Why is $[\text{NiCl}_4]^{2-}$ is paramagnetic but $[\text{Ni}(\text{CO})_4]$ is diamagnetic?

[CBSE 2014]

55. Write the state of hybridisation, shape and IUPAC name of the complex $[\text{Co}(\text{NH}_3)_6]^{3+}$. [Atomic no. of Co = 27].

[CBSE 2014]

56. Write the state of hybridisation, shape and IUPAC name of the following complex:

$[\text{Ni}(\text{CN})_4]^{2-}$

[CBSE 2014]

57. Write the name, stereochemistry and magnetic behaviour of the following:

[At. nos. Mn = 25, Co = 27, Ni = 28]

(A) $\text{K}_4[\text{Mn}(\text{CN})_6]$

(B) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$

[CBSE 2014]

PREVIOUS YEAR
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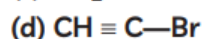
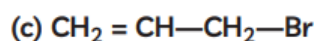
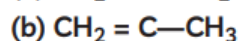
CLASS 12

CHAPTER 6
Haloalkanes and Haloarenes

1. CLASSIFICATION & NOMENCLATURE OF HALOALKANES & HALOARENES

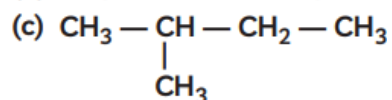
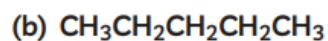
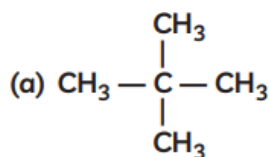
Objective Qs [1 mark]

1. Which of the following belongs to the class of Vinyl halides?



[CBSE 2023]

2. Which of the following isomer of pentane (C_5H_{12}) will give three isomeric monochlorides on photochemical chlorination?

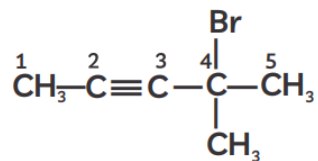


(d) All of the above

[CBSE Term-1 2021]

Very Short & Short Qs [1-3 marks]

3. Write the IUPAC name of



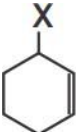
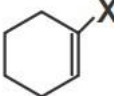
[CBSE 2019]

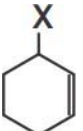
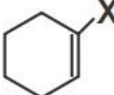
4. Write the structure of 1-Bromo-4-chlorobut2-ene.


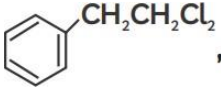
[CBSE 2017]

5. Write the structure of 3-Bromo-2-methyl prop-1-ene.

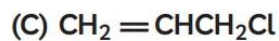
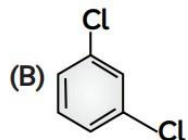
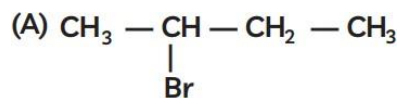
[CBSE 2017]

6. Out of  and , which is an example of allylic halide?
[CBSE 2017]

7. Out of  and , which is an example of vinylic halide?
[CBSE 2017]

8. Out of  and , which is an example of benzylic halide?
[CBSE 2017]

9. Give the IUPAC names of the following compounds:

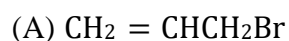


[CBSE 2015]

10. Draw the structure of 2-bromopentane.

[CBSE 2014]

11. Write the IUPAC names of the following compounds:



(B) $(\text{CCl}_3)_3\text{CCl}$

[CBSE 2014]

2. PREPARATION METHODS OF HALOALKANES & HALOARENES

Objective Qs [1 mark]

12. Major product obtained on reaction of 3-Phenyl propene with HBr in presence of organic peroxide is:

- (a) 3 - phenyl -1- bromopropane
- (b) 1 - phenyl-3- bromopropane
- (c) 1 - phenyl-2-bromopropane
- (d) 3 - phenyl -2- bromopropane

[CBSE SQP Term-1 2021]

13. o-Hydroxy benzyl alcohol when reacted with PCl_3 gives the product as (IUPAC name):

- (a) o- hydroxy benzyl chloride
- (b) 2-chloromethylphenol
- (c) o-chloromethylchlorobenzene
- (d) 4-hydroxymethylphenol

[CBSE SQP Term-1 2021]

14. The reaction of toluene with Cl_2 in presence of FeCl_3 gives ' X ' while the of toluene with Cl_2 in presence of light gives ' Y '. Thus ' X ' and ' Y ' are:

- (a) $X =$ benzyl chloride $Y =$ o and $p -$ chlorotoluene
- (b) $X = m -$ chlorotoluene $Y = p -$ chlorotoluene
- (c) $X =$ o and p -chlorotoluene $Y =$ trichloromethylbenzene
- (d) $X =$ benzyl chloride, $Y = m$ -chlorotoluene

[CBSE SQP Term-1 2021]

15. Which reagents are required for one step conversion of chlorobenzene to toluene?

- (a) $\text{CH}_3\text{Cl}/\text{AlCl}_3$
- (b) CH_3Cl , Na, Dry ether

(c) $\text{CH}_3\text{Cl}/\text{Fe}$ dark

(d) $\text{NaNO}_2/\text{HCl}/0 - 5^\circ\text{C}$

[CBSE SQP Term-1 2021]

Very Short & Short Qs [1 -3 marks]

16. How can you convert the following?

But-1-ene to 1-iodobutane

[CBSE 2020]

17. Give reason for the following:

Thionyl chloride method is preferred for preparing alkyl chloride from alcohols.

[CBSE 2019]

18. Write equation for preparation of 1-iodobutane from 1-chlorobutane.

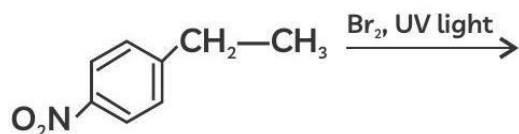
[CBSE 2019]

19. How do you convert: Propene to 1-iodopropane.

[CBSE 2016]

20. Write the major product in the following:

[CBSE 2016]



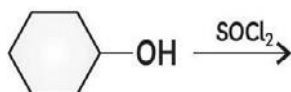
21. Write the structure of the major product in each of the following reactions:



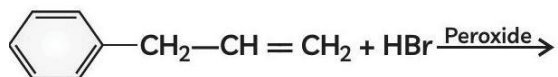
[CBSE 2015]

22. Draw the structure of major monohalo product in each of the following reactions:

(A)

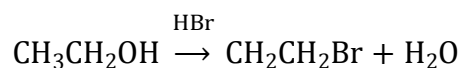


(B)



[CBSE 2014]

23. Write the mechanism of the following reaction:



[CBSE 2014]

3. PHYSICAL AND CHEMICAL PROPERTIES OF HALOALKANES & HALOARENES

Objective Qs [1 mark]

24. Which of the following is not correct?

- (a) In haloarenes, the electron pairs on halogen atom are in conjugation with π -electrons of the ring.
- (b) The carbon-magnesium bond is covalent and non-polar in nature. (c) During S_N1 reaction, the carbocation formed in the slow step being sp^2 hybridised is planar.
- (d) Out of $\text{CH}_2 = \text{CH} - \text{Cl}$ and $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$, $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$ is more reactive towards S_N1 reaction.

[CBSE SQP 2023]

25. Retention of configuration is observed in:

- (a) S_N1 reaction
- (b) S_N2 reaction
- (c) Neither S_N1 nor S_N2 reaction
- (d) S_N2 reaction as well as S_N1 reaction

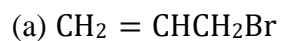
[CBSE 2023]

26. Which of the following reactions are feasible?

- (a) $\text{CH}_3\text{CH}_2\text{Br} + \text{Na}^+\text{O} - \text{C}(\text{CH}_3)_3 \rightarrow \text{CH}_3\text{CH}_2\text{O} - \text{C}(\text{CH}_3)_3$
- (b) $(\text{CH}_3)_3\text{C} - \text{Cl} + \text{Na}^+\text{O} - \text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2 - \text{O} - \text{C}(\text{CH}_3)_3$
- (c) Both (a) and (b)
- (d) Neither (a) nor (b)

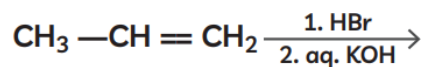
[CBSE 2023]

27. Which one of the following compounds is more reactive towards S_N1 reaction?

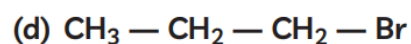
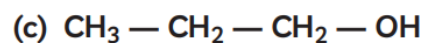
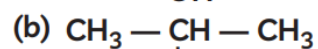
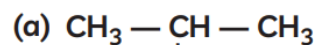


[CBSE SQP 2022]

28. Consider the following reaction



The major end product is:



[CBSE Term-1 2021]

29. Which of the following isomer has the highest melting point?

(a) 1,2-Dichlorobenzene

(b) 1,3 -Dichlorobenzene

(c) 1,4-Dichlorobenzene

(d) All isomers have same melting points

[CBSE SQP Term-1 2021]

30. Complete the following analogy:

Same molecular formula but different structures:

A:: Non superimposable mirror images: B

(a) A : Isomers B: Enantiomer

(b) A : Enantiomers B : Racemic mixture

(c) A : Stereoisomers B : Retention

(d) A : Isomers B : Stereoisomers

[CBSE SQP Term-1 2021]

31. Enantiomers differ only in:

(a) boiling point

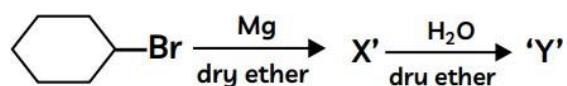
(b) rotation of polarised light

(c) melting point

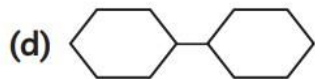
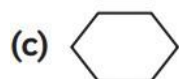
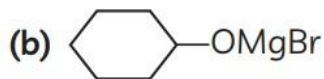
(d) solubility

[CBSE Term-1 2021]

32. In the reaction



compound 'Y' is:



[CBSE Term-1 2021]

33. Which one of the following halides contains $C_{sp^2} - X$ bond?

(a) Allyl halide

(b) Alkyl halide

(c) Benzyl halide

(d) Vinyl halide

[CBSE Term-1 2021]

34. Which of the following is optically inactive?

(a) (+) - Butan-2-ol

(b) (-) - Butan-2-ol

(c) (\pm) - Butan-2-ol

(d) (+) - 2 - Bromobutane

[CBSE Term-1 2021]

35. Which of the following has highest boiling point?

(a) $C_2H_5 - F$

(b) $C_2H_5 - Cl$

(c) $C_2H_5 - Br$

(d) $C_2H_5 - I$

[CBSE Term-1 2021]

36. $CH_3CH_2CH_2Cl \xrightarrow{alc. KOH} B \xrightarrow{HBr} C \xrightarrow{Na/ether} D$ in this reaction *D* is:

(a) Propanone

(b) Hexane

(c) 2,3-dimethylbutane

(d) Allylic bromide

[Delhi Gov. SQP Term-1 2021]

37. Which of the following is a correct statement for C_2H_5Br ?

(a) It reacts with metallic Na to give ethane.

