

CHEMISTRY

VOLUME - II

12th Standard

Based on the New Syllabus and New Textbook for the year 2019-20

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2019-20 Edition

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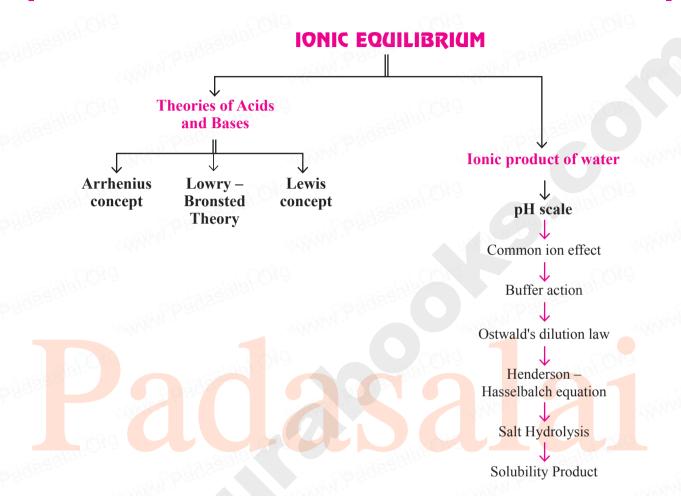
UNIT 8

IONIC EQUILIBRIUM

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8.1	Acids an	d bases		8.7.2	Buffer capacity and buffer
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	8.1.2	Lowry - Bronsted Theory		8.7.3	Henderson – Hasselbalch equation
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	8.7.1	Buffer action			solubility

CONCEPT MAP





Sura's → XII Std - Chemistry → Volume - II

MUST KNOW DEFINITIONS

Lowry - Bronsted **Theory**

According to Lowry – Bronsted concept, an acid is defined as a substance that has a tendency to donate a proton to another substance and base is a substance that has a tendency to accept a proton form other substance. In other words, an acid is a proton donor and a base is a proton acceptor.

Lewis concept

According to Lewis concept, an acid is a species that accepts an electron pair while base is a species that donates an electron pair.

Ionisation of water

The ionic product of water at 25°C is

$$K_{w} = [H_{3}O]^{+} [OH^{-}]$$

 $K_{w} = (1 \times 10^{-7}) (1 \times 10^{-7})$
 $= 1 \times 10^{-14}$

pH scale

pH of a solution is defined as the negative logarithm of base 10 of the molar concentration of the hydronium ions present in the solution.

$$pH = -\log_{10} [H_3O^+]$$

 $pOH = -\log_{10} [OH^-]$

$$pH + pOH = 14$$

Degree of dissociation Degree of dissociation (α) is the fraction of the total number of moles of a substance that dissociates at equilibrium.

$$\alpha = \frac{\text{Number of moles dissociated}}{\text{total number of moles}}$$

Ostwald's dilution

 $k_a = \frac{\alpha^2 C}{1 - \alpha}$ is known as Ostwald's dilution law.

$$\alpha = \sqrt{\frac{k_a}{C}}$$

Common ion effect

The dissociation of a weak acid (CH₃COOH) is suppressed in the presence of a salt (CH₃COONa) containing an ion common to the weak electrolyte. It is called the common ion effect.

Buffer

Buffer is a solution which consists of a mixture of a weak acid and its conjugate base (or) a weak base and its conjugate acid.

Buffer action

This buffer solution resists drastic changes in its pH upon addition of a small quantities of acids (or) bases, and this ability is called buffer action.

Acidic buffer solution

A solution containing a weak acid and its salt.

Example: solution containing acetic acid and sodium acetate

Basic buffer solution

A solution containing a weak base and its salt. **Example :** Solution containing NH₄OH and NH₄Cl

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EVALUATION

CHOOSE THE CORRECT ANSWER

- Concentration of the Ag+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.24×10^{-4} mol L⁻¹ solubility product of Ag₂C₂O₄ is
 - NEET 2017
 - a) $2.42 \times 10^{-8} \text{ mol}^3 \text{L}^{-3}$
 - b) $2.66 \times 10^{-12} \text{ mol}^3 \text{L}^{-3}$
 - c) $4.5 \times 10^{-11} \text{ mol}^3 \text{L}^{-3}$
 - d) $5.619 \times 10^{-12} \,\mathrm{mol}^3 L^{-3}$

[Ans. (d)
$$5.619 \times 10^{-12} \text{ mol}^3 \text{L}^{-3}$$
]

- Following solutions were prepared by mixing different volumes of NAOH of HCL different concentrations. (NEET - 2018)
 - 60 mL $\frac{M}{10}$ HCl + 40mL $\frac{M}{10}$ NaOH
 - 55 mL $\frac{M}{10}$ HCl + 45 mL $\frac{M}{10}$ NaOH
 - $75 \text{ mL } \frac{\text{M}}{5} \text{ HCl} + 25 \text{mL } \frac{\text{M}}{5} \text{ NaOH}$
 - $100 \text{ mL } \frac{M}{10} \text{ HCl} + 100 \text{ mL } \frac{M}{10} \text{ NaOH}$

pH of which one of them will be equal to 1?

- b) i
- c) ii
- d) iii

[Ans. (d) iii]

The solubility of BaSO₄ in water is $2.42 \times 10^{-3} \text{gL}^{-1}$ at 298K. The value of its solubility product (K_{sp}) will be. (Given molar mass of BaSO₄ = $\hat{2}33$ g mol⁻¹)

- a) $1.08 \times 10^{-14} \text{mol}^2 \text{L}^{-2}$
- b) $1.08 \times 10^{-12} \text{ mol}^2 \text{L}^{-2}$
- c) $1.08 \times 10^{-10} \text{ mol}^2 \text{L}^{-2}$
- d) $1.08 \times 10^{-8} \,\text{mol}^2 L^{-2}$

[Ans. (c) $1.08 \times 10^{-10} \text{ mol}^2 \text{L}^{-2}$]

- pH of a saturated solution of Ca(OH), is 9. The Solubility product (K_{sp}) of $Ca(OH_{2})$
 - a) 0.5×10^{-15}
- b) 0.25×10^{-10}
- c) 0.125×10^{-15}
- d) 0.5×10^{-10}

[Ans. (a) 0.5×10^{-15}]

- Conjugate base for bronsted acids H2O and
 - a) OH⁻ and H₂FH⁺, respectively
 - b) H₂O⁺ and F⁻, respectively
 - c) OH⁻ and F⁻, respectively
 - d) H₂O⁺ and H₂F⁺, respectively

[Ans. (c) OH⁻ and F⁻, respectively]

- Which will make basic buffer? **6**.
 - 50 mL of 0.1M NaOH +25mL of 0.1M CH₃COOH
 - b) 100 mL of 0.1M CH₃COOH + 100 mL of 0.1M NH₄OH
 - c) 100 mL of 0.1M HCl + 200 mL of 0.1M NH₄OH
 - d) 100 mL of 0.1M HCl + 100 mL of 0.1M NaOH

[Ans. (c) 100 mL of 0.1M HCl + 200 mL of 0.1M NH₄OH

Which of the following fluoro – compounds is most likely to behave as a Lewis base?

(NEET - 2016)

- a) BF_3

- b) PF₃ C) CF₄
 - d) SiF₄

[Ans. (b) PF₂]

- Which of these is not likely to act as lewis base?
 - a) BF_3
- b) PF₃ C) CO
- d) F-

[Ans. (a) BF_3]

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- **20.** H₂PO₄ the conjugate base of
 - a) PO_4^{3-}
- c) H₃PO₄
- b) P₂O₅
 d) HPO₄²⁻

[Ans. (c) H_3PO_4]

- 21. Which of the following can act as Lowery -Bronsted acid well as base?
- a) HCl b) SO_4^{2-} c) HPO_4^{2-} d) Br^-

Ans. (c) HPO_4^{2-}

- 22. The pH of an aqueous solution is Zero. The solution is
 - a) slightly acidic
- b) strongly acidic
- c) neutral
- d) basic

[Ans. (b) strongly acidic]

- 23. The hydrogen ion concentration of a buffer solution consisting of a weak acid and its salts is given by
 - a) $[H^{+}] = \frac{K_a [acid]}{[salt]}$ b) $[H^{+}] = K_a [salt]$

 - c) $[H^+] = K_a [acid]$ d) $[H^+] = \frac{K_a [salt]}{[acid]}$

[Ans. (a) $[H^+] = \frac{K_a[acid]}{[salt]}$

- 24. Which of the following relation is correct for degree of hydrolysis of ammonium acetate?
 - a) $h = \sqrt{\frac{K_h}{C}}$
- b) $h = \sqrt{\frac{K_a}{K_L}}$
- c) $h = \sqrt{\frac{K_h}{K_a.K_b}}$ d) $h = \sqrt{\frac{K_a.K_b}{K_h}}$

[Ans. (c) $h = \sqrt{\frac{K_h}{K K_L}}$]

- 25. Dissociation constant of NH₄OH is 1.8×10^{-5} the hydrolysis constant of NH₄Cl would be
 - a) 1.8×10^{-19}
- b) 5.55×10^{-10}
- c) 5.55×10^{-5}
- d) 1.80×10^{-5}

[Ans. (b) 5.55×10^{-10}]

Answer the Following Questions

- What are Lewis acids and bases? Give two example for each.
- Ans. Lewis acid A Lewis acid is a positive ion (or) an electron deficient molecule which accepts an electron pair.

Eg: BF₃, AlCl₃, BeF₂.

Lewis Base - A Lewis base is a anion (or) neutral molecule with at least one lone pair of electrons that can donate an electron pair.

Eg: NH₃, R-NH₂, F⁻, Cl⁻.

- 2. Discuss the Lowery - Bronsted concept of acids and bases.
- Ans. Lowry Bronsted Theory (Proton Theory):

According to Lowry - Bronsted concept, an acid is defined as a substance that has a tendency to donate a proton to another substance and base is a substance that has a tendency to accept a proton form other substance. In other words, an acid is a proton donor and a base is a proton acceptor.

When hydrogen chloride is dissolved in water, it donates a proton to the later. Thus, HCl behaves as an acid and H₂O is base. The proton transfer from the acid to base can be represented as

$$HC1 + H_2O \longrightarrow H_3O^+ + C1^-$$

When ammonia is dissolved in water, it accepts a proton from water. In this case, ammonia (NH₃) acts as a base and H2O is acid. The reaction is represented as

$$H_2O + NH_3 \Longrightarrow NH_4^+ + OH^-$$

Let us consider the reverse reaction in the following equilibrium

Proton donar (acid) + C1
Proton acceptor (base) Proton donar (acid) Proton acceptor (hase)

H₃O⁺ donates a proton to Cl⁻ to form HCl i.e., the products also behave as acid and base.

In general, Lowry - Bronsted (acid - base) reaction is represented as

 $Acid_1 + Base_2 \longrightarrow Acid_2 + Base_1$

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- **26.** Will a precipitate be formed when 0.150 L of 0.1M Pb(NO₃)₂ and 0.100 L of 0.2 M NaCl are mixed? K_{sp} (PbCl₂) = 1.2 × 10⁻⁵.
- **Ans.** When two are more solution are mixed, the resulting concentrations are different from the original.

Total volume = 0.250L

$$pb(NO_3)_2 \longrightarrow pb^{2+} + 2NO_3^-$$

0.1M 0.1M 0.2M

Number of moles

 Pb^{2+} = molarity × Volume of the solution in lit

$$[pb^{2+}]_{mix} = \frac{0.1 \times 0.15}{0.25} = 0.06 \text{ M}$$

$$NaCl \longrightarrow Na^{+} + Cl^{-}$$
0.2M 0.2M 0.2M

No. of moles $Cl^- = 0.2 \times 0.1$

$$\left[\text{Cl}^{-}\right]_{\text{mix}} = \frac{0.2 \times 0.1}{0.25} = 0.08 \text{ M}$$

Precipitation of PbCl_{2(s)} occurs if

$$[Pb^{2+}][Cl^{-}]^{2} > K_{sp}$$

 $[Pb^{2+}][Cl^{-}]^{2} = (0.06)(0.08)$
 $= 3.84 \times 10^{-4}$

Since ionic product $[Pb^{2+}][Cl^{-}]^{2} > K_{sp}$, $PbCl_{2}$ is precipitated.

27. K_{sp} of Al(OH)₃ is 1×10^{-15} M. At what pH does 1.0×10^{-3} M Al³⁺ precipitate on the addition of buffer of NH₄Cl and NH₄OH solution?

Ans.
$$Al(OH)_3 \longrightarrow Al_{(aq)}^{3+} + 3OH_{(aq)}^{-}$$

$$K_{sp} = [Al^{3+}][OH^{-}]^{3}$$

Al(OH)₃ precipitates when

$$[Al^{3+}][OH^{-}]^{3} > K_{sp}$$

$$[1 \times 10^{-3}][OH^{-}]^{3} > 1 \times 10^{-15}$$

$$[OH]^3 > 1 \times 10^{-12}$$

$$[OH^{-}] > 1 \times 10^{-4} M$$

$$[OH^{-}] = 1 \times 10^{-4} \,\mathrm{M}$$

$$POH = -log_{10} [OH^-]$$

$$= -\log [1 \times 10^{-4}] = 4$$

$$PH = 14 - 4 = 10$$

Thus, Al(OH)₃ precipitates at a pH of 10.

EVALUATE YOURSELF

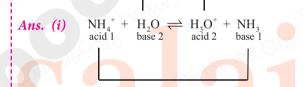
- 1. Classify the following as acid (or) base using Arrhenius concept
 - i) HNO_3
- ii) Ba(OH),
- iii) H₃PO₄
- iv) CH₃COOH

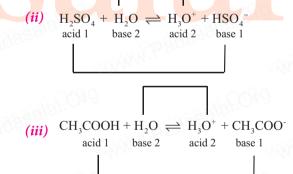
Ans. acid:

- i) HNO_3
- iii) H₃PO₄
- iv) CH₃COOH

Base: ii) Ba(OH)₂

- 2. Write a balanced equation for the dissociation of the following in water and identify the conjugate acid -base pairs.
 - i) NH₄ ii) H₂SO₄ iii) CH₃COOH.





- 3. Identify the Lewis acid and the Lewis base in the following reactions.
 - i. $CaO + CO_2 \longrightarrow CaCO_3$
 - ii. $CH_3 = 0 CH_3 + AlCl_3$ CH_3 CH_3 CH_3 CH_3
- Ans. (i) CaO Lewis base; CO₂ Lewis acid

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Additional Questions and Answers

CHOOSE THE CORRECT ANSWER 1 MARK

- Which one among the following in the strongest Bronsted base
 - a) ClO_4^- b) ClO_3^- c) ClO_2^- d) ClO_3^- [Ans. (d) ClO⁻]
- Which of the following is not a Lewis acid?
 - a) SiCl₄ b) AlCl₃ c) SO₃ d) CO [Ans. (d) CO]
- Analyses the equilibrium

$$HClO_4 + H_2O \Longrightarrow H_3O^+ + ClO_4^-$$

and choose the correct statement.

- a) H₃O⁺ is the conjugate base of H₂O
- b) ClO₄ is the conjugate base of HClO₄
- c) H₂O is the conjugate acid of H₃O⁺
- d) HClO₄ is the conjugate acid of H₃O⁺

[Ans. (b) ClO_4^- is the conjugate base of $HClO_4$]

- Pick the strongest conjugate base among the following
 - a) Cl-
- b) NO₂
- c) SO_4^{2-}
- d) CH₃COO

[Ans. (d) CH₃COO⁻]

- Pick out the incorrect statement regarding Lewis acids and bases.
 - a) A Lewis acid is a electron deficient molecule
 - b) Lewis bases is one which donates an electron
 - c) Lewis base is a cation
 - Both (a) and (c)

[Ans. (c) Lewis base is a cation]

- Pick the odd one out
 - a) Cl⁻
- b) CaO
- c) SO₂
- d) CH₃

[Ans. (c) SO₂]

- With regard to the strength of acids and bases, Find the incorrect statement among the following.
 - Strong acid is one that completely dissociates
 - b) K_a is the dissociation constant
 - c) CH₂COOH is a weak acid
 - d) Smaller the K_a value, greater is the acid [Ans. (d) Smaller the K_a value, greater is the acid strength
- K_w represents
 - a) ionic product constant of water
 - b) Solubility product of water
 - c) Equilibrium constant of water
 - d) Buffer index

[Ans. (a) ionic product constant of water]

- HCl is a strong acid since
 - a) It can be easily oxidised
 - b) It can be easily ionised
 - It dissociates completely to give H⁺ ions in solution
 - d) Both (a) and (b)

Ans. (c) It dissociates completely to give H⁺ ions in solution

- **10**. The conjugate base of NH⁻, is
 - a) NH⁻
- b) NH₃
- c) NH₃⁺ d) NH²⁻

[Ans. (d) NH^{2-}]

- 11. Ionic product of water increases when
 - a) Pressure decreases
 - b) H⁺ ions are added
 - c) OH- ions are added
 - d) temperature increases

[Ans. (d) temperature increases]

- **12.** For two acids A and B, K_a values at 25°C are 2×10^6 and 1.8×10^{-4} respectively. which among the following is true with respect to the above data.
 - a) A and B are equally acidic
 - b) A is stronger than B
 - c) B is stronger than A
 - d) K_a value is not a measure of acid strength

[Ans. (b) A is stronger than B]

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- **13.** If ionic product < solubility product then the solution is .
 - a) saturated
- b) super saturated
- c) unsaturated
- d) none of the above

[Ans. (c) unsaturated]

- 14. The solution whose pH is maintained constant even upon the addition of small amounts of acid or base is called .
 - a) acidic solution
- b) basic solution
- c) buffer solution
- d) true solution

[Ans. (c) buffer solution]

ASSERTION & REASON:

Direction : In each of the following questions a statement of assertion (A) is given and a corresponding statement of reason (R) is given just below it. Mark the correct statement as.