(b) It gives nitroethane on heating with aqueous solution of $AgNO_2$

(c) It gives C_2H_5OH on boiling with alcoholic potash.

(d) It forms diethylthioether on heating with alcoholic KSH.

[CBSE SQP Term-1 2021]

38. Alkyl halides which will undergo S_N1 reaction most readily is:

(a) $(CH_3)_3C - Cl$

(b) $(CH_3)_3C - Br$

(c) $(CH_3)_3C - F$

(d) $(CH_3)_3C - I$

[Delhi Gov. SQP Term-1 2021]

39. Which of the following isomer has the highest melting point:

(a) 1, 2-dichlorobenzene

- (b) 1, 3-dichlorobenzene
- (c) 1, 4-dichlorobenzene
- (d) all isomers have same melting points.

[CBSE SQP Term-I-2021]

40. Racemisation occurs in:

- (a) S_N2 reaction
- (b) S_N1 reaction
- (c) Neither S_N2 nor S_N1 reactions
- (d) S_N2 reaction as well as S_N1 reaction.

[CBSE 2020]

41. The conversion of an alkyl halide into an alcohol by aqueous NaOH is classified as:

- (a) A dehydrohalogenation reaction
- (b) A substitution reaction
- (c) An addition reaction
- (d) A dehydration reaction

[CBSE 2020]

In the following questions (Q. No. 42-44) a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

42. Assertion (A): Chlorobenzene is resistant to electrophilic substitution reaction.

Reason (R): C – Cl bond in chlorobenzene acquires partial double bond characters due to resonance.

[CBSE 2023]

43. Assertion (A): Chlorobenzene is less reactive towards nucleophilic substitution reaction.

Reason (R): Nitro group in chlorobenzene increases its reactivity towards nucleophilic substitution reaction.

[CBSE Term-1 2021]

44. Assertion (A): Alkyl halides are insoluble in water.

Reason (R): Alkyl halides have halogen attached to sp^3 hybrid carbon.

[CBSE SQP Term-1 2021]

Very Short & Short Qs [1 -3 marks]

45. (A) Arrange the isomeric dichlorobenzene in the increasing order of their boiling point and melting points.

(B) Explain why the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.

[CBSE SQP 2023]

46. Answer any 3 of the following:

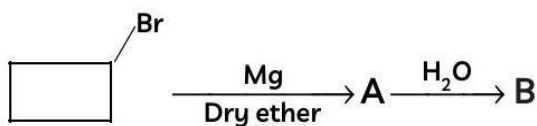
(A) Which isomer of C_5H_{10} gives a single monochloro compound C_5H_9Cl in bright sunlight?

(B) Arrange the following compounds in increasing order of reactivity towards S_N^2 reaction:

2-Bromopentane, 1-Bromopentane, 2-Bromo-2-methylbutane

(C) Why p-dichlorobenzene has higher melting point than those of ortho- and meta-isomers?

(D) Identify A and B in the following:



[CBSE 2023]

47. Give reason for the following:

(A) During the electrophilic substitution reaction of haloarenes, para substituted derivative is the major product.

(B) The product formed during S_N1 reaction is a racemic mixture.

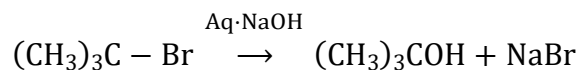
[CBSE SQP 2022]

48. (A) Name the suitable alcohol and reagent, from which 2-chloro-2-methyl propane can be prepared.

(B) Out of the chloromethane and fluoromethane, which one has higher dipole moment and why?

[CBSE SQP 2022]

49. Write the mechanism of the following S_N1 reaction.



[CBSE 2020]

50. "Melting point of a structure depends on the lattice structure of the compound. And the molecules having efficient packaging have high melting points as it requires larger force of attraction to break the structure."

Give reason for the following: *p*-dichlorobenzene has higher melting point than that of ortho or meta isomer.

[CBSE 2019]

51. Out of chlorobenzene and benzyl chloride, which one gets easily hydrolysed by aqueous NaOH and why?

[CBSE 2018]

52. Explain the following:

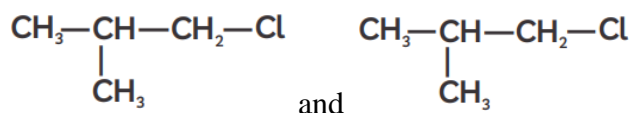
Alkyl halides, though polar, are immiscible with water.

[CBSE 2017, 15]

53. Explain why the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.

[CBSE 2016]

54. Out of the following



Which is more reactive towards S_N1 reaction and why?

[CBSE 2016]

55. Write the structure of an isomer of compound $\text{C}_4\text{H}_9\text{Br}$ which is most reactive towards S_N1 reaction.

[CBSE 2016]

56. Give reasons:

(A) C – Cl bond length in chlorobenzene is shorter than C – Cl bond length in $\text{CH}_3 - \text{Cl}$.

(B) S_N1 reactions are accompanied by racemisation in optically active alkyl halides.

[CBSE 2016]

57. How do you convert:

(A) chlorobenzene to biphenyl

(B) 2-bromobutane to but-2-ene.

[CBSE 2016]

58. (A) $2\text{CH}_3 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3 \xrightarrow[\text{dry ether}]{\text{Na}} ?$

(B) $\text{CH}_3 - \text{CH}_2 - \text{Br} \xrightarrow{\text{AgCN}} ?$

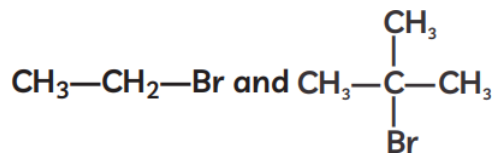
[CBSE 2016]

59. Give reason

n-Butyl bromide has higher boiling point than *t*-butyl bromide.

[CBSE 2015]

60. Which would undergo S_N2 reaction faster in the following pair and why?



[CBSE 2015]

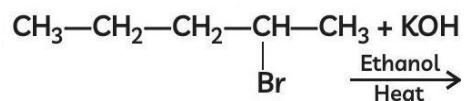
61. Which would undergo S_N2 reaction faster in the following pair and why?

$\text{CH}_3 - \text{CH}_2 - \text{Br}$ and $\text{CH}_3 - \text{CH}_2 - \text{I}$

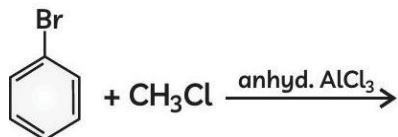
[CBSE 2015]

62. Write the structure of the major product in each of the following reactions:

(A)



(B)



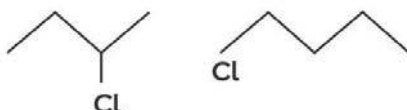
[CBSE 2015]

63. (A) Why is butan-1-ol optically inactive but butane-2-ol is optically active?
 (B) Although chlorine is an electron withdrawing group, yet it is ortho-, para-directing in electrophilic aromatic substitution reaction. Why?

[CBSE 2015]

64. Identify the chiral molecule in the following pair:

[CBSE 2014]



65. What are ambident nucleophiles? Explain with an example.

[CBSE 2014]

66. Write chemical equations when:

- (A) Methyl chloride is treated with AgNO_2 .
 (B) Bromobenzene is treated with CH_3Cl in the presence of anhydrous AlCl_3 .

[CBSE 2014]

67. Write chemical equation when:

- (A) ethyl chloride is treated with aqueous KOH
 (B) chlorobenzene is treated with CH_3COCl in presence of anhydrous AlCl_3 .

[CBSE 2014]

PREVIOUS YEAR
QUESTION
PAPERS

CHEMISTRY

CLASS 12

CHAPTER 7

Alcohols, Phenols and Ethers

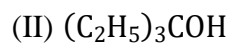
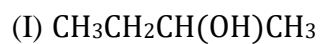
1. CLASSIFICATION, NOMENCLATURE & PREPARATION OF ALCOHOLS & PHENOLS

Objective Qs [1 mark]

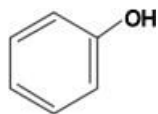
- The major product of acid catalysed dehydration of 1-methylcyclohexanol is:
 - 1-methylcyclohexane
 - 1-methylcyclohexene
 - 1-cyclohexylmethanol
 - 1-methylenecyclohexane

[CBSE SQP 2022]

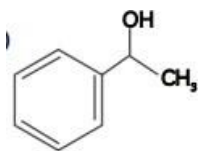
- Identify the secondary alcohols from the following set:



(III)



(IV)



Choose the correct option:

- (I) and (IV)
- (I) and (III)
- (I) and (II)
- (I), (III) and (IV)

[CBSE SQP Term-1 2021]

3. What would be the reactant and reagent used to obtain 2, 4-dimethyl pentan-3-ol?
- (a) Propanal and propyl magnesium bromide
 - (b) 3-Methylbutanal and 2-methyl magnesium iodide
 - (c) 2-Dimethylpropanone and methyl magnesium iodide
 - (d) 2-Methylpropanal and isopropyl magnesium iodide

[CBSE SQP Term-1 2021]

4. What is the common name of Butan-2-ol?
- (a) n-Butyl alcohol
 - (b) sec-Butyl alcohol
 - (c) iso-Butyl alcohol
 - (d) tert-Butyl alcohol

[Delhi Gov. SQP Term-1 2021]

5. Phenol and ethanol may be distinguished with which reagent?

- (a) $\text{NaOH}_{(\text{aq.})}$
- (b) Neutral FeCl_3
- (c) H_2/Ni
- (d) NaHCO_3

[Delhi Gov. SQP Term-1 2021]

6. Which of the following acids reacts with acetic anhydride to form a compound Aspirin?
- (a) Benzoic acid
 - (b) Salicylic acid
 - (c) Phthalic acid
 - (d) Acetic acid

[CBSE SQP Term-1 2021]

7. Which of the following reactions is used to prepare salicylaldehyde?

- (a) Kolbe's reaction
- (b) Etard reaction
- (c) Reimer - Tiemann reaction
- (d) Stephen's reduction

[CBSE SQP Term-1 2021]

Very Short & Short Qs [1 – 3 marks]

8. Write the preparation of phenol from cumene.

[CBSE 2020]

9. How can you convert the following?

Phenol to chlorobenzene.

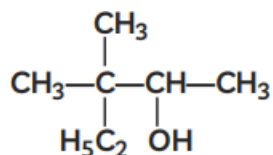
[CBSE, 2020]

10. How can you convert the following?

Sodium phenoxide to o-hydroxybenzoic acid

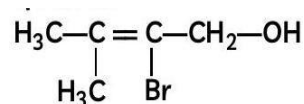
[CBSE 2020]

11. What the IUPAC name of the following?



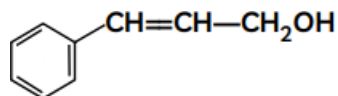
[CBSE 2018]

12. Write the IUPAC name of the following compound.



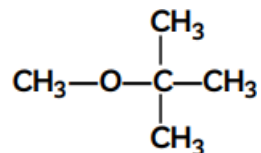
[CBSE 2017]

13. Write the IUPAC name of the following compound.



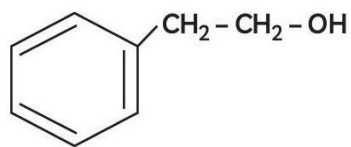
[CBSE 2017]

14. Write the IUPAC name of the following compound.



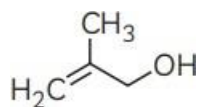
[CBSE 2017]

15. Write the IUPAC name of the following compound:



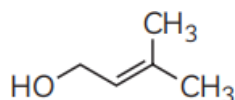
[CBSE 2016]

16. Write the IUPAC name of the given compound:



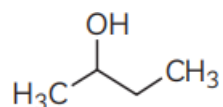
[CBSE 2015]

17. Write the IUPAC name of the given compound:



[CBSE 2015]

18. Name the following according to IUPAC system:



[CBSE 2015]

2. PHYSICAL & CHEMICAL PROPERTIES OF ALCOHOLS & PHENOLS

Objective Qs [1 mark]

19. When Benzene diazonium chloride reacts with phenol, it forms a dye. This reaction is called:

- (a) Diazotisation reaction
- (b) Condensation reaction
- (c) Coupling reaction
- (d) Acetylation reaction

[CBSE 2023]

20. In the following reaction:

$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_2 - \text{OH} \xrightarrow{\text{PCC}}$ the product formed is:

- (a) $\text{CH}_3 - \text{CHO}$ and $\text{CH}_3\text{CH}_2\text{OH}$
- (b) $\text{CH}_3 - \text{CH} = \text{CH} - \text{COOH}$
- (c) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CHO}$
- (d) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CHO}$

[CBSE Term-1 2021]

21. During dehydration of alcohols to alkenes by heating with concentrated H_2SO_4 , the initiation step is:

- (a) protonation of alcohol molecule
- (b) formation of carbocation
- (c) elimination of water
- (d) formation of an ester

[CBSE SQP Term-1 2021]

22. The C – O – H bond angle in alcohol is:

- (a) slightly greater than $109^\circ 28'$.
- (b) slightly less than $109^\circ 28'$
- (c) slightly greater than 120° .
- (d) slightly less than 120° .

[CBSE Term-1 2021]

23. Phenol is less acidic than which of the following:

- (a) o-Methylphenol
- (b) o-Methoxyphenol
- (c) o-Nitrophenol
- (d) Ethanol

[Delhi Gov. SQP Term-1 2021]

24. Reagent used for the conversion of ethanol to ethanal is:

- (a) H_2/Ni
- (b) KMnO_4
- (c) LiAlH_4
- (d) PCC

[Delhi Gov. SQP Term-1 2021]

25. In the following question (Q. No. 25) a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

Assertion (A): Phenol is weaker acid than p-nitrophenol.

Reason (R): $-\text{NO}_2$ group is *O*-directing.

[Delhi Gov. SQP Term-1 2021]

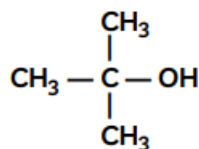
Case Based Qs [4 - 5 marks]

Read the following passages and answer the questions that follow:

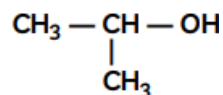
26. Alcohols and Phenols are acidic in nature. Electron withdrawing groups in phenol increase its acidic strength and electron donating groups decrease it. Alcohols undergo nucleophilic substitution with hydrogen halides to give alkyl halides. On oxidation primary alcohols yield aldehydes with mild oxidising agents and carboxylic acids with strong oxidising agents while secondary alcohols yield ketones. The presence of $-\text{OH}$ groups in phenols activates the ring towards electrophilic substitution. Various important products are obtained from phenol like salicylaldehyde, salicylic acid, picric acid etc.

(A) Which of the following alcohols is resistant to oxidation?

(a)



(b)



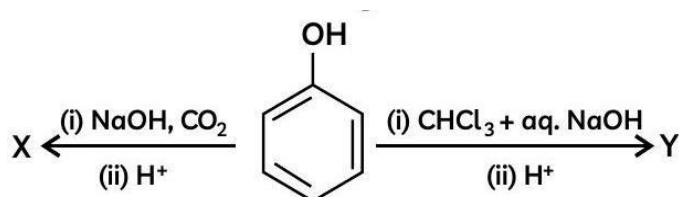
(c) $\text{CH}_3 - \text{CH}_2 - \text{OH}$

(d) $\text{CH}_3 - \text{OH}$

(B) Which of the following group increases the acidic character of phenol?

- (a) CH_3O^-
- (c) NO_2^-
- (b) CH_3^-
- (d) All of these

(C) Consider the following reaction:



The products X and Y are:

- (a) $\text{X} = \text{m-COOH-C}_6\text{H}_4\text{-OH}$ $\text{Y} = \text{m-CHO-C}_6\text{H}_4\text{-OH}$
- (b) $\text{X} = \text{m-CHO-C}_6\text{H}_4\text{-OH}$ $\text{Y} = \text{m-COOH-C}_6\text{H}_4\text{-OH}$
- (c) $\text{X} = \text{m-OH-C}_6\text{H}_4\text{-COOH}$ $\text{Y} = \text{p-CHO-C}_6\text{H}_4\text{-OH}$
- (d) $\text{X} = \text{m-COOH-C}_6\text{H}_4\text{-OH}$ $\text{Y} = \text{m-CHO-C}_6\text{H}_4\text{-OH}$

(D) The strongest acid among the following is:

- (a) Phenol
- (b) Benzyl alcohol
- (c) *m*-Chlorophenol
- (d) Cyclohexanol

(E) The reaction between phenol and chloroform in presence of aq. NaOH is:

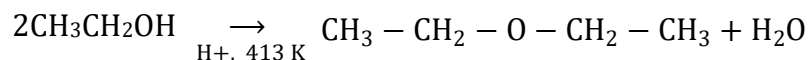
- (a) nucleophilic substitution reaction

- (b) electrophilic addition reaction
- (c) electrophilic substitution reaction
- (d) nucleophilic addition reaction

[CBSE Term-1 2021]

Very Short & Short Qs [1 - 3 marks]

27. (A) Write the mechanism of the following reaction:



(B) Why ortho-nitrophenol is steam volatile while para-nitrophenol is not?

OR

What happens when:

- (A) anisole is treated with CH_3Cl / anhydrous AlCl_3 ?
- (B) phenol is oxidised with $\text{Na}_2\text{Cr}_2\text{O}_7$?
- (C) $(\text{CH}_3)_3\text{C} - \text{OH}$ is heated with $\text{Cu}/573 \text{ K}$?

Write chemical equation in support of your answer.

[CBSE 2023]

28. Write the chemical equation involved in the following:

- (A) Kolbe's reaction
- (B) Williamson synthesis

[CBSE 2023, 14]

29. Write the equation for the following reactions:

- (A) Salicylic acid is treated with acetic anhydride in the presence of conc. H_2SO_4 .
- (B) Tert butyl chloride is treated with sodium ethoxide.
- (C) Phenol is treated with chloroform in the presence of NaOH . [CBSE SQP 2022]

30. Carry out the following conversion: Phenol to salicylaldehyde.

[CBSE 2020]

31. Carry out the following conversion: Propene to Propanol.

[CBSE 2020]

32. Predict the reagent for carrying out the following conversion: Phenol to benzoquinone.

[CBSE 2020]

33. Predict the reagent for carrying out the following conversion: Phenol to 2, 4, 6-tribromophenol.

[CBSE 2020]

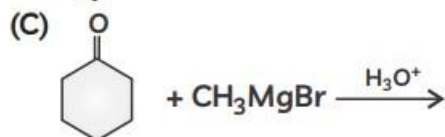
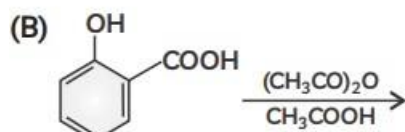
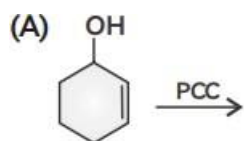
34. Out of *t*-butyl alcohol and *n*-butanol, which one will undergo acid catalysed dehydration faster and why?

[CBSE 2020]

35. Give the mechanism for the formation of ethanol from ethene.

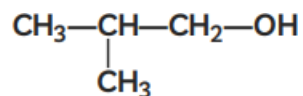
[CBSE 2020]

36. Write the product(s) of the following reactions:

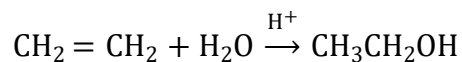


[CBSE 2020]

37. (A) Show how will you synthesise the following alcohol prepared by the reaction of a suitable Grignard reagent on methanol?



(B) Write the mechanism of the following reaction:



[CBSE 2019]

38. Explain the mechanism of dedhydration steps of ethanol.

[CBSE 2018, 15]

39. Give reason for the following: Phenol is more acidic than ethanol.

[CBSE 2017, 15]

40. Give simple chemical tests to distinguish between the following pairs of compounds:

(A) Ethanol and phenol

(B) Propanol and 2 - methylpropan - 2 - ol

[CBSE 2017]

41. Write the structures of the products when butan -2 - ol reacts with the following:

(A) CrO_3

(B) SOCl_2

[CBSE 2017]

42. Write the main product(s) in each of the following reactions:

(A) $\text{CH}_3 - \text{CH} = \text{CH}_2$

(i) B_2H_6

(B) $\text{C}_6\text{H}_5 - \text{OH} \xrightarrow[\text{(ii) } \text{CO}_2 \cdot \text{H}^+]{\text{(i) } aq \cdot \text{NaOH}}$

[CBSE 2016]

43. How are the following conversions carried out?

(A) Propene to propan - 2 - ol

(B) Benzyl chloride to benzyl alcohol

[CBSE 2015, 14]

44. How would you carry out the following conversion?

(A) Benzyl chloride to benzyl alcohol

(B) Ethyl magnesium chloride to propan-1-ol

[CBSE 2015, 14]

45. How do you convert the following?

(A) Phenol to anisole

(B) Propan-2-ol to 2-methylpropan-2-ol

(C) Aniline to phenol

[CBSE 2015]

46. Write the equations involved in the acetylation of salicylic acid.

[CBSE 2015]

47. How are the following conversions carried out?

(A) Propene to Propan - 2 - ol

(B) Ethyl chloride to Ethanal

[CBSE 2014]

48. Explain the following with an example for each:

(A) Kolbe's reaction.