- a) (A) and (R) are true and (R) is the correct explanation of (A) (A)
- b) Both (A) and (R) are true but (R) does not explain (A)
- c) (A) is true but (R) is false
- d) Both (A) and (R) are false
- 1. Assertion: HNO₃ is a strong acid.
 - Reason: HNO₃ is completely ionised in solution and so has high K₂ value

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

- 2. Assertion: According to Bronsted concept, H₂O is an a neutral substance.
 - Reason : H₂O molecule can accept as well as donate a proton.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

- 3. Assertion: pH of acetic acid decreases with dilution.
 - Reason : On dilution, degree of ionisation of acetic acid decreases.

[Ans. (d) Both (A) and (R) are false]

4. Assertion: A solution containing acetic acid and sodium acetate acts as a buffer solution.

Reason: The pH of the above buffer would be equal to pK_a of acetic acid.

[Ans. (b) (A) and (R) are correct but (R) does not explain (A)]

5. Assertion: Solubility of AgCl in water decreases in the presence of NaCl.

Reason : Sodium chloride under goes hydrolysis in water.

[Ans. (b) (A) is correct but (R) is wrong]

6. Assertion: The dissociation of acetic acid decreases on addition of sodium acetate.

Reason: It is due to common ion effect.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

7. Assertion: Ostwald's dilution law is $K_a = \frac{\alpha^2 C}{1 - \alpha}$

Reason : Ostwald's dilution law is applicable only to strong electrolyte.

[Ans. (c) (A) is correct but (R) is wrong]

8. Assertion: K_w increases with increase in temperature.

Reason : Concentration of H₃O⁺ and OH⁻ increases.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

9. Assertion : In the reaction, $I_2 + I^- \rightarrow I_3$, I_2 acts as a Lewis base.

Reason: In this reaction I_2 donates a electron pair to I^- .

[Ans. (d) Both (A) and (R) are false]

10. Assertion: BF₃ is a Lewis acid.

Reason : It accepts a pair of electrons due to the presence of vacant orbital in the valence shell of boron.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

Equilibrium

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MATCH THE FOLLOWING:

1.

28	LIST - I		IST - II
A	Conjugate acid of NH ₃	i)	NH ₂
В	Conjugate base of NH ₃	ii)	SO_4^{2-}
C	Conjugate acid of HSO ₄	iii)	NH ₄ ⁺
D	Conjugate base of HSO ₄	iv)	H_2SO_4

- В C D A
- (a) (iv) (iii) (ii) (i)
- (iii) (i) (iv) (ii)
- (i) (iii) (ii)(iv)
- (iv) (i) (iii) (ii)

[Ans. (b) (iii), (i), (iv), (ii)]

2.

		212101.			
LIST - I		had	LIST - II		
A	Solubility product	i)	$K_a = \alpha^2 C$		
В	Henderson equation	ii)	$[X^{n+}]^m [Y^{m-}]^n$		
C	Buffer index	iii)	$pH = pK_a + log \frac{[salt]}{[acid]}$		
D	Ostwald's dilution law	iv)	$\beta = \frac{dB}{d(pH)}$		
150	difation law	nad	u(pn)		

- D
- (i) (iv) (iii) (ii)
- (iii) (i) (iv) (ii)
- (ii) (c) (iii) (iv) (i)
- (i) (iii)(iv)

[Ans. (d) (ii), (iii), (iv), (i)]

è	LIST - I			LIST - II
Ĭ	A	Lewis acid	i)	MgO
	В	Lewis base	ii)	Fe ³⁺
	C	Acid buffer	iii)	$NH_4Cl + NH_4OH$
N	D	Basic buffer	iv)	CH ₃ COOH+CH ₃ COONa

- D A
- (i) (ii) (iii) (iv) (ii) **(b)** (iii) (iv)
- (c) (ii) (i) (iv) (iii)
- (iv) (i) (iii)

[Ans. (c) (ii), (i), (iv), (iii)]

VERY SHORT ANSWER

2 MARKS

- Give the Limitations of Arrhenius concept theory of acids and bases.
- Ans. (i) Arrhenius theory does not explain the behaviour of acids and bases in non aqueous solvents such as acetone, Tetrahydrofuran etc...
 - This theory does not account for the basicity of the substances like ammonia (NH₃) which do not possess hydroxyl group.
- 2. Define Buffer solution.
- Ans. Buffer is a solution which consists of a mixture of a weak acid and its conjugate base (or) a weak base and its conjugate acid.
- What are the two types of buffer? Give an example for each.
- Acidic buffer solution : a solution containing a weak acid and its salt.

Example: solution containing acetic acid and sodium acetate

- Basic buffer solution : a solution containing a weak base and its salt.
 - **Example:** Solution containing NH₄OH and NH₄Cl.
- Define neutralisation reaction.
- Ans. When an acid reacts with a base, a salt and water are formed and the reaction is called neutralization.
- **5**. Give a condition for a compound to be precipitated.
- Ans. When the product of molar concentration of the constituent ions i.e., ionic product, exceeds the solubility product then the compound gets precipitated.

Ionic product $> K_{sp}$, precipitation will occur and the solution is super saturated.

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- product of water increase or decrease? Give reason to justify your answer.
- **Ans.** With increase in temperature the ionic product of water will increase since the concentration of H_3O^+ and OH^- ions will increase.
- Magnesium is not precipitated from a solution of its salt by a mixture of NH₄OH and NH₄Cl. Explain.
- Ans. Magesium has to precipitate as Mg(OH), when treated with NH₄OH, but addition of NH₄Cl will suppress the ionisation of NH₄OH due to common ion effect. So ionic product of Mg²⁺ and OH⁻ ions will be less than the solubility product (K_{sp}) of $Mg(OH)_2$. Hence will not precipitate.
- Write down the conjugate acid and base of the following
 - (i) NH₂
- HSO₄

Ans.

(ii)

Conjugate Acid

Conjugate Base

 $\begin{array}{ccc}
\mathrm{NH_4^+} & \mathrm{H_2SO_4} \\
\mathrm{NH_2^-} & \mathrm{SO_4^{2-}}
\end{array}$

NOTE:

For the conjugate acid add H⁺ to the given species and for the conjugate base subtract H⁺ ion.

- BF, is termed as an acid though it does not contain H⁺ ions. Explain.
- Ans. According to Lewis concept of Acid and bases, any species capable of accepting an electron pair is an acid. BF₃ is electron deficient so accepts a pair of electron, Hence termed as acid.
- 10. The K_w of a neutral solution is 10^{-12} at a particular temperature. What are its pH and pOH values?
- **Ans.** $pK_w = pH + pOH = 10^{-12}$ For a neutral solution, pH = pOHSo pH = pOH = 6.
- 11. Calculate the ionisation constant for the conjugate base of HF. Ionisation constant of HF at 298 K is 6.8×10^{-4} .
- **Ans.** The conjugate base of HF is F

For F⁻,
$$K_b = \frac{K_w}{K_a} = \frac{10^{-14}}{6.8 \times 10^{-4}}$$

= 1.47 × 10⁻¹¹

- When temperature is increased, will ionic 12. How is common ion effect related to the solubility of the electrolyte?
 - Ans. Common ion effect decreases the solubility of the electrolyte.
 - **13**. Why is aqueous solution of FeCl₃ acidic?
 - Ans. FeCl₃ when dissolved in water gives strong acid HCl and a weak base Fe(OH)₃. A strong acid ionises completely so concentration of H⁺ ion becomes much greater than OH- ion. So aqueous solution of FeCl₃ is acidic.
 - 14. What are the limitations of Ostwald's dilution law?
 - Ans. Ostwald's dilution law is applicable only for weak electrolyte and does not hold good for concentrated solution.

SHORT ANSWER

3 MARKS

- Based on Arrhenius concept, define acid and bases and give an example for each.
- Ans. According to Arrhenius, an acid is a substance that dissociates to give hydrogen ions in water. For example, HCl, H₂SO₄ etc., are acids. Their dissociation in aqueous solution is expressed as

$$HCl_{(g)} \rightleftharpoons H_{(aq)}^+ + Cl_{(aq)}^-$$

Similarly a base is a substance that dissociates to give hydroxyl ions in water. For example, substances like NaOH, Ca(OH)₂ etc., are bases.

$$Ca(OH)_2 \xrightarrow{H_2O} Ca_{(aq)}^{2+} + 2OH_{(aq)}^{-}$$

- 2. What do you mean by auto ionisation of water?
- **Ans.** Pure water itself has a little tendency to dissociate. i.e, one water molecule donates a proton to an another water molecule. This is known as auto ionisation of water and it is represented as below.

Conjugate acid - base pairs

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$$pH + pOH = 14$$

 $pH = 14 - pOH = 14 - \{-log [OH^-]\}$
 $= 14 + log [OH^-]$

$$\therefore pH = 14 + \log(K_hC)^{\frac{1}{2}}$$

$$pH = 14 + log \left(\frac{K_w C}{K_a}\right)^{\frac{1}{2}}$$

$$pH = 14 + \left(\frac{1}{2}\log K_{w} + \frac{1}{2}\log C - \frac{1}{2}\log K_{a}\right)$$

$$[\because K_{w} = 10^{-14}]$$

$$pH = 14 - 7 + \frac{1}{2}\log C + \frac{1}{2}pK_{a}$$

$$\frac{1}{2}\log K_{w} = \frac{1}{2} \times \log 10^{-14} = \frac{-14}{2}(1) = -7$$

$$pH = 7 + \frac{1}{2}pK_{a} + \frac{1}{2}\log C$$

$$[-\log K_a = pK_a]$$

PROBLEMS FOR PRACTICE

- 1. The hydrogen ion concentration of a fruit juice is 3.3×10^{-2} M. What is the pH of the juice ? Is it acidic or basic ?
- *Ans.* The definition of pH is

We are given $[H^+] = 3.3 \times 10^{-2}$

Substituting into the definition of pH, we get

pH =
$$-\log (3.3 \times 10^{-2})$$

= $-(-1.48) = 1.48$

Since the pH is less than 7.00, the solution is acidic.

- 2. Calculate the pH of a buffer containing 0.08 mole of acetic acid and 0.12 mole of sodium acetate per dm_3 of the solution. The ionisation constant of acetic acid is 1.8×10^{-5} .
- **Ans.** The pH of a buffer solution is given by the Henderson's equation.

$$\begin{aligned} pH &=& pK_a + log \frac{\left[salt\right]}{\left[acid\right]} \\ pK_a &=& -log \ K_a = -log \ [1.8 \times 10^{-5}] \end{aligned}$$

 $= \log \frac{1}{1.8 \times 10^{-5}}$ $= \log 1 - \log 1.8 - \log 10^{-5}$ = 5 - 0.2553 = 4.7447 $OH = 4.7447 + \log \frac{0.12}{0.08}$

 $= 4.7447 + \log 1.5$ = 4.7447 + 0.1761pH = 4.921.

3. Calculate the pH of 0.1 M CH_3COOH solution. Dissociation constant of acetic acid is 1.8×10^{-5} M.

Ans. For weak acids,

[H⁺] =
$$\sqrt{K_a \times C}$$

= $\sqrt{1.8 \times 10^{-5} \times 0.1} = \sqrt{1.8 \times 10^{-6}}$
= $1.34 \times 10^{-3} M$
∴ pH = $-\log [H^+] = \log (1.34 \times 10^{-3})$

 $\therefore pH = 2.87.$

UNIT TEST

Time: 40 min Marks: 25

- CHOOSE THE CORRECT ANSWER $(5 \times 1 = 5)$
- The solubility of AgCl (s) with solubility product 1.6×10^{-10} in 0.1M NaCl solution would be
 - a) $1.26 \times 10^{-5} \text{ M}$
- b) $1.6 \times 10^{-9} \text{ M}$
- c) $1.6 \times 10^{-11} \text{ M}$
- d) Zero
- Concentration of the Ag+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.24×10^{-4} mol L⁻¹ solubility product of Ag₂C₂O₄ is
 - a) $2.42 \times 10^{-8} \text{ mol}^3 \text{L}^{-3}$
 - b) $2.66 \times 10^{-12} \,\mathrm{mol}^3 \mathrm{L}^{-3}$
 - c) $4.5 \times 10^{-11} \text{ mol}^3 \text{L}^{-3}$
 - d) $5.619 \times 10^{-12} \text{ mol}^3 \text{L}^{-3}$
- Assertion: The dissociation of acetic acid decreases on addition of sodium

Reason: It is due to common ion effect

- i) (A) and (R) are correct and (R) explains (A)
- ii) (A) and (R) are correct but (R) does not explain (A)
- iii) (A) is correct but (R) is wrong
- iv) Both (A) and (R) are false.
- The hydrogen ion concentration of a buffer solution consisting of a weak acid and its salts is given by
 - a) $[H^{+}] = \frac{K_{a} [acid]}{[salt]}$ b) $[H^{+}] = K_{a} [salt]$

 - c) $[H^+] = K_a [acid]$ d) $[H^+] = \frac{K_a [salt]}{[acid]}$
- Match the list I with list II and select the correct answer using the code given below the list:

	LIST - I	L	IST - II
A	Conjugate acid of NH ₃	i)	NH_2^-
В	Conjugate base of NH ₃	ii)	SO_4^{2-}
C	Conjugate acid of HSO ₄	iii)	NH ₄ ⁺
D	Conjugate base of HSO ₄	iv)	H_2SO_4

- (iv)
 - (ii) (i) (iii)
- **(b)** (iii) (i) (iv) (ii)
- (iii) (ii)(iv) (i)
- (ii) (iv) (i) (iii)

- **VERY SHORT ANSWER**
- $(2 \times 2 = 4)$

- 1. Define pH.
- What are the two types of buffer? Give an example for each.
- III. SHORT ANSWER

- $(2 \times 3 = 6)$
- 1. How will you calculate solubility product from molar solubility?
- 50ml of 0.05M HNO3 is added to 50ml of 0.025M KOH. Calculate the pH of the resultant solution.
- IV. Long Answer

- $(2 \times 5 = 10)$
- 1. Derive Henderson - Hasselbalch equation.
- Derive an expression for Ostwald's dilution law.

Answer Key

- I. 1. (b) 1.6×10^{-9} M
 - **2.** (d) $5.619 \times 10 12 \text{ mol}^3 \text{L}^{-3}$
 - **3.** (i) (A) and (R) are correct and (R) explains (A)
 - **4.** (a) $[H^+] = \frac{K_a [acid]}{[colt]}$
 - **5.** (b) (iii), (i), (iv), (ii)
- 1. Refer Sura's Guide Page Book back Q.No. 13.
 - 2. Refer Sura's Guide Additional 2 marks Q.No. 4.
- III. 1. Refer Sura's Guide Additional 3 marks Q.No. 4.
 - 2. Refer Sura's Guide Book back Q.No. 15.
- 1. Refer Sura's Guide Additional 5 marks Q.No. 3.
 - 2. Refer Sura's Guide Book back Q.No. 12.

UNIT 9

ELECTRO CHEMISTRY

CHAPTER SNAPSHOT

	9.1.1	Molar conductivity
	9.1.2	Equivalent conductance
	9.1.3	Factors affecting electrolytic
		conductance
	9.1.4	Measurement of
		conductivity of ionic 9
		solutions
9.2	Variatio	n of molar conductivity with
	concent	ration
	9.2.1	Debye - Huckel and Onsagar

equation

Kohlraush's law

Conductivity of electrolytic solution

9.3	Electroc	ochemical Cell		
	9.3.1	Galvanic cell		
	9.3.2	Galvanic cell notation		
	9.3.3	Emf of a Cell		
	9.3.4	Measurement of electrode		
		potential		
9.4	Thermo	dynamics of cell reactions		
	9.4.1	Nernst equation		
	9.4.2	Electrolytic cell and		
		electrolysis		
	9.4.3	Electrochemical series		

9.2.2

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EVALUATION

Choose The Correct

- The number of electrons that have a total charge of 9650 coulombs is
 - a) 6.22×10^{23}
- b) 6.022×10^{24}
- c) 6.022×10^{22}
- d) 6.022×10^{-34}

[Ans. (c) 6.022×10^{22}]

Consider the following half cell reactions:

$$Mn^{2+} + 2e^- \longrightarrow Mn E^\circ = -1.18V$$

 $Mn^{2+} \longrightarrow Mn^{3+} + e^{-}E^{\circ} = -1.51V$

The E° for the reaction

 $3Mn^{2+} \longrightarrow Mn + 2Mn^{3+}$, and the possibility of the forward reaction are respectively.

- a) 2.69V and spontaneous
- b) -2.69 and non spontaneous
- c) 0.33V and Spontaneous
- d) 4.18V and non spontaneous

[Ans. (b) -2.69 and non spontaneous]

The button cell used in watches function as follows

$$Zn(s) + Ag_2O(s) + H_2O(l) \rightleftharpoons$$

 $2Ag(s) + Zn^{2+}(aq) + 2OH^-(aq)$

the half cell potentials are

$$Ag_2O(s) + H_2O(l) + 2e^-$$

$$2Ag(s) + 2OH^{-}(aq)$$

 $E^{\circ} = 0.34V$. The cell potential will be

a) 0.84V b) 1.34V c) 1.10V d) 0.42V

[Ans. (c) 1.10V]

- The molar conductivity of 0.5 mol dm⁻³ solution of AgNO₃ with electrolytic conductivity of 5.76×10^{-3} S cm⁻¹ at 298 K is
 - a) 2.88 S cm² mol⁻¹
- b) 11.52 S cm²mol⁻¹
- c) 0.086 S cm²mol⁻¹ d) 28.8 S cm² mol⁻¹

[Ans. (b) $11.52 \text{ S cm}^2\text{mol}^{-1}$]

Electrolyte	KCl	KNO ₃	HCl	NaOAC	NaCl
Λ_{-} (S cm ² mol ⁻¹)	149.9	145.0	426.2	91.0	126.5

Calculate Λ°_{HoAC} using appropriate molar conductances of the electrolytes listed above at infinite dilution in water at 25°C.