(B) Reimer-Tiemann reaction.

[CBSE 2014]

49. Which of the following isomers is more volatile:

o-nitrophenol or p-nitrophenol?

[CBSE 2014]

Long Qs [4 - 5 marks]

50. (A) Write the formula of reagents used in the following reactions.

(i) Bromination of phenol to 2, 4, 6 tribromophenol

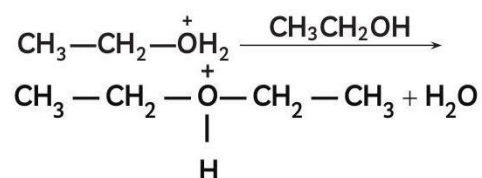
(ii) Hydroboration of propene and then oxidation to propanol.

(B) Arrange the following compound groups in the increasing order of their property indicated,

(i) p-nitrophenol, ethanol, phenol (acidic character)

(ii) Propanol, Propane, Propanal (boiling point)

(C) Write the mechanism (using curved arrow notation) of the following reaction:

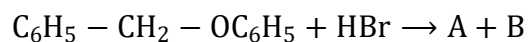


[CBSE 2017]

3. CLASSIFICATION, PREPARATION & PROPERTIES OF ETHERS

Objective Qs [1 mark]

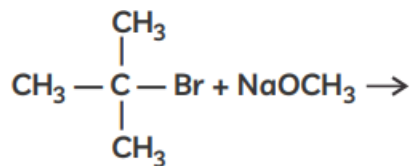
51. What would be the major product of the following reaction?



- (a) A = $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$, B = C_6H_6
(b) A = $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$, B = $\text{C}_6\text{H}_5\text{Br}$
(c) A = $\text{C}_6\text{H}_5\text{CH}_3$, B = $\text{C}_6\text{H}_5\text{Br}$
(d) A = $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$, B = $\text{C}_6\text{H}_5\text{OH}$

[CBSE SQP 2022]

52. Major product formed in the following reaction:



- (a) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{ONa} \\ | \\ \text{CH}_3 \end{array}$
(b) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{OCH}_3 \\ | \\ \text{CH}_3 \end{array}$
(c) $\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ | \quad | \\ \text{CH}_3 - \text{C} - \text{O} - \text{C} - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
(d) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} = \text{CH}_2 \end{array}$

[CBSE Term-1 2021]

53. Williamson's synthesis of preparing dimethyl ether is an:

- (a) S_N1 reaction
- (b) Elimination reaction
- (c) S_N2 reaction
- (d) Nucleophilic addition reaction

[CBSE SQP Term-1 2021]

In the following question, a statement of assertion (A) followed by a statement of Reason (R) is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
- (c) (A) is correct but (R) is wrong.
- (d) (A) is wrong but (R) is correct.

54. Assertion (A): An ether is more volatile than an alcohol of comparable molecular mass.

Reason (R): Ethers are polar in nature.

[CBSE SQP 2022]

Very Short & Short Qs [1-3 marks]

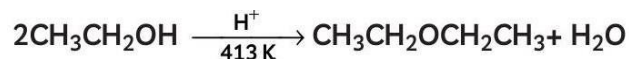
55. Predict the reagent for carrying out the following conversions: Anisole to *p*-bromoanisole.

[CBSE 2020]

56. Write the equation for the preparation of 2-methyl-2-methoxypropane by Williamson synthesis.

[CBSE 2020]

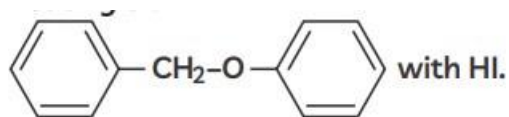
57. Write the mechanism of the following reaction:



[CBSE 2020, 17, 16, 15]

58. Give the structures of final products expected from the following reactions:

- (A) Hydroboration of propene followed by oxidation with H₂O₂ in alkaline medium.
- (B) Dehydration of (CH₃)₃C – OH by heating it with 20% H₃PO₄ at 358 K.
- (C) Heating of:



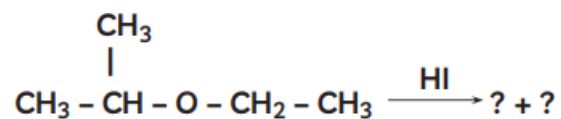
[CBSE 2020]

59. Write the equations involved in the following reaction:

Friedel-Crafts alkylation of anisole.

[CBSE 2019]

60. Write the product in the following reaction:



[CBSE 2017]

61. Give reasons for the following:

(A) Boiling point of ethanol is higher in comparison to methoxymethane.

(B) $(\text{CH}_3)_3\text{C} - \text{O} - \text{CH}_3$ on reaction with HI gives CH_3OH and $(\text{CH}_3)_3\text{C} - \text{I}$ as the main products and not $(\text{CH}_3)_3\text{C} - \text{OH}$ and CH_3I .

[CBSE 2015]

62. Write the equations involved in the following reaction:

Williamson synthesis.

[CBSE 2014]

PREVIOUS YEAR
QUESTION
PAPERS

CHEMISTRY

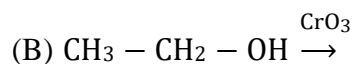
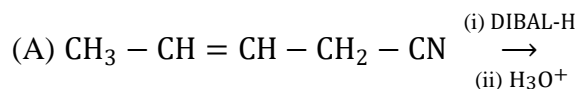
CLASS 12

CHAPTER 8
Aldehydes, Ketones and Carboxylic Acids

1. NOMENCLATURE & PREPARATION OF ALDEHYDES & KETONES

Very Short & Short Qs [1-3 marks]

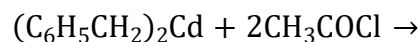
1. What happens when Benzene is treated with acetyl chloride in the presence of anhydrous AlCl_3 ?
[CBSE 2020]
2. What happens when benzene is treated with CH_3COCl in presence of anhydrous AlCl_3 ?
[CBSE 2020]
3. How can you convert the following: Benzene to acetophenone?
[CBSE 2020]
4. Write the major product(s) in the following:



[CBSE 2020]

5. Write chemical equations for the following reaction:
[CBSE 2019, 18]

6. Complete the following reaction:



[CBSE 2019]

7. Write the product in the given reaction:



[CBSE 2017]

8. Write the structure of 2-methylbutanal.

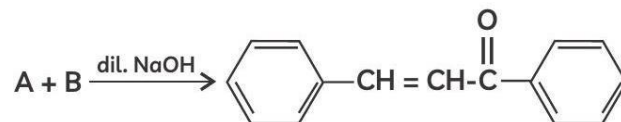
[CBSE 2015]

9. Draw the structure of 3-methylpentanal.
[CBSE 2015]
10. Write the IUPAC name of the following: $\text{CH}_3\text{CH}_2\text{CHO}$
[CBSE 2015]
11. How do you convert the following:
Ethyne to ethanal
[CBSE 2015]
12. Draw the structures of the following:
(A) *p* - Methylbenzaldehyde
(B) 4 - Methylpent- 3-en-2-one
[CBSE 2015]
13. Write the equations involved in the following reactions:
(A) Stephen reaction
(B) Etard reaction
[CBSE 2015]

2. PHYSICAL AND CHEMICAL PROPERTIES OF ALDEHYDES AND KETONES

Objective Qs [1 - 3 marks]

14.



Identify A and B.

- (a) A = 1-phenylethanal, B = Acetophenone
(b) A = Benzophenone, B = Formaldehyde
(c) A = Benzaldehyde, B = Acetophenone

(d) A = Benzophenone, B = Acetophenone

[CBSE SQP 2023]

15. What is IUPAC name of the ketone A, which undergoes iodoform reaction to give $\text{CH}_3\text{CH} = \text{C}(\text{CH}_3)\text{COONa}$ and yellow precipitate of CH_3 ?

(a) 3-Methylpent-3-en-2-one

(b) 3-Methylbut-2-en-one

(c) 2,3-Dimethylethanone

(d) 3-Methylpent-4-one

[CBSE SQP 2023]

16. Which of the following tests/reactions is given by aldehydes as well as ketones?

(a) Fehling's test

(b) Tollen's test

(c) 2,4 DNP test

(d) Cannizzaro reaction

[CBSE SQP 2022]

17. Iodoform test is not given by:

(a) 2-pentanone

(b) ethanol

(c) ethanal

(d) 3-pentanone

[CBSE 2020]

In the following question, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

18. Assertion (A): Strong oxidising agents oxidise toluene and its derivatives to benzoic acids.

Reason (R): It is possible to stop the oxidation of toluene at the aldehyde stage with suitable reagents.
[CBSE SQP 2023]

Very Short & Short Qs [1-3 marks]

19. Arrange the following in the increasing order of their property indicated:

- (A) Benzoic acid, Phenol, Picric acid, Salicylic acid (pK_a values).
- (B) Acetaldehyde, Acetone, Methyl tert butyl ketone (reactivity towards NH_2OH).
- (C) Ethanol, Ethanoic acid, Benzoic acid (boiling point)

[CBSE SQP Term-2 2022]

20. Give reasons to support the answer:

- (A) Presence of Alpha hydrogen in aldehydes and ketones is essential for aldol condensation.
- (B) 3 -Hydroxy pentan-2-one shows positive Tollen's test.

[CBSE SQP Term-2 2022]

21. Write the product formed when benzaldehyde reacts with the following reagents:

- (A) CH_3CHO in presence of dilute NaOH
- (B) Tollen's reagent

[CBSE SQP Term-2 2022]

22. Write the equations involved in the following reactions:

- (A) Clemmensen reduction
- (B) Cannizzaro reaction

[CBSE Term-2 2022]

23. An alkene 'A' (Mol. formula C_5H_{10}) on ozonolysis gives a mixture of two compounds ' B ' and ' C '. Compound ' B ' gives positive Fehling's test and also forms iodoform on treatment with I_2 and NaOH. Compound ' C ' does not give Fehling's test but forms iodoform. Identify the compounds A, B and C. Write the reaction for ozonolysis and formation of iodoform from B and C.

[CBSE SQP Term-2 2022]

24. Write the products formed when $(CH_3)_3CCHO$ reacts with the following reagents:

- (A) CH_3COCH_3 in the presence of dilute NaOH.
- (B) HCN.

(C) Conc. NaOH

[CBSE 2020]

25. What happens when, propanone is treated with methyl magnesium iodide and then hydrolysed?

[CBSE 2020]

26. How can you convert the following: Acetone to propene?

[CBSE 2020]

27. Write chemical equations for the following reactions:

(A) Propanone is treated with dilute BaOH₂.