- a) 517.2 b) 552.7 c) 390.7 d) 217.5

[Ans. (c) 390.7]

- 6. Faradays constant is defined as
 - a) charge carried by 1 electron
 - b) charge carried by one mole of electrons
 - c) charge required to deposit one mole of substance
 - d) charge carried by 6.22×10^{10} electrons.

[Ans. (b) charge carried by one mole of electrons

How many faradays of electricity are required for the following reaction to occur

 $MnO_4^- \longrightarrow Mn^{2+}$

- a) 5F
- b) 3F
- c) 1F
- d) 7F

[Ans. (a) 5F]

- 8. A current strength of 3.86 A was passed through molten Calcium oxide for 41minutes and 40 seconds. The mass of Calcium in grams deposited at the cathode is (atomic mass of Ca is 40 g / mol and 1F = 96500C).

 - a) 4 b) 2
- d) 6
- [Ans. (b) 2]
- During electrolysis of molten sodium chloride, the time required to produce 0.1 mol of chlorine gas using a current of 3A
 - a) 55 minutes
- b) 107.2 minutes
- 220 minutes
- d) 330 minutes

[*Ans.* (b) 107.2 minutes]

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$$E_{cell} = E_{cell}^{\circ} - \frac{2.303 \times 8.314 \times 298}{n (96500)} log \frac{[C]^{l} [D]^{m}}{[A]^{x} [B]^{y}}$$

$$E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{n} log \frac{[C]^{l} [D]^{m}}{[A]^{x} [B]^{y}} \qquad(5)$$

25. Write a note on sacrificial protection.

- Sacrificial protection is the protection of iron and steel against corrosion by using a more reactive metal.
 - (ii) The more active metal loses electrons in preference to iron and converts itself into ionic state.
 - The metal which is often used for covering iron is zinc and the process is called Galvanisation.
 - zinc is stronger oxidising agent than iron and hence it can be more easily corroded than iron. i.e., instead of iron, the zinc is oxidised.

26. Explain the function of H₂ – O₂ fuel cell.

Ans. Fuel cell:

- The galvanic cell in which the energy of combustion of fuels is directly converted into electrical energy is called the fuel cell.
- It requires a continuous supply of reactant to keep functioning.
- The general representation of a fuel cell is (iii) follows

Fuel | Electrode | Electrolyte | Electrode | Oxidant

- Let us understand the function of fuel cell by considering hydrogen - oxygen fuel cell.
- In this case, hydrogen act as a fuel and oxygen as an oxidant and the electrolyte is aqueous KOH maintained at 200°C and 20 - 40 atm.
- (vi) Porous graphite electrode containing Ni and NiO serves as the inert electrodes.
- (vii) Hydrogen and oxygen gases are bubbled through anode cathode, the and respectively.

Oxidation occurs at the anode:

$$2H_{2(g)} + 4 OH_{(aq)}^{-} \longrightarrow 4 H_2O(l) + 4e^{-}$$

Reduction occurs at the cathode

$$\begin{split} &\mathrm{O_{2(g)}} + 2\mathrm{H_2O}(l) + 4\mathrm{e^-} \longrightarrow 4\mathrm{OH_{(aq)}^-} \\ &\mathrm{The\ overall\ reaction\ is} \\ &2\mathrm{H_{2(g)}} + \mathrm{O_{2(g)}} \longrightarrow 2\mathrm{H_2O}(l) \end{split}$$

....(5) 27. Ionic conductance at infinite dilution of Al3+ and SO4- are 189 and 160 mho cm2 equiv-1. Calculate the equivalent and molar conductance of the electrolyte Al₂(SO₄)₃ at infinite dilution.

Ans. The electrolytes is Al₂ (SO₄)₃

Equivalent conductance at infinite dilution

$$\lambda_{\infty} Al_2(SO_4)_3 = \frac{1}{3} \lambda_{\infty} Al^3 + \frac{1}{2} \lambda_{\infty} SO_4^{2-1}$$

$$\lambda_{\infty} \text{Al}_2(\text{SO}_4)_3 = \frac{189}{3} + \frac{160}{2} = 63 + 80$$

 $= 143 \text{ mho cm}^2 \text{ gm equ}^{-1}.$

Molar conductance at infinite dilution

$$\mu_{\infty} \text{Al}_2(\text{SO}_4)_3 = 2 \times 189 + 3 \times 160$$
= 858 mho cm² mol⁻¹.

Evaluate Yourself

Calculate the molar conductance of 0.01M aqueous KCl solution at 25°C. The specific conductance of KCl at 25°C is $14.114 \times 10^{-2} \text{ Sm}^{-1}$.

Ans. Molar conductance
$$\Lambda_{\rm m} = \frac{\kappa \times 10^{-3}}{\rm M} \, {\rm mol}^{-1} {\rm m}^3$$

Specific conductance $\kappa = 14.114 \times 10^{-2} \text{ Sm}^{-1}$

Molar conductance
$$\Lambda_{\rm m} = \frac{14.114 \times 10^{-2} \times 10^{-3}}{0.01}$$

$$= 14.114 \times 10^{-3} \text{ Sm}^2 \text{ mol}^{-1}.$$

The resistance of 0.15 M solution of an electrolyte is 50 Ω . The specific conductance of the solution is 2.4 Sm⁻¹. The resistance of 0.5 N solution of the same electrolyte measured using the same conductivity cell is 480 Ω . Find the equivalent conductivity of 0.5 N solution of the electrolyte.

Ans. Given that

$$\begin{array}{llll} R_1 & = & 50 \, \Omega & & R_2 \, = \, 480 \, \Omega \\ \kappa_1 & = & 2.4 \, \text{Sm}^{-1} & & \kappa_2 \, = \, ? \end{array}$$

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CHOOSE THE CORRECT ANSWER

1 MARK

- Which one of the following solution has highest equivalent conductance?
 - a) 0.1 M NaCl
- b) 0.05 M NaCl
- c) 0.005 M NaCl
- d) 0.25 M NaCl

[Ans. (c) 0.005 M NaCl]

NOTE:

Equivalent conductance increases with dilution.

- Pick out the correct statement regarding resistance of an electrolytic solution
 - a) It is inversely proportional to the length (*l*)
 - b) It is inversely proportional to the cross sectional area (A)
 - c) It is directly proportional to the cross sectional area (A)
 - d) Resistivity is denoted by ρ (rho)

(Ans. (b) It is inversely proportional to the cross sectional area (A)

- Which among the following is the strongest reducing agent?
- c) Zn
- d) Li

[Ans. (d) Li]

- Which of the statements about electrolytic conductance is not true?
 - Conductivity increases with decrease in viscosity.
 - b) Higher dielectric constant shows lower conductance in solution.
 - Temperature increases, conductance also increases.
 - d) Molar conductance increases with increase in dilution.

[Ans. (b) Higher dielectric constant shows lower conductance in solution

- A device in which spontaneous chemical reaction generates electric current.
 - a) Galvanic cell
- b) Voltaic cell
- Daniel cell
- d) All the above

[Ans. (d) All the above]

- Kohlraush's law is applied to calculate
 - a) molar conductance at infinite dilution of a weak electrolyte
 - b) degree of dissociation of weak electrolyte
 - c) solubility of a sparingly soluble salt
 - d) all the above
- [Ans. (d) all the above]
- The limiting molar conductivities of HCl, CH₂COONa and NaCl are respectively 425, 190 and 150 mho cm² mol⁻¹ at 25°C. The molar conductivity of 0.1 M acetic acid is 9.2 mho cm² mol⁻¹. The degree of dissociation of 0.1 M acetic acid is
 - a) 0.10
- b) 0.02 c) 0.19
- d) 0.03

[Ans. (c) 0.19]

HINT:

$$\Lambda_{\text{CH}_3\text{COOH}}^{\circ} = \Lambda_{\text{CH}_3\text{COONa}}^{\circ} + \Lambda_{\text{HCI}}^{\circ} - \Lambda_{\text{NaCI}}^{\circ}$$
$$= 190 + 425 - 150 = 465$$

$$\alpha = \frac{\Lambda_{\rm m}^{\rm C}}{\Lambda_{\rm m}^{\circ}} = \frac{9.2}{465} = 0.19$$

Using the data given below find out the strongest reducing agent

$$E_{Cr_2O_7^{2-}}^{\circ}Cr^{3+} = 1.33V, \qquad E_{Cl_2/Cl^{-}}^{\circ} = 1.36V$$

$$E_{MnO_4^-}^{\circ} / Mn^{2+} = 1.51V, \ E_{Cr^{3+}/Cr}^{\circ} = -0.74V$$

- a) Cr
- b) Cr^{3+} c) Cl^{-} d) Mn^{2+}
- [Ans. (a) Cr]
- Recharging of lead storage battery involves
 - a) anode is reduced to pb
 - b) cathode is reduced to pb
 - c) cathode is oxidised to pb
 - d) anode is oxidised to pbO,

[Ans. (a) anode is reduced to pb]

- 10. The laws of electrolysis were enunciated first by
 - a) Dalton
- b) Faraday
- c) Kekule
- d) Avogadro

[Ans. (b) Faraday]

Electro Chemistry

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9. Assertion: In Daniel cell, oxidation takes place at the zinc electrode

Reason: To maintain electrical neutrality in the anode and cathode compartment, a salt bridge is used

[Ans. (b) (A) and (R) are correct but (R) does not explain (A)]

10. Assertion: Formation of rust requires both oxygen and water.

Reason: The oxidising tendency of iron can be reduced by formation of its alloy with anodic metals

[Ans. (b) (A) and (R) are correct but (R) does not explain (A)]

11. Assertion: The relationship between ΔG and emf of cell is $\Delta G = -nFE$

Reason: In the Nernst equation, 'n' denotes number of protons.

[Ans. (c) (A) is correct but (R) is wrong]

MATCH THE FOLLOWING:

1.

		LIST - I]	LIST - II
	A	Conductance	i)	mho m ⁻¹
ş	В	Specific conductance	ii)	mol ⁻¹ m ³
	C	Specific resistance	iii)	siemen (S)
	D	Molar conductance	iv)	ohm m

A B C D

(a) (iv) (iii) (ii) (i)

(b) (iii) (i) (iv) (ii) (c) (iv) (ii) (iii) (i)

(d) (iii) (iv) (i) (ii)

[Ans. (b) (iii), (i), (iv), (ii)]

9

4	Ī	IST - I	18/14	LIST - II
	A	F ₂	i)	metal ion which is the weakest oxidising agent
	В	Li ⁺	ii)	unreactive metal
	C	Au	iii)	strongest reducing agent
	D	Li	iv)	strongest oxidising agent

- A B C D
- (a) (iii) (i) (iv) (ii)
- **(b)** (iv) (i) (ii) (iii)
- (c) (iv) (iii) (ii) (i)
- (d) (iii) (ii) (iv) (i)

[Ans. (b) (iv), (i), (ii), (iii)]

3.

_					
1,52	LIST - I		LIST - II		
A	Galvanic Cell	i)	converts electrical energy into chemical energy.		
В	B Electrolytic cell		acts as anode as well as cathode		
C	SHE	iii)	Zinc		
D	Sacrificial anode	iv)	converts chemical energy into electrical energy		

- A B C D
- (a) (iv) (i) (ii) (iii)
- **(b)** (iv) (iii) (ii) (i)
- (c) (iii) (i) (iv) (ii)
- (d) (iii) (ii) (iv) (i)

[Ans. (a) (iv), (i), (ii), (iii)]

4

-2	LIST - I	LI	LIST - II	
F	Reduction Half - Reaction	1	E° V	
A	$Au^{3+} + 3e^{-} \longrightarrow Au$	i)	0.34	
В	$Cl_2 + 2e^- \longrightarrow 2Cl^-$	ii)	1.50	
C	$Ag^+ + e^- \longrightarrow Ag$	iii)	1.36	
D	$Cu^{2+} + 2e^{-} \longrightarrow Cu$	iv)	0.80	

- A B C D
- (a) (i) (iv) (iii) (ii)
- **(b)** (iv) (i) (ii) (iii)
- (c) (iii) (ii) (iv) (i)
- (d) (ii) (iii) (iv) (i)

[Ans. (b) (iv), (iii), (ii), (i)]

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5.

LIST - I		LIST - II	
i.C	Cell	Electrolyte	
A	Li – ion battery	i)	KOH + ZnO
В	Leclanche cell	ii)	Lithium salt in organic solvent
C	Lead storage battery	iii)	NH ₄ Cl + ZnCl ₂ in water
D	Mercury button battery	iv)	38% by mass of H ₂ SO ₄

- \mathbf{C} D A
- (ii) (i) (iv) (iii)
- (i) (iii)(iv) (ii)
- (iii) (ii) (i) (iv)
- (iii) (i) (ii)(iv)

[Ans. (d) (ii), (iii), (iv), (i)]

	LIST - I		LIST - II		
A	Faraday's I Law	i)	$I = \frac{V}{R}$		
В	Free energy	ii)	$\Lambda_{\rm m} = \Lambda_{\rm m}^{\circ} - \left(A + B\Lambda_{\rm m}^{\circ}\right) \sqrt{C}$		
C	ohm's law	iii)	m = ZIT		
D	Debye - Huckel	iv)	$\Delta G = -nFE$		
	Onsagar				

- D
- (iii)(ii) (iv) (i)
- (iii) (ii)
- (i) (ii)(c) (iv) (iii)
- (ii) (iv) (iii) (1)

[Ans. (a) (iii), (iv), (i), (ii)]

LIST - I		LIST - II	
Quantity		Unit	
A	Conductance	i)	Ohm ⁻¹ m ² mol ⁻¹
B	Specific conductance	ii)	Ohm ⁻¹ m ²
C	Equivalent conductance	iii)	Ohm ⁻¹ m ⁻¹
D	Molar conductance	iv)	Ohm ⁻¹

- D (iv) (ii) (iii)
- (iv)
- (i)
- (iii)

[Ans. (b) (iv), (iii), (ii), (i)]

LIST - I			LIST - II	
A Daniel cell		i)	Phase boundary	
В	Single vertical line	ii)	Oxidation reaction	
C	Ni and NiO	iii)	Galvanic cell	
D	Anode compartment	iv)	Inert electrode	

- (iii) (ii)(i)
- (iii)(i) (iv) (ii)
- (iii) (iv) (i) (ii)
- (iii) (ii) (iv) (i)

[Ans. (b) (iii), (i), (iv), (ii)]

VERY SHORT ANSWER

2 MARKS

Give the mathematical expression of ohm's

Ans. i.e., I α V (or) $I = \frac{V}{R} \Rightarrow V = IR$

Where 'R' is the resistance of the solution in ohm (Ω)

Here the resistance is the opposition that a cell offers to the flow of electric current through it.

Define resistance. Give its mathematical expression.

Ans. The resistance of such an electrolytic solution is also directly proportional to the length (1) and inversely proportional to the cross sectional area (A).

$$R \alpha \frac{l}{A}$$
$$R = \rho \frac{l}{A}$$

$$R = \rho \frac{l}{\Delta}$$

Ans. The greater the E° value means greater is the tendency shown by the species to accepts electrons and undergo reduction. So higher the (E°) values lesser is the tendency to undergo corrosion.

49. Define electrochemical equivalent.

Ans. The electrochemical equivalent is defined as the amount of substance deposited or liberated at the electrode by a charge of 1 coulomb.

m = z (If I = 1 ampere and t = second).

50. How equivalent are specific and conductances related?

Ans. $\lambda_c = \kappa \times V$

$$\lambda_{\rm C} = \frac{\kappa \times 10^{-3}}{\rm C} \quad \text{mho.m}^2 \text{ (gm.equir)}^{-1}$$

51. Write the cell reaction for the half cell $Cl_{(aq)}^{-}/AgCl_{(s)}Ag$.

Ans. $\operatorname{AgCl}_{(s)} + e^{-} \longrightarrow \operatorname{Ag}_{(s)} + \operatorname{Cl}^{-}$

52. The standard reduction potentials of Fe3+ / Fe and Fe²⁺ / Fe electrode system are -0.035 V and -0.44 V respectively. Predict which of the two oxidations is easy. Fe³⁺ / Fe and Fe²⁺ / Fe.

The ion which has lower reduction potential will be oxidised first at the

> Among (0.035V) and (0.44V), Fe^{2+} / Fe oxidation is easy because it has the lower reduction potential (-0.44V).

53. What is single electrode potential?

An electrochemical cell consists of two Ans. (i) half cells. With an open circuit, the metal electrode in each half cell transfers its ions into solution.

> Thus, an individual electrode develops a potential with respect to the solution.

> The potential of a single electrode in a half cell is called single electrode potential.

Ans. When the emf of a cell is determined under standard conditions, it is called the standard emf.

It is defined as the emf of a cell with 1 M solutions of reactants and products in solution measured at 25°C. It is represented by the symbol E°.

55. Write the Nernst equation.

Ans.
$$E_{cell} = E_{cell}^{\circ} - \frac{RT}{nF} ln \frac{[C]^{l} [D]^{m}}{[A]^{x} [B]^{y}}$$
 (or)
 $E_{cell} = E_{cell}^{\circ} - \frac{2.303RT}{nF} log \frac{[C]^{l} [D]^{m}}{[A]^{x} [B]^{y}}$

SHORT ANSWER

3 MARKS

- Answer the following question with regard to specific resistance.
 - How is specific resistance represented?
 - (ii) What does specific resistance depend
 - (iii) What is the reciprocal of specific resistance? How is it denoted.
 - (iv) What is the unit of resitivity?
- Ans. (i) Specific resistance is denoted by $\rho(\text{rho})$.
 - Specific resistance depends on the nature of the electrolyte.
 - (iii) Reciprocal is specific resistance $\frac{1}{0}$ is specific conductance or conductivity denoted by κ (Kappa).
 - (iv) ohm metre.

Define molar conductance.

Ans. The conductivity cell in which the electrodes are separated by 1m and having V m³ of electrolytic solution which contains 1 mole of electrolyte. The conductance of such a system is called the

$$\Lambda_{m} = \frac{\kappa \left(Sm^{-1}\right) \times 10^{-3}}{M} \text{mol}^{-1} \text{m}^{3}$$

Define equivalent conductance.

Ans. Equivalent conductance is defined as the conductance of 'V' m³ of electrolytic solution containing one gram equivalent of electrolyte in a conductivity cell in which the electrodes are one meter apart.

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Fe²⁺ ions are further oxidised to Fe³⁺ which on further reaction with oxygen to form rust.

$$4Fe_{(aq)}^{2+} + O_{2(g)} + 4H_{(aq)}^{+} \longrightarrow 4Fe_{(aq)}^{3+} + 2H_{2}O(l)$$

$$2Fe_{(aq)}^{3+} + 4H_{2}O(l) \longrightarrow Fe_{2}O_{3}.H_{2}O_{(s)} + 6H_{(aq)}^{+}$$

- 6. Write an account on cell terminology.
- Ans. (i) Current: The flow of electrons through a wire or any conductor.
 - (ii) Electrode: A metallic rod / bar/ strip which conducts electrons into and out of a solution.
 - (iii) Anode: The electrode at which oxidation occurs. It sends electrons into the outer circuit. It has negative charge and is shown as (-) in cell diagrams.

- (iv) Cathode: The electrode at which electrons are received from the outer circuit. It has a positive charge and is known as (+) in the cell diagrams.
- (v) Electrolyte is the salt solution in a cell.
- (vi) Anode compartment: The compartment of the cell in which oxidation half-reaction occurs. It contains the anode.
- (vii) Cathode compartment: The compartment of the cell in which reduction half-reaction occurs. It contains the cathode.
- (viii) Half-cell: Each half of an electrochemical cell, where oxidation occurs and the half where reduction occurs, is called the half cell.

PROBLEMS FOR PRACTICE

1. What is the electrochemical equivalent of a 3. substance when 150 gm of it is deposited by 10 ampere of current passed for 1 sec?

Ans. Given:

Amount of the substance deposited,

$$m = 150 g$$

current strength = 1 = 10 ampere

Time =
$$t = 1$$
 sec.

By Faraday's first law,

Formula: m = Zlt

Solution :
$$\therefore Z = \frac{m}{It} = \frac{150}{10 \times 1}$$

Electrochemical equivalent

 $= 15.0 \text{ gm coloumb}^{-1}$.

2. The electrochemical equivalent of an electrolyte is 2.35 gm amp⁻¹ sec⁻¹. Calculate the amount of the substance deposited when 5 ampere is passed for 10 sec.

Ans. Given: Electrochemical

equivalent =
$$Z = 2.35 \text{ g amp}^{-1} \text{ sec}^{-1}$$

Time =
$$t = 10$$
 sec.

Current strength = 1 = 5 ampere.

Formula : m = Z1t

Solution : $= 2.35 \times 10 \times 5 = 117.5 \text{ gm}$

The amount of the substance deposited

= 117.5 g.

3. To 1 M solution of AgNO₃, 0.75 F quantity of current is passed. What is the concentration of the electrolyte, AgNO₃ remaining in the solution?

Ans. Given: Initial concentration of

$$AgNO_3 = 1M = 1N$$

Quantity of current $= 0.75 \, \text{F}$

Formula:

1 Faraday = 1 equivalent mass

Solution:

For 1F current In ${\rm AgNO_3}$ will be liberated.

For 0.75 F current 0.75 N AgNO $_3$ will be liberated

The concentration of AgNo₃ remaining

$$= 1.0 - 0.75$$

$$= 0.25 \text{ N}$$

∴ The concentration of AgNO₃ remaining

= 0.25 M

4. 0.5 F of electric current was passed through 5 molar solution of AgNO₃, CuSO₄ and AlCl₃ connected in series. Find out the concentration of each of the electrolyte after the electrolysis.

Ans. Given:

Quantity of electricity, Q = 0.5 F

Concentration of solution, C = 5 M

- I. Choose the Correct Answer $(5 \times 1 = 5)$
- 1. During electrolysis of molten sodium chloride, the time required to produce 0.1mol of chlorine gas using a current of 3A is
 - a) 55 minutes
- b) 107.2 minutes
- c) 220 minutes
- d) 330 minutes
- 2. Assertion: pure iron when heated in dry air is converted with a layer of rust.

Reason: Rust has the composition Fe₃O₄

- a) if both assertion and reason are true and reason is the correct explanation of assertion.
- b) if both assertion and reason are true but reason is not the correct explanation of assertion.
- c) assertion is true but reason is false
- d) both assertion and reason are false.
- 3. The number of electrons that have a total charge of 9650 coulombs is
 - a) 6.22×10^{23}
- b) 6.022×10^{24}
- c) 6.022×10^{22}
- d) 6.022×10^{-34}
- 4. Which among the following is the strongest reducing agent?
 - a) F₂
- b) Cl₂
- c) Zn
- d) Li
- 5. The emf of a cell with 1 M solution of reactants and products in solution at 25°C is called
 - a) Half cell potential
 - b) Standard emf
 - c) Single electrode potential
 - d) Redox potential

- II. VERY SHORT ANSWER
- $(2\times 2=4)$
- 1. Define anode and cathode.
- **2.** Define specific resistance.
- III. SHORT ANSWER

- $(2 \times 3 = 6)$
- 1. Write a note on sacrificial protection.
- **2.** Define equivalent conductance.
- IV. Long Answer

- $(2 \times 5 = 10)$
- 1. State Faraday's Laws of electrolysis.
- 2. A current of 1.608 A is passed through 250 mL of 0.5 M solution of copper sulphate for 50 minutes. Calculate the strength of Cu²⁺ after electrolysis assuming volume to be constant and the current efficiency is 100%.

Answer Key

- I. 1. b) 107.2 minutes
 - **2.** d) both assertion and reason are false
 - **3.** c) 6.022×10^{22}
 - **4.** d) Li
 - 5. b) Standard emf
- II. 1. Refer Sura's Guide Page Book back Q.No. 1.
 - 2. Refer Sura's Guide Additional 2 marks Q.No. 3.
- III. 1. Refer Sura's Guide Book back Q.No. 25.
 - 2. Refer Sura's Guide Additional 3 marks Q.No. 3.
- IV. 1. Refer Sura's Guide Book back Q.No. 5.
 - 2. Refer Sura's Guide Book back Q.No. 13.



UNIT 10

SURFACE CHEMISTRY

CHAPTER SNAPSHOT

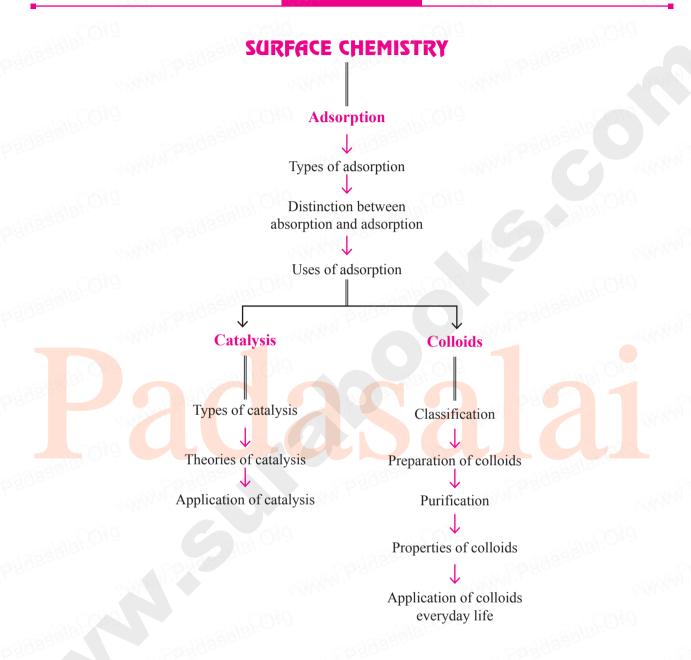
1	0.1	1 A	dsor	ntion	and	Absc	rntion

- **10.1.1** Types of adsorption
- **10.1.2** Factors affecting adsorption
- **10.1.3** Adsorption isotherms and isobars
- **10.1.4** Applications of adsorption
- 10.2 Catalysis
 - **10.2.1** Characteristics of catalysts
 - **10.2.2** Theories of Catalysis
- **10.3** Enzyme Catalysis
 - 10.3.1 Mechanism of enzyme catalysed reaction

10.4 Colloid, Dispersion phase and dispersion medium

- **10.4.1** Classifications of Colloidal solution
- **10.4.2** Preparation of Colloids
- **10.4.3** Purification of colloids
- **10.4.4** Properties of Colloids
- 10.5 Emulsions
 - **10.5.1** Deemulsification
- **10.6** Various application of colloids

CONCEPT MAP





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EVALUATION

Choose The Correct Answer

1. For Freundlich isotherm a graph of $\log \frac{x}{m}$ is

plotted against log p. The slope of the line and its y - axis intercept respectively corresponds to

- a) $\frac{1}{n}$, k
- b) $\log \frac{1}{n}$, k
- c) $\frac{1}{n}$, $\log k$
- d) $\log \frac{1}{n}, \log k$

[Ans. (c) $\frac{1}{n}$, log k]

- Which of the following is incorrect for physisorption?
 - a) reversible
 - b) increases with increase in temperature
 - c) low heat of adsorption
 - d) increases with increase in surface area

Ans. (b) increases with increase in temperature

- Which one of the following characteristics are associated with adsorption?
 - a) ΔG and ΔH are negative but ΔS is positive
 - b) ΔG and ΔS are negative but ΔH is positive
 - c) ΔG is negative but ΔH and ΔS are positive
 - d) ΔG , ΔH and ΔS all are negative.

[Ans. (d) ΔG , ΔH and ΔS all are negative]

- Fog is colloidal solution of
 - a) solid in gas
- b) gas in gas
- c) liquid in gas
- d) gas in liquid

[Ans. (c) liquid in gas]

Assertion: Coagulation power of Al3+ is more than Na+.

> greater the valency of the Reason flocculating ion added, greater is its power to cause precipitation

- a) if both assertion and reason are true and reason is the correct explanation of assertion.
- b) if both assertion and reason are true but reason is not the correct explanation of assertion.
- assertion is true but reason is false
- d) both assertion and reason are false.

[Ans. (a) if both assertion and reason are true and reason is the correct explanation of assertion

Statement:

To stop bleeding from an injury, ferric chloride can be applied. Which comment about the statement is justified?

- a) It is not true, ferric chloride is a poison.
- b) It is true, Fe³⁺ ions coagulate blood which is a negatively charged sol
- c) It is not true; ferric chloride is ionic and gets into the blood stream.
- d) It is true, coagulation takes place because of formation of negatively charged sol with Cl-.

[Ans. (b) It is true, Fe³⁺ ions coagulate blood which is a negatively charged sol

- **7**. Hair cream is
 - a) gel
- b) emulsion
- c) solid sol
- d) sol

[Ans. (b) emulsion]

- Which one of the following is correctly matched?
 - a) Emulsion
- Smoke
- b) Gel
- butter
- c) foam
- Mist
- d) whipped cream

[Ans. (b) Gel – butter]

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19. On which of the following properties does 720. Match the following the coagulating power of an ion depend?

(NEET - 2018)

- a) Both magnitude and sign of the charge on the ion.
- b) Size of the ion alone
- the magnitude of the charge on the ion alone
- d) the sign of charge on the ion alone.

Ans. (d) the sign of charge on the ion alone

A	Pure nitrogen	i)	Chlorine
В	Haber process	ii)	Sulphuric acid
C	Contact process	iii)	Ammonia
D	Deacons	iv)	sodium azide (or)
	Process		Barium azide

Which of the following is the correct option?

	A	B	C	D
a)	(i)	(ii)	(iii)	(iv)
b)	(ii)	(iv)	(i)	(iii)

(c) (iii) (iv) (ii)(i) (iv) (iii) (ii) (i)

[Ans. (d) (iv), (iii), (ii), (i)]

Q A SHORT ANSWER QUESTIONS

Give two important characteristics of physiscorption.

Physisorption decreases with increase in temperature. Ans. (i)

(ii) No transfer of electrons.

(iii) Multilayer of the adsorbate is formed on the adsorbent.

Differentiate physisorption and chemisorption.

Ans.

S.NO	Physical adsorption or van der waals adsorption or Physisorption	Chemical adsorption or Chemisorption or Activated adsorption
1.	It is instantaneous	It is very slow
2.	It is non-specific	It is very specific depends on nature of adsorbent and adsorbate.
3.	In Physisorption, when pressure increases the amount of adsorption increases.	Chemical adsorption is fast with increase pressure, it can not alter the amount.
4.	Physisorption decreases with increase in temperature.	When temperature is raised chemisorption first increases and then decreases.
5.	No transfer of electrons	Chemisorption involves transfer of electrons between the adsorbent and adsorbate.
6.	Heat of adsorption is low in the order of 40kJ/mole.	Heat of adsorption is high i.e., from 40-400kJ/mole.
7.	Multilayer of the adsorbate is formed on the adsorbent.	Monolayer of the adsorbate is formed.
8.	It occurs on all sides.	Adsorption occurs at fixed sites called active centres. It depends on surface area
9.	Activation energy is insignificant.	Chemisorption involves the formation of activated complex with appreciable activation energy.

Additional Questions and Answers

CHOOSE THE CORRECT ANSWER

- Which among the following true regarding adsorption?
 - Adsorption is a spontaneous process
 - (ii) Adsorption is always accompanied by increase in free energy.
 - (iii) Adsorption is an endothermic process
 - (iv) Adsorption can occur in all interfacial surfaces.
 - a) only (ii)
- b) (ii) and (iii)
- only (i)
- d) (i) and (iv)

[Ans. (d) (i) and (iv)]

- Which among the following does not affect adsorption?
 - a) surface area of the adsorbent
 - b) catalyst
 - c) temperature
 - d) pressure

[Ans. (b) catalyst]

- Freundlich According adsorption isotherm,
 - a) $\frac{x}{m} = kp$
- b) $\frac{m}{x} = (kp)^{\frac{1}{n}}$
- c) $\frac{x}{m} = kp^{\frac{1}{n}}$
- d) $\frac{x}{m} = \frac{k}{\frac{1}{n}}$

[Ans. (c) $\frac{x}{m} = kp^{\frac{1}{n}}$]

- Which of the following is true regarding Freundlich adsorption isotherm equation?
 - a) Purely empirical
 - b) Valid only over a limited pressure range.
 - The value of constants k and n varies with temperature
 - d) All the above

[Ans. (d) all the above]

- Pick the odd one out.
 - dialysis
- b) electro dialysis
- c) electrophoresis
- d) ultrafilteration

[Ans. (c) electrophoresis

- Adsorption is accompanied by
 - a) decrease in free energy
 - b) increase in free energy
 - c) increase in entropy
 - d) both (b) and (c)

[Ans. (a) decrease in free energy]

- **7**. Which of the following interface cannot be obtained?
 - a) solid solid
- b) solid liquid
- c) gas gas
- d) liquid liquid

[Ans. (c) gas - gas]

- Which among the following is an example of absorption?
 - a) Water on calcium chloride
 - b) Water on silica gel
 - c) Ammonia gas on charcoal
 - d) Hydrogen on finely divided nickel

[Ans. (a) Water on calcium chloride]

Auto catalysis is observed in the reaction given below.

> $CH_3COOC_2H_5 + H_2O \longrightarrow CH_3COOH + C_2H_5OH$ Identify the auto catalyst.