(B) Acetophenone is treated with Zn(Hg)/ conc. HCl

[CBSE 2019]

28. How do you convert the following:

Ethanal to Propanone

[CBSE 2018]

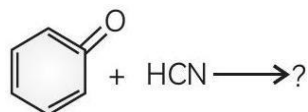
29. (X), (Y) and (Z) are three non-cyclic functional isomers of a carbonyl compound with molecular formula C₄H₈O. Isomers (X) and (Z) give positive Tollens' test whereas isomer (Y) does not give Tollens' test but gives positive Iodoform test. Isomers (X) and (Y) on reduction with Zn(Hg)/ conc. HCl give the same product (W).

(A) Write the structures of (X), (Y), (Z) and (W).

(B) Out of (X), (Y) and (Z) isomers, which one is least reactive towards addition of HCN ?

[CBSE 2018]

30. Write the products in the following reaction:



[CBSE 2018]

31. (A) Write the chemical reaction involved in Wolff - Kishner reduction.

(B) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction. C₆H₅COCH₃, CH₃ - CHO, CH₃COCH₃

(C) A and B are two functional isomers of compound C_3H_6O . On heating with NaOH and I_2 , isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae of A and B.

[CBSE 2016]

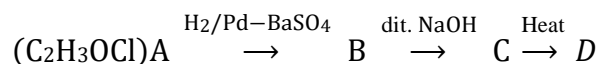
32. (A) Write the chemical equation for the reaction involved in Cannizzaro reaction.

(B) Draw the structure of the semicarbazone of ethanal.

(C) How can you distinguish between propanal and propanone?

[CBSE 2016]

33. A compound 'A' of molecular formula C_2H_3OCl undergoes a series of reactions as shown below. Write the structures of A, B, C and D in the following reactions:



[CBSE 2015]

34. Describe the following reactions:

(A) Acetylation

(B) Aldol condensation

[CBSE 2015]

35. Draw the structures of the following derivatives:

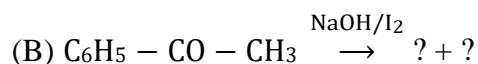
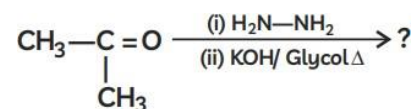
(A) Propanone oxime,

(B) Semicarbazone of CH_3CHO .

[CBSE 2015]

36. Predict the products of the following reactions:

(A)



[CBSE 2015]

37. Write the structures of the main products when acetone ($\text{CH}_3 - \text{CO} - \text{CH}_3$) reacts with the following reagents:

(A) $\text{Zn} - \text{Hg} / \text{conc. HCl}$

(B) $\text{H}_2\text{N} - \text{NHCONHN}_2 / \text{H}^+$

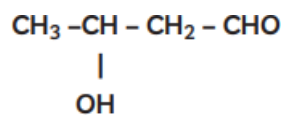
(C) CH_3MgBr and then H_2O^+

[CBSE 2015]

38. How will you convert ethanal into the following compounds? Give the chemical equations involved.

(A) $\text{CH}_3 - \text{CH}_3$

(B)



(C) $\text{CH}_3\text{CH}_2\text{OH}$

[CBSE 2015]

39. Give simple chemical tests to distinguish between the following pair of compounds:

Propanal and butan-2-one

[CBSE 2014]

40. Give simple chemical tests to distinguish between the following pairs of compounds:

(A) Benzaldehyde and benzoic acid

(B) Propanal and propanone

[CBSE 2014]

41. Write the products formed when ethanal reacts with the following reagents:

(A) CH_3MgBr and then H_3O^+

(B) $\text{Zn} - \text{Hg} / \text{conc. HCl}$

(C) $\text{C}_6\text{H}_5\text{CHO}$ in the presence of dilute NaOH

[CBSE 2014]

Long Qs [4 - 5 marks]

42. Convert the following:

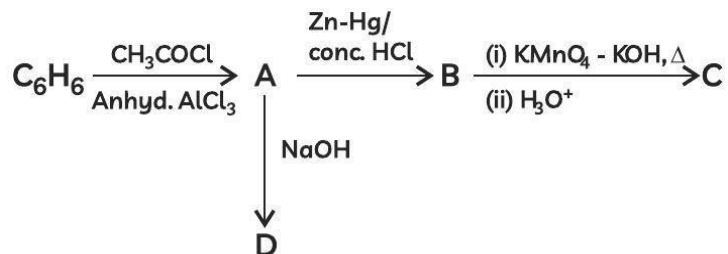
(A) Bromomethane to ethanoic acid.

(B) Benzene to *p*-nitrobenzoic acid.

(C) Benzoic acid to benzaldehyde.

[Delhi Gov. SQP Term-2 2022]

43. Complete the reaction sequence by writing structures of A-D. Also name the reaction involved in the conversion of A to B.



[Delhi Gov. SQP Term-2 2022]

44. An organic compound A (C_8H_6) on treatment with dilute sulphuric acid containing mercuric sulphate gives a compound B, which can also be obtained from a reaction of benzene with an acid chloride in the presence of anhydrous aluminium chloride. The compound B, when treated with iodine in aqueous KOH, yields C and a yellow compound D. Identify A, B, C and D with justification. Show how B is formed from A ?

[CBSE 2020]

3. NOMENCLATURE & PREPARATION METHODS OF CARBOXYLIC ACIDS

Very Short Type Qs [1 mark]

45. Convert the following:

(A) Benzoic acid to Benzaldehyde

(B) Propan-1-ol to 2-Bromopropanoic acid

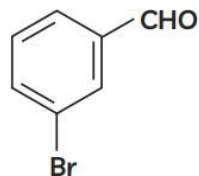
(C) Acetaldehyde to But-2-enal

[CBSE Term-2 2022]

46. Complete the following:

(A)

(B) Write IUPAC name of the following compound:



(C) Write chemical test to distinguish between the following compounds: Phenol and Benzoic acid.

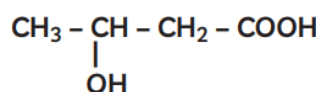
[CBSE Term-2 2022]

47. How do you convert the following:

Toluene to benzoic acid?

[CBSE 2018]

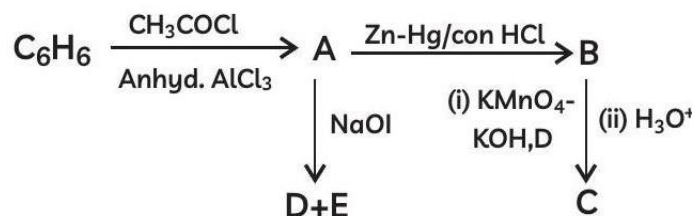
48. Write the IUPAC name of the compound:



[CBSE 2014]

Long Qs [4 - 5 marks]

49. Write the structure of A, B, C, D and E in the following reactions:



[CBSE 2016]

4. PHYSICAL AND CHEMICAL PROPERTIES OF CARBOXYLIC ACIDS

Objective Qs [1 mark]

In the following question, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

50. Assertion (A): Carboxylic acids are more acidic than phenols.

Reason (R): Phenols are ortho and para directing.

[CBSE 2020]

Very Short & Short Qs [1 - 3 mark]

51. You are given four organic compounds " A ", " B ", " C " and " D ". The compounds " A ", " B " and " C " form an orange-red precipitate with 2,4 DNP reagent. Compounds " A " and " B " reduce Tollen's reagent while compounds " C " and " D " do not. Both " B " and " C " give a yellow precipitate when heated with iodine in the presence of NaOH. Compound " D " gives brisk effervescence with sodium bicarbonate solution. Identify " A ", " B ", " C " and " D " given the number of carbon atoms in three of these carbon compounds is three while one has two carbon atoms. Give an explanation for your answer.

[CBSE SQP 2023]

52. Arrange the following in the increasing order of their property indicated:

(A) Ethanal, propanone, propanal, butanone (reactivity towards nucleophilic addition)

(B) 4-Nitrobenzoic acid, benzoic acid, 3, 4-dinitrobenzoic acid. 4-methoxy benzoic acid (Acid strength)

[CBSE Term-2 2022]

53. Write the equation for the following:

(A) Salicylic acid is treated with acetic anhydride in the presence of conc. H_2SO_4

(B) Tert butyl chloride is treated with sodium ethoxide.

(C) Phenol is treated with chloroform in the presence of NaOH

[CBSE SQP 2022]

54. A hydrocarbon (a) with molecular formula C_5H_{10} on ozonolysis gives two products (b) and (c). Both (b) and (c) give a yellow precipitate when heated with iodine in presence of NaOH while only (b) give a silver mirror on reaction with Tollen's reagent.

(A) Identify (a), (b) and (c).

(B) Write the reaction of (b) with Tollen's reagent

(C) Write the equation for iodoform test for (c).

(D) Write down the equation for aldol condensation reaction of (b) and (c).

[CBSE SQP 2022]

55. An organic compound (a) with molecular formula $C_2Cl_3O_2H$ is obtained when (b) reacts with Red P and Cl_2 . The organic compound (b) can be obtained on the reaction of methyl magnesium chloride with dry ice followed by acid hydrolysis.

(A) Identify (a) and (b)

(B) Write down the reaction for the formation of (a) from (b). What is this reaction called?

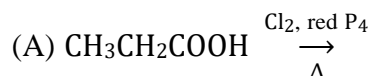
(C) Give any one method by which organic compound (b) can be prepared from its corresponding acid chloride.

(D) Which will be the more acidic compound (a) or (b)? Why?

(E) Write down the reaction to prepare methane from the compound (b).

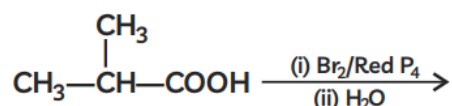
[CBSE SQP 2022]

56. Write structure of the products formed:



[CBSE 2019]

57. Complete the following reaction:



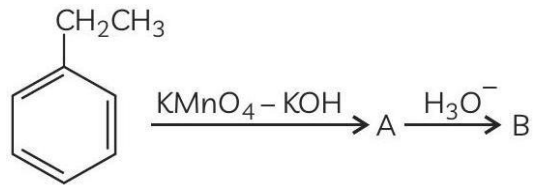
[CBSE 2019]

58. Carry out the following conversions:

Propanoic acid to Acetic acid

[CBSE 2019]

59. Write structures of compounds (A) and (B) in each of the following reactions:



[CBSE 2019]

60. Account for the following:

(A) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction.

(B) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid.