- a) CH₃COOC₂H₅ b) H₂O
- c) CH₃COOH
- d) C₂H₅OH

[Ans. (c) CH₃COOH]

- 10. Which among the following reactions is an example of auto catalysis?
 - $CH_3COOC_2H_5 + H_2O \longrightarrow$

 $CH_3^2COOH + C_2H_5OH$

- (ii) $2H_2O_2 \longrightarrow 2H_2O + O_2$
- (iii) $2SO_2 + O_2 \longrightarrow 2SO_3$
- (iv) $2AsH_3 \longrightarrow 2As + 3H_2$
- a) only (i)
- b) (i) and (ii)
- c) (i) and (ii)
- d) (i) and (iv)

[Ans. (d) (i) and (iv)]

- 11. Fog is a colloidal solution of
 - a) gas in liquid
- b) liquid in gas
- c) gas in solid
- d) solid in gas

[Ans. (d) solid in gas]

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- 53. The oxidation of sodium sulphite by air is \ 61. The dispersed phase and dispersion medium retarded by
 - a) MnO₂
- b) H₂S
- c) Alcohol
- d) As₂O₂

[Ans. (c) Alcohol]

- 54. The rate of decomposition of hydrogen peroxide decreases in presence of
 - a) Platinum
- b) Iron
- c) MnO₂
- d) Glycerine

[Ans. (d) Glycerine]

- 55. The iron catalyst used in the synthesis of ammonia in Haber's process is poisoned by
 - a) As_2O_3
- b) V_2O_5
- c) H₂S
- d) Glycerine

[Ans. (c) H₂S]

- **56.** Silver salt used in photography is
 - a) AgCl
- b) AgNO₃
- c) AgF
- d) AgBr

[Ans. (d) AgBr]

- 57. Colloidal milk of magnesia is used
 - a) as germ killer
 - b) as fertilizer
 - c) for stomach disorders
 - d) as tonic Ans. (c) for stomach disorders
- 58. Haze is a colloidal solution of
 - a) gas in liquid
- b) liquid in gas
- c) gas in solid
- d) solid in gas

[Ans. (d) solid in gas]

- 59. Emulsifying agent used for O/W type emulsion is:
 - a) proteins
 - b) heavy metal salts of fatty acids
 - c) long chain alcohol
 - d) lamp black

[Ans. (a) proteins]

- **60.** Which of the following is not a favourable condition for physical adsorption?
 - a) high pressure
 - b) negative ΔH
 - c) higher critical temperature of absorbate
 - d) high temperature

[Ans. (d) high temperature]

- in soap lather are respectively.
 - a) gas and liquid
- b) liquid and gas
- c) solid and gas
- d) solid and liquid

[Ans. (a) gas and liquid]

- 62. Which one of the following has minimum gold number?
 - a) starch
- b) sodium oleate
- c) gum arabic
- d) gelatin

[Ans. (d) gelatin]

FILL IN THE BLANKS:

- When temperature is raised, chemisorption
 - a) increases
- b) decreases
- c) first decreases and then increases
- d) first increases and then decreases

Ans. (d) first increases and then decreases

- Variation of adsorption at constant pressure is
 - a) isobar
- b) isotherm
- c) isochor
- d) isomer

[Ans. (a) isobar]

- Extent of physisorption of a gas increases with
 - a) increase in temperature
 - b) decrease in surface area of adsorbent
 - c) decrease in pressure
 - d) decrease in temperature

[Ans. (d) decrease in temperature]

- 4. A substance which destroys the activity of a catalyst is
 - a) negative catalyst
- b) catalytic poison
- c) both (a) and (b)
- d) promoter

[Ans. (b) catalytic poison]

- In the decomposition of hydrogen peroxide acts a negative catalyst.
 - a) H₂S
- b) glycerol
- c) pt
- d) Fe

[Ans. (b) glycerol]

Surface Chemistry

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- A B C D
- (a) (iv) (ii) (iii) (i)
- **(b)** (ii) (iv) (i) (iii)
- (c) (ii) (iii) (iv) (i)
- (d) (iii) (iv) (ii) (i)

[Ans. (b) (ii), (iv), (i), (iii)]

8.

LIST - I		LIST - II	
A	Ostwald's process	i)	CuCl ₂
В	Deacon's process	ii)	Fe_2O_3
C	Bosch's process	iii)	Ni (finely divided)
D	Vanaspati Ghee	iv)	Platinised asbestos

- A B C D
- (a) (iv) (i) (ii) (iii)
- **(b)** (ii) (i) (iv) (iii)
- (c) (iv) (iii) (ii) (i)
- (d) (iii) (iv) (i) (ii)

[Ans. (a) (iv), (i), (ii), (iii)]

9.

28	LIST - I	LIST - II		
A	Sol	i)	Cloud	
В	Aerosol	ii)	Froth of air	
C	Liquid Aerosol	iii)	Paint	
D	Foam	iv)	Smoke	

- A B C D
- (a) (ii) (iv) (iii) (i)
- **(b)** (iii) (iv) (i) (ii)
- (c) (iv) (iii) (ii) (i)
- (d) (i) (ii) (iii) (iv)

[Ans. (b) (iii), (iv), (i), (ii)]

VERY SHORT ANSWER

2 MARKS

1. What is an interface?

Ans. The surface of separation of the two phases where the concentration of adsorbed molecule is high is known as **interface**.

2. What do you mean by positive and negative adsorption?

Ans. (i) In adsorption, if the concentration of a substance in the interface is high, then it is called **positive adsorption**.

(ii) In adsorption, if the concentration of a substance in the interface is less, then it is called **negative adsorption**.

3. Define adsorption isobar.

Ans. When amount of adsorption is plotted versus temperature at constant pressure it is called **adsorption isobar**.

4. Define adsorption isotherm.

Ans. A plot between the amount of adsorbate adsorbed and pressure or concentration of adsorbate at constant temperature is called adsorption isotherms.

5. What are limitations of Freundlich adsorption isotherm?

- Ans. (i) This equation is purely empirical and valid over a limited pressure range.
 - (ii) The values of constants k and n also found vary with temperature.
 - (iii) No theoretical explanations were given.
- 6. What are the concepts of catalysis that intermediate compound formation theory throws light on?

Ans. Intermediate compound formation theory:

- (i) the specificity of a catalyst and
- (ii) the increase in the rate of the reaction with increase in the concentration of a catalyst.

7. What are the limitations of intermediate compound formation theory?

Ans. Limitations:

- (i) The intermediate compound theory fails to explain the action of catalytic poison and activators (promoters).
- (ii) This theory is unable to explain the mechanism of heterogeneous catalysed reactions.

8. What is a dispersed phase and a dispersion medium in a colloid?

Ans. In a colloidal, the substance present in larger amount is called **dispersion medium** and the substance present in less amount is called **dispersed phase**.

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Surface Chemistry

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50. Which will adsorb more gas, a lump of charcoal or its powder and why?

Ans. Powdered charcoal will adsorb more gas because of its larger surface area than a lump of charcoal.

51. Write the Freundlich adsorption isotherm?

Ans. According to Freundlinch,

$$\frac{x}{m} = kp^{\frac{1}{n}}$$

where x is the amount of adsorbate or adsorbed on 'm' gm of adsorbent at a pressure of p. K and n are constants.

52. Name the types of emulsions.

- Ans. (i) Oil dispersed in water (O/W type)
 - (ii) Water dispersed in oil (W/O type).

SHORT ANSWER

3 MARKS

1. Give any three application of adsorption.

- Ans. (i) Fuller's earth and silica gel are used for refining process.
 - (ii) Sugar prepared from molasses is decolourised to remove coloured impurities by adding animal charcoal which acts as decolourising material.
 - (iii) Catalysis is an important branch of surface chemistry which is based on the phenomenon of adsorption of materials on the catalyst surface.

2. Write a note.

- (i) Positive catalyst
- (ii) Negative catalyst
- Ans. (i) Positive catalyst: A catalyst which enhances the speed of the reaction is called positive catalyst and the phenomenon is known as positive catalysis.

Eg: Decomposition of $KClO_3$ in the presence of manganese dioxide (MnO_2) .

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2 \uparrow$$

(ii) Negative catalyst: A catalyst which retard (or) reduce the reaction rate is known as negative catalyst or inhibitors and the phenomenon is known as negative catalysis.

Eg: Decomposition of H_2O_2 decreases in the presence of glycerine.

$$2H_2O_2 \xrightarrow{\text{Glycerine}} 2H_2O + O_2$$

3. Write a note on auto catalysis?

- **Ans.** (i) In certain reactions one of the products formed acts as a catalyst to the reaction.
 - (ii) Initially the rate of reaction will be very slow but with the increase in time the rate of reaction increases.
 - (iii) Auto catalysis is observed in the following reactions.

$$CH_3COOC_2H_5 + H_2O \longrightarrow CH_3COOH + C_2H_5OH$$

Acetic acid acts as the autocatalyst

(iv) $2AsH_3 \longrightarrow 2As + 3H_2$ Arsenic acts as an autocatalyst.

4. What are active centres?

- Ans. (i) The surface of a catalyst is not smooth. It bears steps, cracks and corners.
 - (ii) Hence the atoms on such locations of the surface are co-ordinatively unsaturated.
 - (iii) So, they have much residual force of attraction.
 - (iv) Such sites are called active centres. So, the surface carries high surface free energy.
 - (v) The presence of such active centres increases the rate of reaction by adsorbing and activating the reactants.

5. What are the important concepts of catalysis that adsorption theory explains?

Ans. The adsorption theory explains the following

- (i) Increase in the activity of a catalyst by increasing the surface area. Increase in the surface area of metals and metal oxides by reducing the particle size increases the rate of the reaction.
- (ii) The action of catalytic poison occurs when the poison blocks the active centres of the catalyst.
- (iii) A promoter or activator increases the number of active centres on the surfaces.



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LONG ANSWER

5 MARKS

Write the characteristics of adsorption.

Ans. Characteristics of adsorption:

- Adsorption can occur in all interfacial surfaces i.e. the adsorption can occur in between gas-solid, liquid solid, liquidliquid, solid- solid and gas-liquid.
- Adsorption is always accompanied by decrease in free energy. When ΔG reaches zero, the equilibrium is attained.
- (iii) Adsorption is a spontaneous process.
- When molecules are adsorbed, there is always a decrease in randomness of the molecules.

We know, $\Delta G = \Delta H - T \Delta S$ where ΔG is Change in Free energy.

 Δ H is Change in enthalpy and Δ S - Change in entropy.

Hence, $\Delta H = \Delta G + T \Delta S$

Adsorption is exothermic as there is an interaction between adsorbate and adsorbent.

Explain the factors affecting adsorption.

Ans. Factors affecting adsorption:

Ans. The adsorption is well understood by considering the various factors affecting it. Qualitatively, the extent of surface adsorption depends on

- Nature of adsorbent
- Nature of adsorbate (ii)
- (iii)
- Concentration at a given temperature.

Surface area of adsorbent:

As the adsorption is a surface phenomenon it depends on the surface area of adsorbent. i.e., higher the surface area, higher is the amount adsorbed.

Nature of adsorbate:

The nature of adsorbate can influence the adsorption. Gases like SO2, NH2, HCl and CO₂ are easily liquefiable as have greater vanderwaal's force of attraction. On the other hand, permanent gases like H2, N2 and O2 cannot be liquefied easily. These permanent gases are having low critical

temperature and adsorbed slowly, while gases with high critical temperature are adsorbed readily.

(iii) **Effect of temperature:**

chemical adsorption is fast with increase pressure, it cannot alter the amount. In Physisorption, when pressure increases the amount of adsorption increases.

(iv) Effect of pressure:

When pressure increases, adsorption becomes steadily increase in case of chemisorption and increases in case of physisorption.

Write a note on Freundlich adsorption isotherm.

Ans. Freundlich adsorption isotherm:

According to Freundlinch,

$$\frac{x}{m} = kp^{\frac{1}{n}}$$

where x is the amount of adsorbate or adsorbed on 'm' gm of adsorbent at a pressure of p. K and n are constants.

Value n is always less than unity.

This equation is applicable for adsorption of gases on solid surfaces. The same equation

becomes $\frac{x}{m} = K c^{-}$, when used for adsorption

in solutions with c as concentration.

These equation quantitively predict the effect of pressure(or concentration) on the adsorption of gases(or adsorbates) at constant temperature.

Taking log on both sides of equation $\frac{x}{m} = kp^{-n}$

$$\log \frac{x}{m} = \log K + \frac{1}{n} \log p$$

$$\left(\frac{x}{m}\right)$$

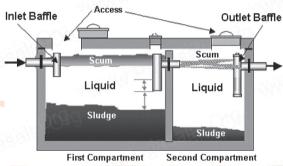
$$\frac{\tan \theta = \frac{1}{n}}{\log p}$$

$$\log p$$

 $\log \frac{x}{m}$ vs log p graph

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- (vi) Cortrell's precipitator: Carbon dust in air is solidified by cortrell's precipitator. In it, a high potential difference of about 50,000V is used. The charge on carbon is neutralized and solidified. Thus the air is free from carbon particles.
- (vii) The blue colour of the sky in nature is due to Tyndall effect of air particles.
- (viii) Formation of delta: The electrolyte in sea and river water coagulates the solid particles in river water at their intersection. So, the earth becomes a fertile land.
- (ix) Analytical application: Qualitative and quantitative analysis are based on the various properties of colloids.



Sewage disposal

HOTS

- 1. Gelatin is generally added to Ice cream. Give reason.
- Ans. Ice cream is a emulsion of milk or cream in water (O/W type). Gelatin is added as an emulsifier to stabilize the emulsion.

- 2. Vanishing cream and cold cream both are emulsions. Then, what is the difference between the two?
- Ans. Vanishing cream is an emulsion of oil-in-water whereas cold cream is an emulsion of water-in-oil. The latter is used for day skin as the base (dispersion medium) in this cream is oil.
- 3. Adsorption of a gas on the surface of solid is generally accompanied by decrease in entropy. Still it is a spontaneous process. Explain.
- **Ans.** Adsorption is an exothermic process, i.e., energy factor favours the process. As $\Delta G = \Delta H T\Delta S$, in adsorption, though ΔS is -ve but ΔH is also -ve and $\Delta H > T\Delta S$ in magnitude so that ΔG is -ve. Hence, the process is spontaneous.
- 4. Why artificial rain can be caused by throwing common salt on the clouds?
- Ans. Clouds are colloidal dispersion of water particles in air. The colloidal water particles carry charge. On throwing common salt on the clouds, coagulation of water particles takes place as common salt is an electrolyte.
- 5. Why is ferric chloride preferred over potassium chloride in case of a cut leading to bleeding?
- Ans. Blood has negatively charged colloidal particles. It is coagulated by positive ions. As Fe³⁺ ions have greater positive charge than K⁺ ions, coagulation with Fe³⁺ ions is faster and hence is preferred.
- 6. Why the sun looks red at the time of setting? Explain on the basis of colloidal properties.
- Ans. At the time of setting, the sun is at the horizon. The light emitted by the sun has to travel a longer distance through the atmosphere. As a result, blue part of the light is scattered away by the dust particles in the atmosphere. Hence, the red part is visible.

Time: 40 min Marks: 25

- CHOOSE THE CORRECT ANSWER $(5 \times 1 = 5)$
- Assertion: Coagulation power of Al3+ is 1. more than Na+.
 - : Greater the valency of the Reason flocculating ion added, greater is its power to cause precipitation
 - a) if both assertion and reason are true and reason is the correct explanation of assertion.
 - b) if both assertion and reason are true but reason is not the correct explanation of assertion.
 - assertion is true but reason is false
 - d) both assertion and reason are false.
- Adsorption of a gas on solid metal surface is spontaneous and exothermic, then
 - a) ΔH increases
- b) ΔS increases
- c) ΔG increases
- d) ΔS decreases
- Fog is colloidal solution of
 - a) solid in gas
- b) gas in gas
- c) liquid in gas
- d) gas in liquid
- The phenomenon of Tyndall's effect is not observed in
 - a) emulsion
- b) colloidal solution
- true solution
- d) none
- Which type of colloid is a sol?
 - Solid in liquid
- b) Liquid in solid
- Soild in solid
- d) Gas in solid

- VERY SHORT ANSWER
- Give two important characteristics of physisorption.

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- What are the methods by which colloids are prepared?
- III. SHORT ANSWER

- $(2 \times 3 = 6)$
- 1. Write a note on electro-osmosis.
- 2. Explain the advantages of using nano catalyst.
- IV. **LONG ANSWER**

- $(2 \times 5 = 10)$
- Differentiate physisorption and chemisorption. 1.
- Describe adsorption theory of catalysis.

Answer Key

- **1.** a) Both assertion and reason are true and I. reason is the correct explanation of assertion.
 - 2. d) ΔS decreases
 - **3.** c) liquid in gas
 - 4. c) true solution
 - **5.** a) Solid in liquid
- 1. Refer Sura's Guide Book back Q.No. 1.
 - 2. Refer Sura's Guide Additional 2 marks Q.No. 9.
- III. 1. Refer Sura's Guide Book back Q.No. 21.
 - 2. Refer Sura's Guide Additional 3 marks Q.No. 8.
- IV. 1. Refer Sura's Guide Book back Q.No. 2.
 - 2. Refer Sura's Guide Book back Q.No. 25.



HYDROXY COMPOUNDS AND ETHERS

CHAPTER SNAPSHOT

- 11.1 Classification of alcohols
- 11.2 IUPAC Nomenclature
- 11.3 Structure of the functional group of alcohol
- 11.4 Alcohols
- 11.5 Phenols
- 11.6 Ethers



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EVALUATION

Choose The Correct NSWER

- An alcohol (x) gives blue colour in Victormayer's test and 3.7g of X when treated with metallic sodium liberates 560 mL of hydrogen at 273 K and 1 atm pressure what will be the possible structure of X?
 - a) CH₂ CH (OH) CH₂CH₂
 - b) CH₃ CH (OH) CH₃
 - c) $CH_3 C(OH) (CH_3)_7$
 - d) CH₃- CH₂ CH (OH) CH₂ CH₃

[Ans. (a) CH₃ CH (OH) CH₂CH₃]

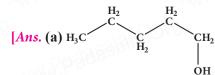
- 2. Which of the following compounds on reaction with methyl magnesium bromide will give tertiary alcohol?
 - a) benzaldehyde
- b) propanoic acid
- c) methyl propanoate d) acetaldehyde

[Ans. (c) methyl propanoate]

3. i) BH₃ / THF

The X is

- d) None of these

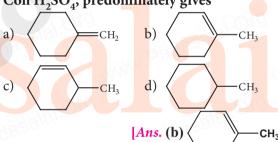


- the In reaction sequence, Ethane $\xrightarrow{\text{HOCl}} A \xrightarrow{\text{X}} \text{ethan } -1, 2 - \text{diol}$. A and X respectively are
 - a) Chloroethane and NaOH
 - b) ethanol and H₂SO₄
 - c) 2 chloroethan -1-ol and NaHCO₃
 - d) ethanol and H₂O [Ans. (c) 2 chloroethan -1-ol and NaHCO₂
 - Which one of the following is the strongest acid
 - a) 2 nitrophenol
- b) 4 chlorophenol
- c) 4 nitrophenol
- d) 3 nitrophenol

Ans. (c) 4 – nitrophenol treatment with

Con H, SO,, predominately gives

СН2-ОН



- 7. Carbolic acid is
 - Phenol
- b) Picric acid
- benzoic acid
- d) phenylacetic acid

[Ans. (a) Phenol]

- 8. Which one of the following will react with phenol to give salicyladehyde after hydrolysis?
 - a) Dichlo methane
- b) trichloroethane
- c) trichloro methane d) CO₂

[Ans. (c) trichloro methane]

9. $(CH_3)_3$ -C-CH(OH)CH₃

 $\xrightarrow{\text{Con H}_2 \text{SO}_4}$ X (major product)

- a) $(CH_3)_3CCH = CH_3$
- b) $(CH_3)_2C = C(CH_3)_2$
- c) $CH_2 = C(CH_3)CH_2 CH_2 CH_3$
- d) $CH_2 = C (CH_3) CH_2 CH_2 CH_3$

[Ans. (b) $(CH_3)_2C = C(CH_3)_2$]

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- 19. One mole of an organic compound (A) with 72. the formula C₃H₈O reacts completely with two moles of HI to form X and Y. When Y is boiled with aqueous alkali it forms Z. Z answers the iodoform test. The compound (A) is
 - a) propan 2-ol
- b) propan -1-ol
- c) ethoxy ethane
- d) methoxy ethane

[Ans. (d) methoxy ethane]

- 20. Among the following ethers which one will produce methyl alcohol on treatment with hot HI?
 - a) $(H_3C)_3 C CH_3$
 - b) $(CH_3 + CH CH_2 O CH_3)$
 - c) CH_3 $(CH_2)_3$ O $-CH_3$
 - d) $CH_3 CH_2 CH O CH_3$ CH_3 CH_3 [Ans. (a) $(H_3C)_3$ $C O CH_3$]

- 21. Williamson synthesis of preparing dimethyl ether is a / an /
 - a) SN¹ reactions
- b) SN² reaction
- c) electrophilic addition
- d) electrophilic substitution

[Ans. (b) SN² reaction]

- 22. On reacting with neutral ferric chloride, phenol gives
 - a) red colour
- b) violet colour
- dark green colour d) no colouration

[Ans. (b) violet colour]

SHORT ANSWER QUESTIONS

Identify the product(s) is / are formed when 1 - methoxy propane is heated with excess HI. Name the mechanism involved in the reaction.

Ans. CH_1 -OCH_1CH_1CH_2 + 2HI \longrightarrow CH_2 I + CH_2 CH_1CH_1 + H_2 O Methyl Propyl iodide 1-methoxy Propane Iodide

nucleophilic undergo substitution reaction with HBr or HI

Draw the major product formed when 1-ethoxyprop-1-ene is heated with one equivalent of HI

Ans. $C_{2}H_{\varepsilon}$ -O-CH=CH-CH₂+HI \longrightarrow $C_{3}H_{\varepsilon}I$ + HO-CH=CH-CH₃ 1-ethoxy Prop-1-ene Ethyl Prop-1-en-1-ol

- Suggest a suitable reagent to prepare secondary alcohol with identical group using Grignard reagent.
- Ans. The suitable reagent used to prepare secondary alcohol using Grignand reagent is ethanal.

$$\begin{array}{c} CH_3CH_2MgBr + CH_3CHO \xrightarrow{\mbox{Ether}} \\ Ethyl \\ magnesium \\ bromide \\ \end{array} (Acetaldehyde) \\ \begin{array}{c} CH_3 \\ CH_3CH_2 - C - OMgBr \\ H \end{array}$$

$$\begin{array}{c} \xrightarrow{\text{H}_2\text{O}} \text{CH}_3\text{CH}_2\text{CHCH}_3 + \text{Mg(OH) Br} \\ \text{OH} \\ \text{Butan-2-ol} \end{array}$$

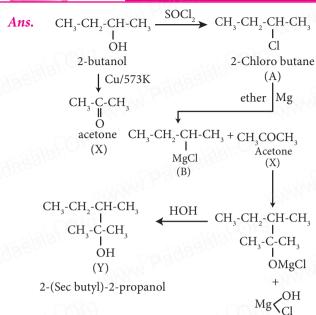
What is the major product obtained when two moles of ethyl magnesium bromide is treated with methyl benzoate followed by acid hydrolysis.

C,H, Ans. $C_1H_2MgBr + C_2H_2COOCH_3 \longrightarrow C_2H_2-C-OCH_3$ Ethyl Magnesium Methyl Bromide Benzoate Br $Mg + C_6H_5 - C_7CH_3$ $HOH C_2H_5 - MgBr + C_6H_5 - C_7CH_3$

- Predict the major product, when 2-methyl but -2-ene is converted into an alcohol in each of the following methods.
 - Acid catalysed hydration
 - (ii) Hydroboration
 - (iii) Hydroxylation using Bayer's reagent

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A - 2-chloro butane

B - Magnesium chloride

C - Acetone

D - 2-(sec butyl) -2- propanol

- 25. 3,3 dimethylbutan -2-ol on treatment with conc. H₂SO₄ to give tetramethyl ethylene as a major product. Suggest a suitable mechanisms
- *Ans.* When 3,3-dimethyl-2-butanol is heated conc H₂SO₄, the elimination occurs after carbocation rearrangement resulting in the formation of 2,3-dimethyl but-2-ene.

$$\begin{array}{c} \text{CH}_{3} \text{ OH} \\ \text{CH}_{3}\text{-C} \text{-CH-CH}_{3} \\ \text{CH}_{3}\text{-C} \\ \text{CH}_{3} \end{array} \xrightarrow{\text{Con H}_{2}\text{SO}_{4}} \begin{array}{c} \text{CH}_{3}\text{-CH-CH}_{3} \\ \text{CH}_{3}\text{-CH-CH}_{3} \\ \text{CH}_{3} \end{array}$$

$$3,3\text{-dimethyl-2-butanol}$$

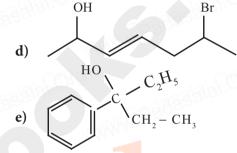
$$\begin{array}{c} \text{CH}_{3} \\ \text{CH}_{3} \\ \text{CH}_{3} \end{array} = \text{C} \xrightarrow{\text{CH}_{3}} \begin{array}{c} \text{CH}_{3} \\ \text{CH}_{3} \\ \text{CH}_{3} \end{array} \xrightarrow{\text{CH}_{3}\text{-CH-CH}_{3}} \begin{array}{c} \text{CH}_{3}\text{-CH-CH-CH}_{3} \\ \text{CH}_{3} \\ \text{CH}_{3} \end{array}$$

Evaluate Yourself

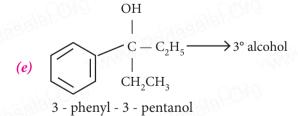
1. Classify the following alcohols as 1°, 2°, and 3° and give their IUPAC Names.

Br

- a) $CH_3 CH_2 CH(OH) CH_2 C(CH_3)_2$
- b) $(C_2H_5)_3COH$
- c) $CH_2 = C(Cl) CH (OH) CH_3$



- Ans. (a) 2° alcohol
 - 5 bromo 5 methyl hexan 2 ol
 - (b) $(C_2H_5)_3 C OH$ C_2H_5 $C_2H_5 - C - OH \rightarrow 3^{\circ}$ alcohol C_2H_5 C_2H_5 C_2H_5
 - (c) 2° alcohol 3 - chloro but - 3 ene - 2 - ol
 - (d) 2° alcohol 6 - bromo Hept - 3 - ene - 2 - ol



2,3,dimethyl but -2-ene



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Additional Questions and Answers

CHOOSE THE CORRECT ANSWER

1 MARK

- Which among the following alkene on acid hydration will produce tertiary butyl alcohol?
 - a) CH₃-C=CH₂ CH,
- b) CH₃-CH=CH₂
- c) CH₃-CH CH,
- d) CH₃-CH₂-CH=CH-CH₃

- Pick out the odd one among the following
 - a) CH₂CHOHCH₂
- b) CH,CH,-CH-OH CH,
- c) $(CH_3)_3C-OH$
- d) C₆H₅CHOHC₂H₅

[Ans. (c) (CH₃)₃C-OH]

- Which one of the alcohol cannot be prepared by grignard reagent?
 - a) Methanol
- b) ethanol
- c) iso propyl alcohol d) phenyl methanol

[Ans. (a) Methanol]

- Which among the following statement are correct with regard to alkyl halides?
 - Alkyl halides on heating with aq NaOH gives alcohols
 - b) 1° alkyl halides proceed by SN, mechanism
 - 2° and 3° alkyl halides undergo substitution by SN₁ mechanism
 - d) all the above

[Ans. (d) all the above]

- Which among the following reagent is not used to differentiate ethanol and phenol?
 - a) neutral FeCl₂
- b) $C_6H_5N_2Cl$
- c) NaOH
- d) anhy ZnCl₂

[Ans. (d) anhy ZnCl₂]

- Which one of the following alcohols on oxidation gives carboxylic acid with lesser number of carbon atoms?
 - a) $(CH_3)_2$ - CH^-CH_2OH
 - b) CH₃CH₂CHOHCH₃
 - c) CH₃-(CH₂)₃-CH₂OH
 - d) both (a) and (c)

[Ans. (b) CH₂CH₂CHOHCH₃]

- An organic compound 'A' reacts with methyl magnesium chloride followed by hydrolysis to form 'B'. 'B' gives a blue colour with Victor Meyers test. Identify A and B respectively.
 - acetaldehyde, tert butyl alcohol
 - b) acetone, iso propyl alcohol
 - c) acetaldehyde, isopropyl alcohol
 - d) acetone, ethanol

[Ans. (c) acetaldehyde, isopropyl alcohol]

- Which one of the following would not react with conc. HCl and anhy. ZnCl₂ at room temperature?
 - a) (CH₃)₃COH
- b) (CH₃)₂CHOH
- c) CH₃-CH₂-CH-OH d) CH₃CH₂CH₂OH CH,

[Ans. (d) CH₃CH₂CH₂OH]

Glycol $\xrightarrow{773 \text{ K}}$ 'A'.

Identify 'A'

a)
$$\begin{array}{c} CH_2 \\ I \\ CH_2 \end{array}$$
 $>$ O

c)
$$O \stackrel{\text{CH}_2\text{-CH}_2}{\longleftarrow} C$$

d)
$$HO-CH_2-CH_2$$
 O $HO-CH_2-CH_2$

[Ans. (a) $\frac{CH_2}{CH_2}$ > 0]

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9. Assertion (A): Anisole reacts with HI to 72. give phenol and methyl

iodide

The strong C-O bond in Reason (R) anisole does not cleave so methanol is never formed.

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

- **10.** Assertion (A): Ether is used as a solvent for Grignard reagent
 - Reason (R) decomposes grignard reagent to give methane.

[Ans. (c) (A) is true but (R) is false]

- 11. Assertion (A): Ethyl alcohol manufactured by fermentation of sugar
 - Lower alcohols are oils, Reason (R) liquids or waxy solids.

[Ans. (c) (A) is true but (R) is false]

- 12. Assertion (A): Compounds with hydroxy groups are gem diols.
 - Reason (R) Ethanol which contains 5% methanol is known as methylated spirit.

[Ans. (b) Both (A) and (R) are true but (R) does not explain (A)

CORRECT STATEMENT (S):

- (a) An example of unsymmetrical ether is CH₃OC₂H₅.
- (b) Ethers exhibit functional isomerism with alcohols.
- (c) Halogenated ether on treating with alcohols forms higher ether.
- (d) Ether is lighter than water.

[Ans. (c) Halogenated ether on treating with alcohols forms higher ether

- (a) Diethylether with chlorine in presence of sunlight forms $(C_2Cl_5)_2O$.
- (b) The formula of diethyl oxonium chloride is $(C_2H_5)_2 - O^+Cl^-$.
- (c) In anisole oxygen is strongly bonded to benzene ring.
- (d) Ether is used as solvent for Grignard reagent. [Ans. (b) The formula of diethyl oxonium chloride is $(C_2H_5)2 - O+CI$
- (a) $CH_3OCH_3 \xrightarrow{Dry HI} CH_3I + CH_3OH$.
 - (b) Ether is used as substitute for petrol.
 - (c) In Williamson synthesis, ether is formed using alkoxide and alcohol.
 - (d) Ethers act as lewis base due to the presence of non-bonding electrons on oxygen.

[Ans. (c) In Williamson synthesis, ether is formed using alkoxide and alcohol

- Which among the following is the correct statement regarding diethyl ether?
 - (a) Undergoes nitration
 - (b) High boiling liquid
 - (c) With HI forms phenol and CH₃I
 - (d) Forms peroxide in air

[Ans. (d) Forms peroxide in air]

INCORRECT STATEMENT (S):

- Which of the following is incorrect with respect to anisole?
 - (a) With nitrating mixture forms nitroanisoles.
 - (b) Not used as a solvent.
 - (c) Forms peroxides easily.
 - (d) Used in perfumery.

[Ans. (c) Forms peroxides easily.]

- 2. Pick out incorrect statement regarding ethers
 - a) Ethers have higher boiling points than alkanes of comparable mass.
 - b) Ethers are miscible with water
 - c) Diethyl ether is used as refrigarant
 - d) Anisole is used as surgical anesthetic agent

[Ans. (d) Anisole is used a surgical anesthetic agent

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3. Pick out the wrong statement regarding ethers.

- a) dimethyl ether and diethyl ehters are simple ethers
- b) ethyl methyl ether is a symmetrical ether
- c) the reaction between sodium ethoxide and methyl bromide is known as williamson's ether synthesis
- d) Diethyl ether is used as an anaesthetiz

[Ans. (b) ethyl methyl ether is a symmetrical ether]

4. Pick out the incorrect statement regarding anisole

- a) Anisole is not as reactive as phenol
- b) The -OCH₃ group is m-directing
- c) Anisole is used in perfumery
- d) Nitration of anisole forms two substituted isomers

[Ans. (b) The -OCH₃ group is m-directing]

MATCH THE FOLLOWING:

1.	30	LIST - I	S A	LIST - II
	A	Phenyl amine	i)	Picric acid
	В	Ethyl phenyl ether	ii)	Anisole
	С	2,4,6 trinitro phenol	iii)	Phenetole
	D	methyl phenyl ether	iv)	Aniline

- A B C D
- (a) (iii) (iv) (i) (ii)
- **(b)** (iv) (iii) (i) (ii)
- (c) (ii) (i) (iv) (iii)
- (d) (ii) (iv) (iii) (i)

[Ans. (b) (iv), (iii), (i), (ii)]

Distinguish Reagents methanol and i) sodium metal ethanol 1-propanol and 2 I₂/KOH ii) propanol ethanol and diethyl iii) neutral FeCl₂ ether Phenol and Lucas reagent iv) cyclohexanol

Δ	R	C	D
1 1	D		D

- (a) (iv) (iii) (i) (ii)
- **(b)** (ii) (i) (iii) (iv)
- (c) (iii) (ii) (iv) (i)
- (d) (ii) (iv) (i) (iii)

[Ans. (d) (ii), (iv), (i), (iii)]

3 .	B. LIST - I		LIST - II		
	A	Dow's	i)	OH + CCly ₄ OH COOH + OH	
		100	000/1	O O COOH	
	В	Cannizzaro	ii)	$CH_3CH_2OH + \frac{ConcHCl}{anhy ZnCl_2} C_2H_5Cl + H_2Cl$	
	C	Lucas test	iii)	$C_6H_5Cl+ NaOH \xrightarrow{623 \text{ K}} C_6H_5OH + NaCl$	
	D	Riemer Tiemann	iv)	$2C_6H_5CHO + H_2O \xrightarrow{NaOH} C_6H_5CH_2OH + C_6H_5COOH$	
				- 1 TYPO	

A B C D

- (a) (ii) (iv) (i) (iii)
- **(b)** (ii) (iv) (iii) (i)
- (c) (iii) (iv) (ii) (i)
 - (**d**) (iv) (iii) (i) (ii)

[Ans. (c) (iii), (iv), (ii), (i)]

4.		LIST - I	j	LIST - II
	A	Diethyl ether	i)	Perfumery
	В	methoxy benzene	ii)	Bakelite
	C	phenol	iii)	explosive
	D	Ethyleneglycol	iv)	anaesthetic

A B C D

- (a) (ii) (iv) (iii) (i) (b) (iv) (i) (ii) (iii)
- (c) (iii) (iv) (ii) (ii) (i)
- (d) (iv) (iii) (i) (ii) (d) (iv) (iii) (iii)

[Ans. (b) (iv), (i), (ii), (iii)]

5 .	5. Compound		Cocid ation products		
	A	phenol	i)	СООН	
	. c. 2	^{3/9} 5093		COOH	
	В	glycerol	ii)	CHO CHO	
	C	glycol	iii)	CH ₃ COOH	
	D	ethanol	iv)	0==0	

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

(iv) [Ans. (a) (iv), (i), (iii), (ii)]

VERY SHORT ANSWER

2 MARKS

- Give reasons: Methanol is miscible with water while iodo-methane is not.
- Methanol (CH_3OH) is miscible with water because it is able to form hydrogen bonding with water due to the presence of hydroxyl group whereas iodo-methane (CH₂I) does not contain –OH group.
 - Since it is not able to form hydrogen bonding with water it is insoluble in
- 2. Compare the acid strength in 1°, 2° and 3° alcohol giving reason.
- Ans. (i) Alcohols are weaker acid than water because of +I effect of alkyl group. Hence, alcohols react only with electropositive metals evolving hydrogen.

$$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2$$

Sodium ethoxide

- The acid strength decreases in the order 1°>2°>3° because of the electron releasing effect of the alkyl groups.
- How will you convert C,H₅OH C,H_5OC,H_5 ?
- Ans. When C_2H_5OH (Ethanol) is treated with conc. H₂SO₄ at 410 K, intermolecular dehydration take place and the product formed will be diethyl ether C_2H_5 -O- C_2H_5 .

$$2C_2H_5OH + H_2SO_4 \xrightarrow{\quad 410K\quad} C_2H_5O - C_2H_5 + H_2O$$
 Ethanol Diethylether

- Complete the reaction and write the names of products. $C_2H_5OH + NH_3 \xrightarrow{Al_2O_3 \over 360^{\circ}C}$?
- Ans. Ethanol react with ammonia in presence of heated alumina or thoria catalyst at 633 K to form mixture of amines.

$$\begin{array}{c} C_2H_5OH + NH_3 \xrightarrow{Al_2O_3} C_2H_5NH_2 \xrightarrow{C_2H_5OH} \\ \text{Ethanol} \quad] \qquad \qquad \text{Ethyl amine} \end{array}$$

$$\begin{array}{ccc} (C_2H_5)_2NH & \xrightarrow{\quad C_2H_5OH \quad} & (C_2H_5)_3N \\ & & & & & & \\ \text{Diethylamine} & & & & & \\ \end{array}$$

- Explain 'esterification' reaction with an example.
- Ans. Alcohols react with carboxylic acids in the presence of an acid to give esters

$$CH_3 - CH_2 - OH + HO - C - CH_3 \xrightarrow{H^+}$$
ethanol Ethanoiacid

$$O$$
 \parallel
 $CH_3 - C - O - CH_2 - CH_3$
ethylethanoate

- Why is glycol more viscous than ethanol?
- Ans. Glycol contains two hydroxyl groups which are able to form intermolecular hydrogen bonding made it much stronger. Hydrogen bond can be formed at both OH groups resulting in a polymeric structure.

$$\begin{array}{c} H \\ CH_2\text{--}O \xrightarrow{} H\text{--}O \\ ----O \xrightarrow{} CH_2 \\ H \end{array}$$

This leads to high viscosity in glycol whereas in ethanol there is no strong intermolecular bydrogen bonding and it is less viscous.