[CBSE 2018]

61. Do the following conversion in not more than two steps:

Ethyl benzene to benzoic acid

[CBSE 2017]

62. Why carboxylic acid does not give reactions of carbonyl group?

[CBSE 2017, 16]

63. How will you convert the following in not more than two steps:

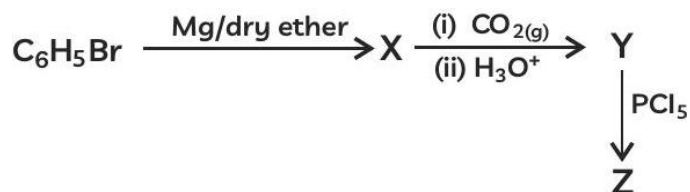
(A) Acetophenone to benzoic acid

(B) Ethanoic acid to 2-hydroxyethanoic acid

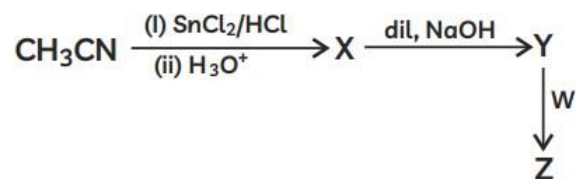
[CBSE 2017]

64. Write the structures of compounds X, Y and Z in each of the following reactions:

(A)



(B)



[CBSE 2017]

65. Arrange the following in the increasing order of their boiling points.



[CBSE 2016, 15]

66. Describe the following giving chemical equation:

Decarboxylation

[CBSE 2015]

67. Give simple chemical test to distinguish between the following pair of compounds:

Benzoic acid and phenol.

[CBSE 2014]

68. Write the chemical equation to illustrate the following name reaction:

Hell-Volhard-Zelinsky reaction

[CBSE 2014]

PREVIOUS YEAR
QUESTION
PAPERS

CHEMISTRY

CLASS 12

CHAPTER 9

Amines

1. STRUCTURE & CLASSIFICATION OF AMINES

Case Based Qs [4 - 5 marks]

Read the following passages and answer the questions that follow:

1. Amine, any member of a family of nitrogen-containing organic compounds that is derived, either in principle or in practice, from ammonia (NH_3).

Naturally occurring amines include the alkaloids, which are present in certain plants; the catecholamine neurotransmitters (i.e., dopamine, epinephrine, and norepinephrine); and a local chemical mediator, histamine, that occurs in most animal tissues.

Most of the numerous methods for the preparation of amines may be broadly divided into two groups: (1) chemical reduction (replacement of oxygen with hydrogen atoms in the molecule) of members of several other classes of organic nitrogen compounds and (2) reactions of ammonia or amines with organic compounds.

Amines are classified as primary, secondary, or tertiary depending on whether one, two, or three of the hydrogen atoms of ammonia have been replaced by organic groups. In chemical notation these three classes are represented as RNH_2 , R_2NH , and R_3N , respectively. A fourth category consists of quaternary ammonium compounds, which are obtained by replacement of all four hydrogen atoms of the ammonium ion, NH_4^+ ; an anion is necessarily associated ($\text{R}_4\text{N}^+\text{X}^-$). Amines are also classified as aliphatic, having only aliphatic groups attached, or aromatic, having one or more aryl groups attached. They may be open-chain, in which the nitrogen is not part of a ring, or cyclic, in which it is a member of a ring (generally aliphatic). The carbylamine reaction, also known as Hofmann's isocyanide test, is a chemical test for the detection of primary amines.

(A) Name two alkaloids present in neurotransmitters.

(B) Write the structure of n-methyl ethanamine.

(C) Account for the following:

(i) Primary amines ($\text{R}-\text{NH}_2$) have higher boiling point than tertiary amines (R_3N).

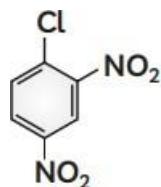
(ii) pK_b of aniline is more than that of methylamine.

[CBSE Term-2 2022]

2. Biogenic amines are produced by bacterial decarboxylation of corresponding amino acids in foods. Concentration of biogenic amines in fermented food products is affected by several factors in the manufacturing process, including hygienic of raw materials, microbial composition, fermentation condition, and the duration of fermentation. Intake of low amount of biogenic amines normally does

not have harmful effect on human health. However, when their amount in food is too high and detoxification ability is inhibited or disturbed, biogenic amines could cause problem. To control concentration of BAs in food, decarboxylase activity for amino acids can be regulated. Levels of BAs can be reduced by several methods such as packaging, additives, hydrostatic pressure, irradiation, pasteurization, smoking, starter culture, oxidizing formed biogenic amine, and temperature. The objective of this review paper was to collect, summarize, and discuss necessary information or useful data based on previous studies in terms of BAs in various foods.

Write the IUPAC name of the given compound:



- (a) 2, 4 - Dinitrochlorobenzene
- (b) 1, 4 - Dinitrochlorobenzene
- (c) N-ethyl - N-methylethanamine
- (d) None of the above

[CBSE 2017]

Very Short & Short Qs [1 - 3 marks]

3. How will you synthesize propanamine by Gabriel phthalimide synthesis? Write relevant chemical reactions.

[Delhi Gov. SQP Term-2 2022]

4. Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

[CBSE 2020]

5. Write IUPAC names of the following compound:



[CBSE 2017]

6. Write IUPAC name of the following compound $(\text{CH}_3)_2\text{N} - \text{CH}_2\text{CH}_3$

[CBSE 2017]

7. Write IUPAC name of the following compound: $(\text{CH}_3\text{CH}_2)_2\text{NCH}_3$ [CBSE 2017]

8. How will you convert the following:

(A) Nitrobenzene into aniline

(B) Ethanoic acid into methanamine

[CBSE 2014]

2. PHYSICAL AND CHEMICAL PROPERTIES OF AMINES

Objective Qs [1 mark]

9. Arrange the following in the increasing order of their boiling points:

A: Butanamine, B: N,N-Dimethylethanamine, C: N- Ethylethanamine

(a) $C < B < A$

(b) $A < B < C$

(c) $A < C < B$

(d) $B < C < A$

[CBSE SQP 2022]

10. Which of the following statements is not correct for amines?

(a) Most alkyl amines are more basic than ammonia solution.

(b) pK_b value of ethylamine is lower than benzylamine.

(c) CH_3NH_2 on reaction with nitrous acid releases NO_2 gas.

(d) Hinsberg's reagent reacts with secondary amines to form sulphonamides.

[CBSE SQP 2022]

11. Assertion (A): Tertiary amines are more basic than corresponding secondary and primary amines in gaseous state.

Reason (R): Tertiary amines have three alkyl groups which cause +I effect. [CBSE SQP 2022]

12. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives:

[CBSE 2020]

(a) $CH_3CH_2NH_2$

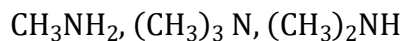
(b) CH_3CH_2Br

(c) CH_3NH_2

(d) CH_3COONa

Very Short & Short Qs [1 -3 mark]

13. Arrange the following compounds in the increasing order of their basic strength in aqueous solution:



[CBSE Term-2 2022]

14. What is Hinsberg reagent?

[CBSE Term-2 2022]

15. Account for the following:

(A) Aniline cannot be prepared by the ammonolysis of chlorobenzene under normal conditions.

(B) N-ethylethanamine boils at 329.3 K and butanamine boils at 350.8 K, although both are isomeric in nature.

(C) Acylation of aniline is carried out in the presence of pyridine.

[CBSE SQP Term-2 2022]

16. Convert the following:

(A) Phenol to N-phenylethanamide.

(B) Chloroethane to methanamine.

(C) Propanenitrile to ethanol.

[CBSE SQP Term-2 2022]

17. What happens when:

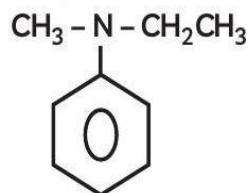
(A) N-ethylethanamine reacts with benzenesulphonyl chloride.

(B) benzylchloride is treated with ammonia followed by the reaction with Chloromethane.

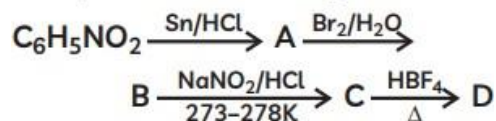
(C) aniline reacts with chloroform in the presence of alcoholic potassium hydroxide.

[CBSE SQP Term-2 2022]

18. (A) Write the IUPAC name for the following organic compound:



(B) Complete the following:



[CBSE SQP Term-2 2022]

19. Give reasons:

- (A) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.
- (B) Aniline does not give Friedel-Crafts reaction.
- (C) Although $-\text{NH}_2$ group is o/p directing, yet aniline on nitration gives a good yield of m-nitroaniline.

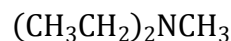
[CBSE SQP 2022]

20. Write equations involved in the following reactions:

- (A) Ethanamine reacts with acetyl chloride.
- (B) Aniline reacts with bromine water at room temperature
- (C) Aniline reacts with chloroform and ethanolic potassium hydroxide.

[CBSE SQP Term-2 2022]

21. (A) Write the IUPAC name for the following organic compound:



(B) Write the equations for the following:

- (i) Gabriel phthalimide synthesis
- (ii) Hoffmann bromamide degradation

[CBSE SQP Term-2 2022]

22. Arrange the following compounds in decreasing order of their boiling points: Butanol, Butanamine, Butane

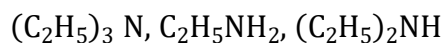
[CBSE 2020]

23. How will you distinguish between the following pairs of compounds?

- (A) Aniline and ethanamine
- (B) Aniline and N-methylaniline

[CBSE 2020]

24. Arrange the following in increasing order of base strength in gas phase.



[CBSE 2019]

25. Carry out the following conversion:

Bromomethane to ethanol.

[CBSE 2019]

26. Carry out the following conversions:

Benzoic acid to aniline

[CBSE 2019]

27. Give a simple chemical test to distinguish between the following pair of compounds: $(\text{CH}_3)_2\text{NH}$ and $(\text{CH}_3)_3\text{N}$

[CBSE 2019]

28. Write the chemical equations involved in the following reactions:

[CBSE 2019]

Hoffmann-bromamide degradation reaction.

OR

Describe the following by giving the relevant chemical equation:

Carbylamine reaction

[CBSE 2018]

29. Give reason:

$(\text{CH}_3)_2\text{NH}$ is more basic than $(\text{CH}_3)_3\text{N}$ in an aqueous solution.

[CBSE 2018]

30. (A) Give a simple chemical test to distinguish between aniline and N,N-dimethylaniline.

(B) Arrange the following in the increasing order of their pK_b values:



[CBSE 2018]

31. Give reasons for the following:

Primary amines have higher boiling point than tertiary amines?

[CBSE 2016, 14]

32. Illustrate the following reactions giving suitable example in each case:

(A) Ammonolysis

(B) Acetylation of amines

[CBSE 2015]

33. How do you convert the following:

ethanenitrile to ethanamine

[CBSE 2015]

34. An aromatic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br₂ and KOH forms a compound 'C' of molecular formula C₆H₇N.

Write the structures and IUPAC names of compounds A, B, and C.