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36. Arrange the following in the decreasing order of order of acid strength.

Ans.
$$O_2N$$
—OH > MeO —OH > OH > CH₃—OH

SHORT ANSWER

3 MARKS

- 1. When phenol on treatement with Br₂/H₂O readily gives a precipitate of 2, 4, 6 tribomo phenol.
- Ans. (i) Phenol reacts with bromine water to give a white precipitate of 2,4,6-tri bromo phenol.

$$\begin{array}{c}
\text{OH} \\
& 3\text{Br}_2, \text{H}_2\text{O}
\end{array}$$

$$\begin{array}{c}
\text{Br} \\
& \text{Br}
\end{array}$$

$$+ 3\text{HBr}$$

Phenol

2,4,6-tribromophenol

(ii) It readily forms tribromo derivative since it has two-o and one-p position free with respect to OH group.

- **2.** Explain Swern oxidation of propan-2-ol to propanane.
- Ans. (i) In this method, dimethyl sulfoxide (DMSO) is used as the oxidising agent, which converts alcohols to ketones / aldehydes.
 - (ii) In this method an alcohol is treated with DMSO and oxalyl chloride followed by the addition of triethylamine.

- 3. Explain the manufacture of glycerol from triglycerides.
- **Ans.** Glycerol occurs in many natural fats and it is also found in long chain fatty acids in the form of glyceryl esters (Triglycerides). The alkaline hydrolysis of these fats gives glycerol and the reaction is known as **saponification**.

- 4. Write a note on Friedel Crafts reaction of anisole.
- **Ans.** Anisole undergoes Friedel Craft's reaction in presence of anhydrous AlCl₃ as a catalyst.

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- What is major product formed when 3,3-dimethyl-2-butanol is heated in the presence of H₂SO₄.
- Ans. Saytzeff's rule: During intramolecular dehydration, if there is a possibility to form a carbon - carbon double bond at different locations, the preferred location is the one that gives the more (highly) substituted alkene i.e., the stable alkene.

For example, the dehydration of 3,3 – dimethyl - 2- butanol gives a mixture of alkenes. The secondary carbocation formed in this reaction undergoes rearrangement to form a more stable tertiary carbocation.

$$\begin{array}{c} \text{CH}_3 \stackrel{\bullet}{\text{O}} - \text{H} \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_3 \\ \text{CH}_$$

- Explain the mechanism involved in the intermolecular dehydration of alcohols to give ethers.
- Ans. Inter molecular dehydration of alcohol: We have already learnt that when ethanol is treated with con.H SO₂ 4at 443K, elimination takes place to form ethene. If the same reaction is carried out at 413K, substitution competes over elimination to form ethers.

$$CH_{3}CH_{2} - \overset{\frown}{\bigcirc} - H \xrightarrow{H \overset{\frown}{\square} OSO_{3}H} CH_{3}\overset{\frown}{CH_{2}}\overset{\frown}{\square} \overset{\frown}{\bigcirc} - H \xrightarrow{H \overset{\frown}{\square} - CH_{2}CH_{3}}$$

$$H_{3}O^{\circ} + CH_{3}CH_{2} - O - CH_{2}CH_{3} \xrightarrow{H_{3}O^{\circ}} CH_{3}\overset{\frown}{\square} \overset{\frown}{\bigcirc} - CH_{2}CH_{3}$$

- Explain auto-oxidation of ether.
- Ans. When ethers are stored in the presence of atmospheric oxygen, they slowly oxidise to form hydroperoxides and dialkylperoxides. These are explosive in nature. Such a spontaneous oxidation by atmospheric oxygen is called autooxidation.

Some of the reaction of diethyl ether,



- Starting from phenol how would you obtain the following compounds?
 - (a) 1, 4-benzo quinone,
 - (b) picric acid,
 - (c) Anisole?
- Ans. (a) Phenol undergoes oxidation with air or acidified K₂Cr₂O₇ with conc. H₂SO₄ to form 1,4-benzoquinone.

$$\begin{array}{c|c} OH & & & \\ \hline K_2Cr_2O_7 & & & \\ \hline Conc. \ H_2SO_4 & & \\ (O) & & & \\ \end{array}$$

Phenol

1,4-benzoquinone

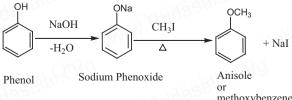
When phenol reacts with nitrating mixture conc. H₂SO₄ and conc. HNO₃, the product formed is picric acid.

$$\begin{array}{c|c}
OH & OH \\
\hline
 & 298 \text{ K} \\
\hline
 & Conc. \text{ H}_2\text{SO}_4/\text{HNO}_3
\end{array}$$

$$\begin{array}{c}
OH \\
NO_2
\\
NO_2
\end{array}$$

2,4,6 - trinitro phenol (Picric acid)

When phenol reacts with diazo methane in alkaline medium, anisole is formed.



methoxybenzene



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PROBLEMS FOR PRACTICE

- An organic compound (A) of molecular formula C₂H_oO gives turbidity within 5-10 min on reaction with anhydrous ZnCl₂/HCl. Compound (A) on treatment with sodium hypochlorite gives a carbonyl compound (B) which on further chlorination gives compound (C) of molecular formula C₃H₃OCl₃. Identify (A), (B) and (C). Explain the reactions.
- (A) that gives turbidity within 5-10 min on reaction with anhydrous ZnCl₂/HCl means it must be secondary alcohol.

$$\begin{array}{ccc} \text{CH}_3\text{-CH-CH}_3 & \xrightarrow{\text{anhydrous ZnC}I_2\text{/HCl}} & \text{CH}_3\text{-CH-CH}_3 & + \text{HCl} \\ & \text{OH} & & \text{Cl} \end{array}$$

(ii) Iso propyl alcohol on treatment with sodium hypochlorite, undergoes oxidation to give acetone compound (B).

$$\begin{array}{ccc}
CH_3-CH-CH_3 & \xrightarrow{(O)} & CH_3-C-CH_3 \\
OH & O \\
(A) & (B)
\end{array}$$

Acetone on treatment with chlorine gives trichloro acetone and it is (C).

Compound	Compound Name	Formula
A	Isopropyl alcohol	CH ₃ -CH-CH ₃ OH
В	Acetone	CH ₃ -C-CH ₃
C	Trichloro acetone	CCl ₃ -C-CH ₃ O

An organic compound (A) C₂H₆O liberates hydrogen on treatment with metallic sodium. (A) on mild oxidation gives (B) C₂H₄O which answers iodoform test. (B) when treated with conc. H₂SO₄ undergoes polymerisation to give (C), a cyclic compound. Identify (A), (B) and (C) and explain the reactions.

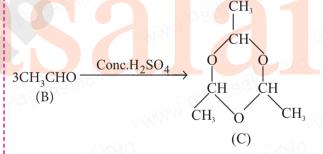
Ans. (i)
$$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2 \uparrow$$
(A)

Ethyl alcohol on mild oxidation gives acetaldehyde (B) It answers idoform test.

$$CH_3$$
- $CH_2OH \xrightarrow{Mild(O)} CH_3CHO + H_2O$
(B)

(A) (B)
$$CH_3CHO + 3I_2 + NaOH \xrightarrow{B} CHI_3 + HCOONa + 3 HI$$
(B) Iodoform

(iii) Acetaldehyde when treated with Conc. H₂SO₄ undergoes polymerisation and the product obtained is paraldehyde (C).



Compound	Compound Name	Formula
A	Ethyl alcohol	CH ₃ CH ₂ OH
В	Acetaldehyde	CH ₃ CHO
C	Paraldehyde	CH ₃ CH O CH CH CH CH ₃ CH CH CH ₃

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HOTS

- When tertiary butyl alcohol and 1-butanol are separately treated with a few drops of KMnO₄, in one case only the purple colour disappears and a brown precipitate is formed. Which of the two alcohols gives the above reaction and what is that brown precipitate?
- Ans. 1-Butanol, being primary alcohol gets oxidised by dilute KMnO₄. The brown precipitate is due to the formation of manganese dioxide.

 $2KMnO_4 + H_2O \longrightarrow 3KOH + 2MnO_2 + 3(O)$ Manganese dioxide

(brown precipitate)

butanoic acid

- Compound (A) C₆H₁₂O₂ on reduction with LiAlH₄ yields two compounds B and C. The compound (B) on oxidation gave (D) which on treatment with aqueous alkali and subsequent heating furnished E. The latter on catalytic hydrogenation gave (C). Compound (D) on oxidation gave monobasic acid (molecular formula weight = 60). Deduce the structure of (A), (B), (C), (D) and (E).
- Ans. (i) E is monobasic acid (RCOOH) having molecular weight 60 and it is formed from D on oxidation. So E must be acetic acid and D must be acetaldehyde.
 - (B) on oxidation gives CH₃CHO. So (B) must be alcohol (CH₃CH₂OH).
 - Acetaldehyde (D) on treating with aqueous alkali (NaOH) gives aldol which on heating gives 2- butenal (E).

$$CH_{3} - CHO \xrightarrow{\text{NaOH}} CH_{3}CHOHCH_{2}CHO$$

$$\xrightarrow{\text{(D)}} Aldol$$

$$\xrightarrow{\text{heat}} CH_{3} - CH = CH CHO$$

$$\xrightarrow{\text{2-Butenal (E)}} CH_{3} - CH$$

(iv) Compound E on catalytic hydrogenation gives butyl alcohol.

$$CH_3 - CH = CHCHO \xrightarrow{H_2} CH_3CH_2 - CH_2-CH_2OH$$
1-Butanol

Hence compound (A) must be an ester. Ester (A) on reduction with LiA1H, yields two alcohols (B) and (C). (A) is ethyl butvrate.

CH₃CH₂CH₂COOCH₂CH₃ — LiA/H₄ → CH₃CH₂OH + CH₃CH₂CH₂CH₃OH

Ethyl alcohol

Butyl alcohol

(C)

(B)

'A' can also be CH₃COOCH₂CH₂CH₂CH₃CH₃. This structure will be answering all the above reactions.

- Give the Grignard reagent and carbonyl compound that can be used to prepare
 - (a) CH₂-CH₂-CH₂-OH
 - (b) (CH₃),C(OH)CH,CH,CH₃
 - (c) $C_6H_5CH_2CH(OH)CH_3$

(d)
$$CH_3 - CH_2 - C - CH_3$$

 C_6H_5

CH₃CH₂MgBr + HCHO Ans. (a) Ethyl magnesium bromide Formaldehyde

> **(b)** $CH_3 - CH_2 - CH_2MgBr + CH_3 - C - CH_3$ Propyl mangesium bromide

C₆H₅CH₂MgBr + CH₃CHO Benzyl magnesium bromide Acetaldehyde

$$\begin{array}{ccc} 2\mathrm{C_6H_5MgBr} + & \mathrm{CH_3-CH_2-C-CH_3} \\ \text{Phenyl magnesium bromide} & & \mathbb{O} \\ & & \mathrm{C} \\ & & \mathrm{C} \\ & & \mathrm{C} \\ \end{array}$$

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- Halo alkane are easily prepared from alcohols while aryl halides cannot be prepared from phenol.- Justify.
- Alcohols are weakly basic in nature so Ans. (i) easily in presence of strong acids.
 - Due to the presence of +ve charge on the oxygen atom, C-O in protonated alcohols became weak hence easily cleaved by halideions to form alkyl halides.
- (iii) Where as phenols are much weaker bases due to delocalisation of the lone pair of electrons on the oxygen atom due to resonance and so are not easily protonated.
- The C-O bond in phenols has some double bond character; hence not easily cleaved by halide ions to form respedive aryl halides.



UNIT TEST

Time: 40 min Marks: 25

- CHOOSE THE CORRECT ANSWER $(5 \times 1 = 5)$
- Which one of the following is the strongest
 - a) 2 nitrophenol
- b) 4 chlorophenol
- c) 4 nitrophenol
- d) 3 nitrophenol
- Glycerol an oxidation with gives glyceric acid and tartronic acid.
 - a) dil HNO,
- b) Conc HNO,
- bismuth nitrate
- d) Fenton's reagent
- The major product obtained when phenol is treated with sodium hydroxide and carbon di oxide is
 - a) Salicyaldehyde
- b) Salicylic acid
- c) benzaldehyde
- d) benzoic acid
- Which among the following is the correct statement regarding diethyl ether?
 - (a) Undergoes nitration
 - (b) High boiling liquid
 - (c) With HI forms phenol and CH₃I
 - (d) Forms peroxide in air
- Alcohols are isomeric with
 - (a) aldehyde
- (b) ketones
- (c) ethers
- (d) esters
- II. VERY SHORT ANSWER
- $(2\times 2=4)$
- Can we use nucelophiles such as NH₂,CH₂O for the Nucleophilic substitution of alcohols.
- Why is glycol more viscous than ethanol?

III. SHORT ANSWER

- $(2 \times 3 = 6)$
- Account for the following:
 - (a) Lower members of alcohols are soluble in water but higher members are not.
 - (b) Alcohols cannot be used as solvent for Grignard reagent.
- Explain Kolbe's reaction.
- IV. Long Answer

- $(2 \times 5 = 10)$
- How will you distinguish the primary, secondary and tertiary alcohols by Victor Meyer's method?
- Write a note on the 'Acidic nature of phenol'.

Answer Key

- 1. (c) 4 nitrophenol
 - **2.** (a) dil HNO₃
 - 3. (b) Salicylic acid
 - **4.** (d) Forms peroxide in air
 - **5.** (c) ethers
- 1. Refer Sura's Guide Page Book back Q.No. 7.
 - 2. Refer Sura's Guide Additional 2 marks Q.No. 8.
- III. 1. Refer Sura's Guide Additional 3 marks Q.No. 12.
 - 2. Refer Sura's Guide Book back Q.No. 12.
- 1. Refer Sura's Guide Additional 5 marks Q.No. 7.
 - 2. Refer Sura's Guide Additional 5 marks Q.No. 9.



UNIT 12 CARBONYL COMPOUND

CHAPTER SNAPSHO

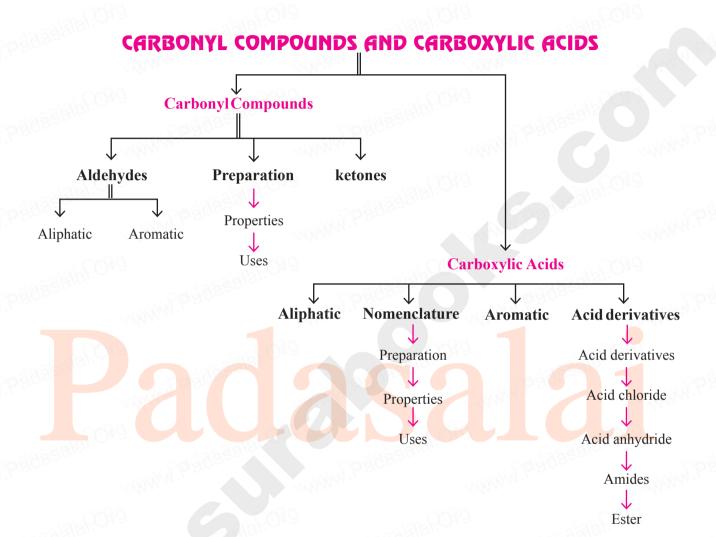
12.1	Nomenclature of Aldehydes and
	ketones

- 12.2 Structure of carbonyl group
- **12.3** Preparation of aldehydes and ketones
- 12.4 Physical properties of aldehydes and ketones

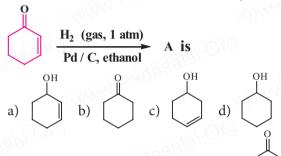
12.5 Carboxylic Acids

- 12.6 Acid Halide
- 12.7 Acid anhydride
- 12.8 Esters
- 12.9 **Acid Amides**
- **12.10** Uses of carboxylic acid

CONCEPT MAP



The correct structure of the product 'A' formed in the reaction (NEET)



- The formation of cyanohydrin from acetone is an example of
 - a) nucleophilic substitution
 - b) electrophilic substitution
 - c) electrophilic addition
 - d) nucleophilic addition

[Ans. (d) nucleophilic addition]

- Reaction of acetone with one of the following reagents involves nucleophilic addition followed by elimination of water. The reagent is
 - a) Grignard reagent
 - b) Sn / HCl
 - hydrazine in presence of slightly acidic solution
 - d) hydrocyanic acid [Ans. (c) hydrazine in presence of slightly acidic solution
- In the following reaction,

$$HC \equiv CH \xrightarrow{\text{H}_2SO_4} \text{HgSO}_4$$

X Product 'X' will not give

- a) Tollen's test
- b) Victor meyer test
- c) Iodoform test
- d) Fehling solution test

[Ans. (b) Victor meyer test

- CHOOSE THE CORRECT 5. $CH_2 = CH_2 \xrightarrow{i) O_3} X \xrightarrow{NH_3} Y$ 'Y' is
 - a) Formaldelyde
 - b) diacetoneammonia
 - c) hexamethylenetetraamine
 - d) oxime

[Ans. (c) hexamethylenetetraamine]

Predict the product Z in the following series of reactions

Ethanoic acid $\xrightarrow{PCl_5} X$

$$\frac{C_6H_6}{\text{Anhydrous AlCl}_3} Y \xrightarrow{\text{i) CH}_3\text{MgBr}} Z.$$

- a) $(CH_3)_2 C(OH)C_6H_5$
- b) CH₂CH(OH)C₆H₅
- c) CH₃CH(OH)CH₃ CH₃ $CH_2 - OH$



[Ans. (a) (CH₃), C(OH)C₆H₅]

Assertion: 2, 2 - dimethyl propanoic acid does not give HVZ reaction.