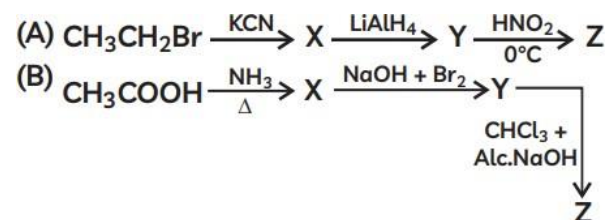
[CBSE 2015]

35. Account for the following:

Ethylamine is soluble in water whereas aniline is not.

[CBSE 2014]

36. Give the structures of products X, Y and Z in the following reactions:



[CBSE 2014]

37. How will you convert the following:

Aniline to N-phenylethanamide.

[CBSE 2014]

Long Type Qs [4 - 5 marks]

38. An organic compound with molecular formula C₇H₇NO₂ exists in three isomeric forms, the isomer 'A' has the highest melting point of the three. 'A' on reduction gives compound 'B' with molecular

formula C_7H_9N . 'B' on treatment with $NaNO_2/HCl$ at $0 - 5^\circ C$ to form compound 'C'. On treating C with H_3PO_2 , it gets converted to D with formula C_7H_8 , which on further reaction with CrO_2Cl_2 followed by hydrolysis forms 'E' C_7H_6O . Write the structure of compounds A to E. Write the chemical equations involved.

[CBSE SQP 2023]

39. Give reasons for any 3 of the following observations:

(A) Aniline is acetylated before nitration reaction.

(B) pK_b of aniline is lower than the m-nitroaniline.

(C) Primary amine on treatment with benzenesulphonyl chloride forms a product which is soluble in NaOH however secondary amine gives product which is insoluble in NaOH.

(D) Aniline does not react with methyl chloride in the presence of anhydrous $AlCl_3$ catalyst.

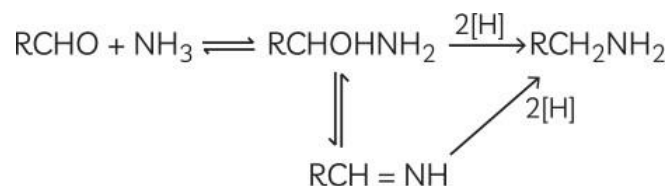
[CBSE SQP 2022]

3. DIAZONIUM SALTS- NAMING, PREPARATION & PROPERTIES

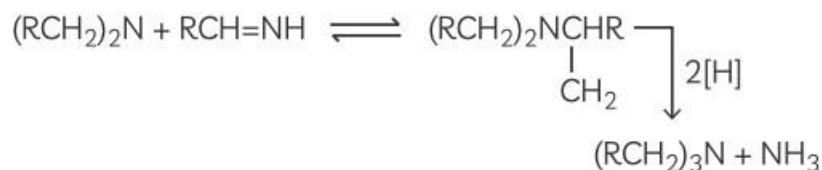
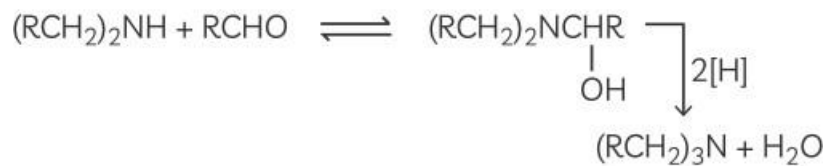
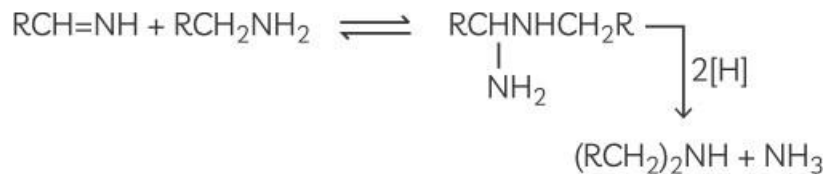
Case Based Qs [4 - 5 marks]

Read the following passage and answer the questions that follow:

40. Reductive alkylation is the term applied to the process of introducing alkyl groups into ammonia or a primary or secondary amine by means of an aldehyde or ketone in the presence of a reducing agent. The present discussion is limited to those reductive alkylations in which the reducing agent is hydrogen and a catalyst or "nascent" hydrogen, usually from a metal acid combination; most of these reductive alkylations have been carried out with hydrogen and a catalyst. The principal variation excluded is that in which the reducing agent is formic acid or one of its derivatives; this modification is known as the Leuckart reaction. The process of reductive alkylation of ammonia consists in the addition of ammonia to a carbonyl compound and reduction of the addition compound or its dehydration product. The reaction usually is carried out in ethanol solution when the reduction is to be affected catalytically.



Since the primary amine is formed in the presence of the aldehyde it may react in the same way as ammonia, yielding an addition compound, a Schiff's base ($RCH = NCH_2R$) and finally, a secondary amine. Similarly, the primary amine may react with the imine, forming an addition product which also is reduced to a secondary amine. Finally, the secondary amine may react with either the aldehyde or the imine to give products which are reduced to tertiary amines.



Similar reactions may occur when the carbonyl compound employed is a ketone.

(A) Ethanal on reaction with ammonia forms an imine (*X*) which on reaction with nascent hydrogen gives (*Y*). Identify '*X*' and '*Y*'.

- (a) *X* is $\text{CH}_3\text{CH} = \text{NH}$ and *Y* is CH_3NH_2
- (b) *X* is $\text{CH}_3\text{CHOHNH}_2$ and *Y* is $\text{CH}_3\text{CH}_2\text{NH}_2$
- (c) *X* is $\text{CH}_3\text{CHOHNH}_2$ and *Y* is CH_3NH_2
- (d) *X* is $\text{CH}_3\text{CH} = \text{NH}$ and *Y* is $\text{CH}_3\text{CH}_2\text{NH}_2$

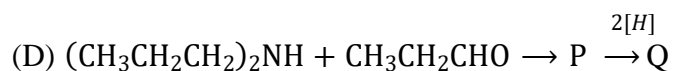
(B) Acetaldehyde is reacted with ammonia followed by reduction in presence of hydrogen as a catalyst. The primary amine so formed further reacts with acetaldehyde. The Schiff's base formed during the reaction is:

- (a) $\text{CH}_3\text{CH} = \text{NCH}_3$
- (b) $\text{CH}_3\text{CH} = \text{NCH}_2\text{CH}_3$
- (c) $\text{CH}_2 = \text{NCH}_2\text{CH}_3$
- (d) $\text{CH}_3\text{CH}_2\text{CH} = \text{NCH}_3$

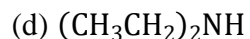
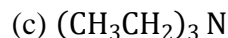
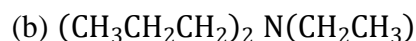
(C) The reaction of ammonia and its derivatives with aldehydes is called:

- (a) nucleophilic substitution reaction
- (b) electrophilic substitution reaction
- (c) nucleophilic addition reaction

(d) electrophilic addition reaction



The compound *Q* is:



(E) Reductive alkylation of ammonia by means of an aldehyde in presence of hydrogen as reducing agents results in formation of:

(a) Primary amines

(b) Secondary amines

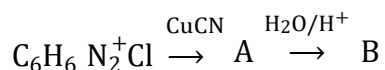
(c) Tertiary amines

(d) Mixture of all three amines

[CBSE 2021]

Very Short & Short Qs [1 – 3 marks]

41. Write the structures of *A* and *B* in the following reactions:

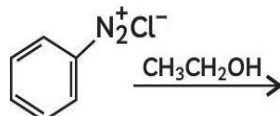


[CBSE 2020]

42. Carry out the following conversion: p-nitrotoluene to 2-bromobenzoic acid.

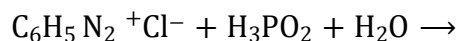
[CBSE 2019]

43. Write the structure of the main product of the following reaction:



[CBSE 2018]

44. Complete the following reaction equation:



[CBSE 2015]

45. The conversion of primary aromatic amines into diazonium salts is known as:

[CBSE 2014]

46. (A) Write the reaction involved in the following:

Diazotisation

(B) Give reason: Aromatic diazonium salts are more stable than aliphatic diazonium salts.

[CBSE 2018]

47. (A) How will you convert aniline into p-bromoaniline? Write relevant chemical equation.

(B) Arrange following in increasing order basic strength:

(i) Aniline, *p*-nitroaniline, *p*-toluidine

(ii) Aniline, ammonia, ethanamine

[Delhi Gov. SQP Term-2 2022]

48. Explain following:

(A) Aniline does not undergoes Friedel-Crafts reaction.

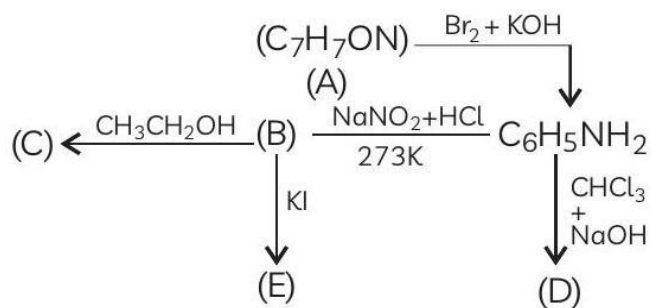
(B) Aniline is less basic than cyclohexylamine.

(C) Aromatic amines cannot be synthesized by Gabriel phthalimide synthesis.

[Delhi Gov. SQP Term-2 2022]

Long Type Qs [4 – 5 marks]

49. An aromatic compound 'A' of molecular formula C_7H_7ON undergoes a series of reaction as shown below. Write the structures of A, B, C, D and E in the following reactions:



[CBSE 2015]

PREVIOUS YEAR
QUESTION
PAPERS

CHEMISTRY

CLASS 12

CHAPTER 10

Biomolecules

1. CARBOHYDRATES

Objective Qs [1 mark]

1. Which of the following is a polysaccharide?

- (a) Glucose
- (b) Maltose
- (c) Glycogen
- (d) Lactose

[CBSE SQP Term-1 2021]

2. Which one of the following reactions is not explained by the open chain structure of glucose?

- (a) Formation of pentaacetate of glucose with acetic anhydride.
- (b) Formation of addition product with 2, 4-DNP reagent.
- (c) Silver mirror formation with Tollen's reagent.
- (d) Existence of alpha and beta forms of glucose.

[CBSE SQP Term-1 2021]

3. Glucose on reaction with Br₂ water gives:

- (a) saccharic acid
- (b) hexanoic acid
- (c) gluconic acid
- (d) salicylic acid

[CBSE Term-1 2021]

4. Which of the following sugar is known as dextrose?

- (a) Glucose
- (b) Fructose
- (c) Ribose
- (d) Sucrose

[CBSE Term-1 2021]

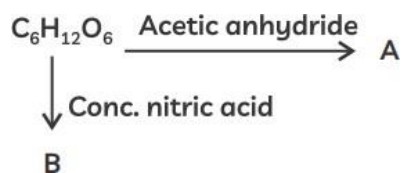
5. Find incorrect statement from the following for glucose:

- (a) It is present in furanose form.
- (b) It is an aldohexose.

- (c) It does not give 2, 4-DNP test.
- (d) It forms n-hexane when heated with HI.

[Delhi Gov. SQP Term-1 2021]

6. In the following reaction, identify A and B :



- (a) A = COOH – (CH₂)₄ – COOH, B = OHC (CHOCOCH₃)₄ – CH₂OCOCH₃
- (b) A = COOH – (CH₂)₄ – CHO, B = OHC – (CHOCOCH₃)₄ – CH₂OCOCH₃
- (c) A = OHC – (CHOCOCH₃)₃ – CH₂OCOCH₃ B = COOH – (CH₂O)₄ – CHO,
- (d) A = OHC – (CHOCOCH₃)₄ – CH₂OCOCH₃ B = COOH – (CH₂O)₄ – COOH

[CBSE SQP Term-1 2021]

7. Which one of the following statement is correct about sucrose?

- (a) It can reduce tollen's reagent however cannot reduce Fehling's reagent.
- (b) It undergoes mutarotation like glucose and fructose.
- (c) It undergoes inversion in the configuration on hydrolysis.
- (d) It is laevorotatory in nature.

[CBSE SQP Term-I 2021]

8. $\alpha - D - (+)$ - glucose and $\beta - D - (+)$ - glucose are:

- (a) anomers
- (b) enantiomers
- (c) conformers
- (d) epimers

[CBSE 2020]

9. Dissacharides that are reducing in nature are:

- (a) sucrose and lactose

- (b) sucrose and maltose
- (c) lactose and maltose
- (d) sucrose, lactose and maltose

[CBSE SQP 2020]

In the following question, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

10. Assertion (A): Sucrose is a non - reducing sugar.

Reason (R): It has glycosidic linkage.

[CBSE 2020]

Very Short & Short Qs [1 - 3 marks]

11. When sucrose is hydrolysed the optical rotation values are measured using a polarimeter and are given in the following table:

S.No.	Time (hours)	Specific Rotation
1	0	+66.5°
2	∞	-39.9°

- (A) Account for the two specific rotation values.
- (B) What is the specific name given to sucrose based on the above observation?
- (C) One of the products formed during the hydrolysis of sucrose is a glucose, that reacts with hydroxylamine to give compound A. Identify compound A.

[CBSE SQP 2023]

12. What happens when *D* - glucose is treated with the following reagents?

- (A) Bromine water

(B) HNO_3

[CBSE SQP 2022]

13. Account for the following:

(A) There are 5 – OH groups in glucose

(B) Glucose is a reducing sugar

[CBSE SQP 2022]

14. Define the following terms:

(A) Oligosaccharides

(B) Invert sugar

[CBSE 2020]

15. Name the disaccharide which on hydrolysis gives two molecules of glucose. [CBSE 2020]

16. Write the name of linkage joining two monosaccharides.

[CBSE 2020]

17. Write the products of hydrolysis of lactose.

[CBSE 2019]

18. Write chemical reactions to show that open structure of D-glucose contains the following:

(A) Straight chain

(B) Five alcohol groups

(C) Aldehyde as carbonyl group

[CBSE 2019]

19. Write the product when D-glucose react with conc. HNO_3 .

[CBSE 2018]

20. Glucose on reaction with acetic anhydride gives glucose pentaacetate. What does it suggest about the structure of glucose?

[CBSE 2017]

21. Which one of the following is a disaccharide: Starch, Maltose, Fructose, Glucose?

[CBSE 2015]

22. Write the product obtained when D-glucose reacts with $\text{H}_2\text{N} - \text{OH}$.

[CBSE 2015]

23. Which one of the following is a monosaccharide:

Starch, Maltose, Fructose, Cellulose.

[CBSE 2015]

24. Which of the two components of starch is water soluble?

[CBSE 2014]

25. Write the product formed on reaction of D-glucose with Br₂ water.

[CBSE 2014]

26. Write the product formed when glucose is treated with HI.

[CBSE 2014]

27. Define the following term: Polysaccharides

[CBSE 2014]

2. PROTEINS

Objective Qs [1 mark]

28. Which of the following statement is correct?

(a) Fibrous proteins are generally soluble in water.

(b) Albumin is an example of fibrous proteins. (c) In fibrous proteins, the structure is stabilised by hydrogen bonds and disulphide bonds.

(d) pH does not affect the primary structure of protein. [CBSE SQP Term-1 2021]

29. The sequence of α -amino acids in a polypeptide chain in a protein is called its:

(a) Tertiary structure

(b) Primary structure

(c) Secondary structure

(d) None of these

[Delhi Gov. SQP Term-1 2021]

30. Complete the following analogy:

Curdling of milk : A : : α -helix : B

- (a) A: Primary structure, B : Secondary structure
- (b) A: Denatured protein, B : Primary structure
- (c) A: Secondary structure, B : Denatured protein
- (d) A: Denatured protein, B : Secondary structure

[CBSE Term-1 2021]

31. Peptide linkage is present in:

- (a) carbohydrates
- (b) vitamins
- (c) protein
- (d) rubber

[CBSE 2020]

32. Amino acids are:

- (a) acidic
- (b) basic
- (c) amphoteric
- (d) neutral

[CBSE 2020]

33. In the following question, a statement of assertion (A) followed by a statement of reason (R) is given. Choose the correct answer out of the following choices.

Assertion (A): Proteins are found to have two different types of secondary structures viz alpha-helix and beta-pleated sheet structure.

Reason (R): The secondary structure of proteins is stabilised by hydrogen bonding.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

[CBSE SQP 2022]

Very Short & Short Qs [1 - 3 marks]

34. Differentiate between the following:

(A) Amylose and Amylopectin

(B) Peptide linkage and glycosidic linkage

[CBSE 2019]

35. Name the species formed when an aqueous solution of amino acid is dissolved in water?

[CBSE SQP 2019]

36. Define the following with an example of each:

(A) Denatured Protein.

(B) Essential Amino Acid.

[CBSE 2018]

37. What is the difference between fibrous protein and globular protein?

[CBSE 2017, 15]

38. Give one example each for fibrous and globular protein.

[CBSE 2016]

39. What is the difference between acidic amino acids and basic amino acids? [CBSE 2015]

40. What type of linkage is responsible for the formation of proteins?

[CBSE 2014]

3. VITAMINS, HORMONES & NUCLEIC ACIDS.

Objective Qs [1 mark]

41. The vitamins which can be stored in our body are:

(a) Vitamin A, B, D and E

(b) Vitamin A, C, D and K

(c) Vitamin A, B, C and D

(d) Vitamin A, D, E and K

[CBSE SQP 2023]

42. Match the following:

I	II
---	----

(i) Amino acids	(A) Protein
(ii) Thymine	(B) Nucleic acid
(iii) Insulin	(C) DNA
(iv) phosphodiester linkage	(D) Zwitter ion
(v) Uracil	

Which of the following is the best matched options?

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

[CBSE SQP Term-1 2021]

43. Nucleosides are composed of:

- (a) a pentose sugar and phosphoric acid.
- (b) a nitrogenous base and phosphoric acid.
- (c) a nitrogenous base and a pentose sugar.
- (d) a nitrogenous base, a pentose sugar and phosphoric acid.

[CBSE Term-1 2021]

44. The base which is present in DNA but not in RNA, is:

- (a) Cytosine
- (b) Guanine
- (c) Adenine
- (d) Thymine

[CBSE Term-1 2021]

Case Based Qs [4 - 5 marks]

Read the following passage and answer the questions that follow:

45. Strengthening the Foundation: Chargaff Formulates His "Rules"

Many people believe that James Watson and Francis Crick discovered DNA in the 1950s. In reality, this is not the case. Rather, DNA was first identified in the late 1860s by Swiss chemist Friedrich Miescher. Then, in the decades following Miescher's discovery, other scientists--notably, Phoebus Levene and Erwin Chargaff--carried out a series of research efforts that revealed additional details about the DNA molecule, including its primary chemical components and the ways in which they joined with one another. Without the scientific foundation provided by these pioneers, Watson and Crick may never have reached their groundbreaking conclusion of 1953: that the DNA molecule exists in the form of a three-dimensional double helix.

Chargaff, an Austrian biochemist, as his first step in this DNA research, set out to see whether there were any differences in DNA among different species. After developing a new paper chromatography method for separating and identifying small amounts of organic material, Chargaff reached two major conclusions:

(I) The nucleotide composition of DNA varies among species.

(II) Almost all DNA, no matter what organism or tissue type it comes from maintains certain properties, even as its composition varies. In particular, the amount of adenine (A) is similar to the amount of thymine (T), and the amount of guanine

(G) approximates the amount of cytosine (C). In other words, the total amount of purines ($A + G$) and the total amount of pyrimidines ($C + T$) are usually nearly equal. This conclusion is now known as "Chargaff's rule."

Chargaff's rule is not obeyed in some viruses. These either have single-stranded DNA or RNA as their genetic material.

(A) A segment of DNA has 100 adenine and 150 cytosine bases. What is the total number of nucleotides present in this segment of DNA?

(B) A sample of hair and blood was found at two sites. Scientists claim that the samples belong to same species. How did the scientists arrive at this conclusion?

(C) The sample of a virus was tested and it was found to contain 20% adenine, 20% thymine, 20% guanine and the rest cytosine. Is the genetic material of this virus (i) DNA- double helix (ii) DNA- single helix (iii) RNA? What do you infer from this data?

OR

How can Chargaff's rule be used to infer that the genetic material of an organism is double- helix or single- helix?

[CBSE SQP 2022]

Very Short & Short Qs [1 - 3 marks]

46. (A) DNA fingerprinting is used to determine paternity of an individual. Which property of DNA helps in the procedure?
(B) What structural change will occur when a native protein is subjected to change in pH ?
[CBSE SQP 2023]
47. Why Vitamin C can't be stored in our body?
[CBSE 2016]
48. What is the difference between a nucleotide and nucleoside?
[CBSE 2016, 14]
49. What type of linkage is present in nucleic acids?
[CBSE 2016]
50. Write the name of the vitamin whose deficiency causes bone deformities in children.
[CBSE 2015]
51. "Vitamins are organic compounds that people need in small quantities. Most vitamins need to come from food because the body either does not produce them or produces very little. Different vitamins play different roles in the body, and a person requires a different amount of each vitamin to stay healthy."
Deficiency of which vitamin causes:
(A) night blindness
(B) poor coagulation of blood. [CBSE 2014]
52. Deficiency of which vitamin causes scurvy?
[CBSE 2014]
53. Why are vitamin A and vitamin C essential for us?
[CBSE 2014]
54. Name the base that is found in nucleotide of RNA only.
[CBSE 2014]
55. Differentiate between following:
(A) Amylose and Amylopectin
(B) Globular and Fibrous protein

(C) Nucleotide and Nucleoside.

[CBSE 2014]