: 2 - 2, dimethyl propanoic acid Reason does not have - - hydrogen atom

- a) if both assertion and reason are true and reason is the correct explanation of assertion.
- b) if both assertion and reason are true but reason is not the correct explanation of assertion.
- assertion is true but reason is false
- both assertion and reason are false.

[Ans. (a) if both assertion and reason are true and reason is the correct explanation of assertion

SHORT ANSWER **O**UESTIONS

- How is propanoic acid is prepared starting from
 - an alcohol (a)
 - an alkylhalide **(b)**
 - an alkene (c)

Ans. (a) From an alcohol:

Primary alcohols on oxidation in the presence of acidified K2Cr2O7 or acidified KMnO₄ or alkali KMnO₄ gives the corresponding acids.

$$\begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+} \text{CH}_3\text{CH}_2\text{COOH} \\ \text{Propanol} & \text{Propanoic acid} \end{array}$$

From an alkyl halide:

Alkyl halides when treated with aqueous alkaline solutions gives the corresponding alcohols.

$$\begin{array}{c} \text{CH}_{3}\text{CH}_{2}\text{CH}_{2}\text{Br} + \text{NaOH} \xrightarrow{\text{H}_{2}\text{O}} \text{CH}_{3}\text{CH}_{2}\text{CH}_{2}\text{OH} \\ \text{Propyl bromide} \end{array}$$

Alcohols on oxidation gives carboxylic acid

$$\begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{K_2\text{Cr}_2\text{O}_7/\text{H}^+} \rightarrow \text{CH}_3\text{CH}_2\text{COOH} \\ \text{Propanol} & \text{Propanoic acid} \end{array}$$

From an alkene:

Propene adds on to borane (BH₃) to give tripropyl borane.

$$3CH_3 - CH = CH_2 + BH_3 \longrightarrow (CH_3CH_2CH_2)_3 B$$
Propene Tripropyl borane

$$\begin{array}{c} \text{H}_2\text{O}_2/\text{OH}^- \\ \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{H}_3\text{BO}_3 \\ \text{Propyl alcohol} \end{array}$$

This reaction is hydroboration

$$\begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{K_2\text{Cr}_2\text{O}_7/\text{H}^+} \text{CH}_3\text{CH}_2\text{COOH} \\ \text{Propanol} & \text{Propanoic acid} \end{array}$$

Alternate method:

$$CH_3CH = CH_2 + HBr \xrightarrow{peroxide} CH_3CH_2CH_2Br$$
n propyl bromide

(Anti-markovnikos rule)

$$\label{eq:ch3} \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{NaOH} \xrightarrow{\quad \text{H}_2\text{O} \\ \quad \text{Propanol}} \\ \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$$

$$\begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} & \xrightarrow{\text{(O)}} \text{CH}_3\text{CH}_2\text{COOH} \\ \text{Propanol} & \text{Propanoic acid} \end{array}$$

2. Compound (A) with molecular formula C2H3N on acid hydrolysis gives (B) which reacts with thionylchloride to give compound (C). Benzene reacts with compound (C) in presence of anhydrous AlCl₂ to give compound (D). Compound (D) on reduction with gives (E). Identify (A), (B), (C), (D) and (E). Write the equations.

Ans. Compound with molecular formula C₂H₃N is CH₂CN(A) acetonitrile or Methyl cyanide.

$$\begin{array}{ccc}
CH_3CN & \xrightarrow{H_2O} & CH_3COOH \\
(A) & (B) \\
Methyl cyanide & Acetic acid
\end{array}$$

Acid hydrolysis of nitriles give the corresponding carboxylic acid.

$$CH_3COOH + SoCl_2 \longrightarrow CH_3COCl + SO_2 + HCl$$
(B) Thionyl
Acetic acid chloride Acetyl chloride

COCH₃

$$\begin{array}{c}
 & 2(H) \\
\hline
 & LiAl H_4 \\
 & (or)
\end{array}$$
Coherent Methyl carbinol

Na/C₂H₅OH

Acetophenone

$$\begin{array}{c} 4 \\ \hline Zn/Hq/HCl-Clemmenson \ reduction \\ or \\ N_2H_4 / C_2H_5OH - Wolff \ Kishner \ reduction \\ \end{array} \begin{array}{c} C_6H_5CH_2CH_3 \\ \hline Ethyl \ Benzene \\ (E) \end{array}$$

- (A) CH₃CN acetonitrile
- (B) CH₂COOH acetic acid
- (C) CH₃COCl acetyl chloride
- (D) C₆H₅COCH₂ acetophenone
- (E) Depending upon the reducing agent
- (E) $C_6H_5CHOHCH_3 \rightarrow Phenylmethyl carbinol$

 $C_6H_5CH_2CH_3 \rightarrow Ethyl Benzene$



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Evaluate Yourself

- Write the IUPAC name for the following compound.
 - i) CH₃-**CHO**
 - (CH_3) , $C = CHCOCH_3$
 - iii)
 - (CH₃), C (OH)CH₂CHO
- 4 methyl benzaldehyde Ans. (i)
 - 4 methyl pent 3 en 2 one
 - (iii) 4, 6 dimethyl hept 3 ene 2 one
 - (iv) 3 hydroxy 3 methyl butanal.
- Write all possible structural isomers and position isomers for the ketone represented by the molecular formula $C_5H_{10}O$.
- CH₃ CO CH₂ CH₃ CH₃ pentan - 2 - one
 - $CH_3 CH_2 CO CH_2 CH_3$ pentan - 3 - one
 - (iii) CH₃ CO CH CH₃ CH₂ 3 - methyl butan - 2 - one
- What happens when the following alkenes are subjected to reductive ozonolysis?
 - 1) **Propene**
- 2) 1 Butene
- 3) Isobutylene
- Ans. 1) **Propene:**

$$\begin{array}{c} \text{CH}_3\text{CH} = \text{CH}_2 + \text{O}_3 \longrightarrow \text{CH}_3 - \text{CH} \qquad \text{CH}_2 \\ \text{Propene} & \text{O} \longrightarrow \text{O} \\ \hline & & \text{O} \longrightarrow \text{O} \\ \hline & & & \text{CH}_3\text{CHO} + \text{HCHO} \\ \text{Acetaldehyde} & \text{formaldchyde} \end{array}$$

1 - Butene 2)

$$CH_3 - CH_2 - CH = CH_2 + O_3 \longrightarrow CH_3 - CH_2 - CH \qquad CH_2$$

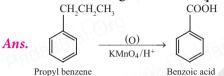
$$O \longrightarrow O$$
Ozonide
$$Zn/H_2O \longrightarrow CH_3CH_2CHO + HCHO$$

Proponal

Isobutylene

$$\begin{array}{c} \text{CH}_3 \\ \text{CH}_3 \\ \text{CH}_3 \\ \text{Iso butylene} \end{array} \\ \text{C} \\ \text{CH}_2 \\ \text{CH}_3 \\ \text{C} \\ \text{O} \\ \text{$$

4. What happens when n-propyl benzene is oxidised using H⁺ / KMnO₄?



How will you prepare benzoic acid using Grignard reagent.

Ans.
$$C_6H_5MgBr + O = C = O \longrightarrow OMgBr$$

Phenyl magnesium carbondi Addition product

 $C_6H_5C = O$

Phenyl magnesium product

 $C_6H_5C = O$

- Why acid anhydride are preferred to acyl chloride for carrying out acylation reactions?
- Ans. Acetic anhydride is preferred for acylation due
 - (i) Its ease of availability and cheap compared to acetyl chloride.
 - (ii) when acylation is carried out with acetyl chloride, the by product is HCl which is a strong acid and has the potential for unwanted reactions whereas with acetic anhydride, the by product is only acetic acid.
 - Acetyl chloride is more reactive and hence more liable to undergo side reaction. Therefore acetic anhydride is preferred for acylation.

formaldehyde

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Additional Questions and Answers

CHOOSE THE CORRECT ANSWER

1 MARK

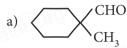
Give the common and IUPAC name of the compound HO-CH, -CH-CHO

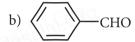


- glyceraldehyde, hydroxy propanal
- b) glyceraldehyde, 2, 3 dihydroxy propanal
- c) crotonaldehyde, hydroxy propanal
- d) crotonaldehyde, 2, 3 dihydroxy propanal

[Ans. (b) glyceraldehyde, 2, 3 – dihydroxy propanal]

Cannizaro reaction is not given by





- c) CH₃CHO
- d) HCHO

[Ans. (c) CH₃CHO]

- Which among the following on oxidation with alk.KMnO, will give butanone?
 - a) Butan -1- ol
- b) Butan -2- ol
- Both (a) and (b)
- d) Neither (a) nor (b)

[Ans. (b) Butan -2- ol]

The IUPAC name of the compound



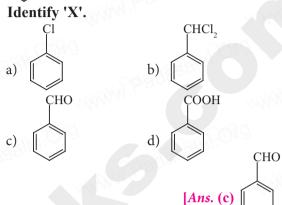
- a) 4 methoxy 2 nitro benzaldehyde
- b) 4 methoxy 6 nitro benzaldehyde
- c) 2 formyl 5 methoxynitrobenzene
- d) 4 formyl 5 nitroanisole

Ans. (a) 4 - methoxy - 2 - nitro benzaldehyde

- Which among the carbonyl compounds cannot be prepared by Rosenmund reduction?
 - a) Ketones
- b) Formaldehyde
- Acetaldehyde
- d) Both (a) and (b)

[Ans. (d) Both (a) and (b)]

CO, HCl AlCl₃ / CuCl



- Which among the following statement is incorrect regarding urotropine?
 - a) It is an urinary antiseptic
 - b) It is hexa methylene diamine
 - c) Used in the preparation of an explosive
 - d) All the above

Ans. (b) It is hexa methylene diamine



Choose a suitable reagent to carry out the above reaction.

- a) NaBH₄
- b) H₂/Pd
- c) KMnO₄
- d) H₂SO₄

[Ans. (c) KMnO₄]

- Which of the following acids do not exhibit optical isomerism?
 - a) lactic acid
- b) tartaric acid
- maleic acid
- d) both (a) and (b)

[Ans. (c) maleic acid]

- 10. A compound 'X' when mixed with ethanol and a drop of concentrated H₂SO₄ gave a compound with fruity odour. Identify 'X'.
 - a) HCHO
- b) CH₃OH
- c) CH₃COOH
- d) CH₃NH₂

[Ans. (c) CH₃COOH]

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 CH_3

- 78. The IUPAC name of CH₃ CH CH₂COOH is
 - a) methyl butanoic acid
 - b) 2-methyl butanoic acid
 - c) α methyl butyric acid
 - d) 3-methyl butanoic

[Ans. (d) 3-methyl butanoic]

- 79. The decarboxylating agent is
 - a) soda lime
- b) lime water
- c) quick lime
- d) lime of milk

[Ans. (a) soda lime]

- **80.** The order of reactivity of carboxylic acid derivatives is
 - a) Acid chloride > Ester > Amide > Acid anhydride
 - b) Acid chloride > Acid anhydride > Ester > Amide
 - c) Acid chloride > Amide > Acid anhydride > Ester
 - d) Acid anhydride > Ester > Amide > Acid chloride

[Ans. (b) Acid chloride > Acid anhydride > Ester > Amide]

ASSERTION & REASON:

Direction : In each of the following questions a statement of assertion (A) is given and a corresponding statement of reason (R) is given just below it. Mark the correct statement as.

- a) (A) and (R) are true and (R) is the correct explanation of (A)
- b) Both (A) and (R) are true but (R) does not explain (A)
- c) (A) is true but (R) is false
- d) Both (A) and (R) are false
- 1. Assertion: Fehling solution does not oxidise benzaldehyde to benzoic acid.

Reason: Fehling solution is a alkaline solution of copper sulphate containing Rochelle salt.

[Ans. (b) (A) and (R) are correct but (R) does not explain (A)]

- 2. Assertion: Formic acid reduces Tollens reagent.
 - Reason : Formic acid contains an aldehyde as well as acid group.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

- 3. Assertion: Wolff kishner and clemmensen's reagents both bring about the oxidation of aldehydes and ketones.
 - Reason : Clemmensen's reagent is a powerful oxidising agent

[Ans. (d) Both (A) and (R) are false]

- 4. Assertion: 100% pure acetic acid is called glacial acetic acid
 - Reason: Its called so as it forms ice like crystals when cooled.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

- 5. Assertion: Trichloro acetic acid is much stronger acid than acetic acid
 - Reason: Acidity decreases with increasing number of electron withdrawing substituents.

[Ans. (c) (A) is correct but (R) is wrong

- **6.** Assertion: In Rosenmund reduction acetyl chloride is reduced to alcohol
 - **Reason**: BaSO₄ acts a positive catalyst in this reaction

[Ans. (d) Both (A) and (R) are false]

- 7. Assertion: Acid chlorides are preferably prepared from carboxylic acids with SOCl₂ as chlorinating agents.
 - Reason : with SOCl₂, the products formed are gases which escape leaving the acid chloride in pure state.

[Ans. (a) (A) and (R) are correct and (R) explains (A)]

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LIST - I LIST - II 11. Silver lactate i) Calico printing Formic acid ii) Astringent \mathbf{C} Cyclic diester iii) Gout Oxalic acid Lactide iv)

- A B C D
- (a) (ii) (iv) (iii) (i)
- **(b)** (ii) (iii) (iv) (i)
- (c) (iii) (ii) (iv) (i)
- (d) (iv) (i) (iii) (ii)

[Ans. (b) (ii), (iii), (iv), (i)]

VERY SHORT ANSWER

2 MARKS

- 1. Name one reagent used to distinguish acetaldehyde and acetone.
- Ans. (i) Schiff's reagent is used to distinguish acetaldehyde and acetone.
 - (ii) Acetaldehyde restores the original colour (red-pink) of the schiff's reagent.
 - (iii) Acetone does not restore this colour.
- 2. Give four examples of carbonyl compounds?
- Ans. (i) H–C–H Formaldehyde
 - (ii) CH₃-C-H Acetaldehyde
 - (iii) CH₃-C-CH₃ Acetone
 - (iv) $C_6H_5-C-CH_3$ Acetophenone
- 3. Does formaldehyde undergo aldol condensation? Justify your answer.
- Ans. (i) Formaldehyde does not undergo aldol condensation.
 - (ii) Aldol condensation reaction is the characteristic of carbonyl compounds having α- hydrogen atom. So this reaction does not take place in formaldehyde.
- 4. What type of aldehydes undergo Cannizaro reaction?

Ans. Aldehydes that do not have α -hydrogen atom undergo Cannizaro reaction.

Eg: HCHO, C₆H₅CHO.

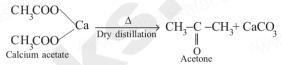
5. What is urotropine? Give its use.

Ans. Hexamethylene tetramine formed by the reaction of formaldehyde and ammonia is called **urotropine**.



6. What happens when calcium acetate is dry distilled?

Ans. When calcium acetate is dry distilled, acetone is formed.



- 7. What is formalin? Write its use.
- Ans. (i) 40 % aqueous solution of formaldehyde is known as formalin.
 - (ii) It is used as a preservative for biological specimens and in leather tanning.
- 8. Ethanal is more reactive towards nucleophilic addition reaction than propanone. Why?
- Ans. (i) Ethanal (CH₃CHO) is more reactive towards nucleophilic addition reaction than propanone (CH₃-C-CH₃) because of steric on and electronic reasons.
 - (ii) Greater the number of alkyl groups attached, less will be the reactivity of carbonyl compound towards nucleophilic addition.
 - (iii) So ethanal is more reactive than propanone.
- 9. Write a note on haloform reaction.

Ans. Acetaldehyde and methyl ketones, containing CH_3-C- group, when treated with halogen and

alkali give the corresponding haloform This is known as Haloform reaction.

$$\begin{array}{c}
\text{CH}_3 - \text{C} - \text{CH}_3 \xrightarrow{\text{Scl}_2} \text{CCl}_3 - \text{C} - \text{CH}_3 \\
\parallel & 0 & 0 \\
\hline
 & & \text{NaOH} \rightarrow \text{CHCl}_3 + \text{CH}_3 - \text{C} - \text{ONa} \\
\parallel & & 0
\end{array}$$

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60. Write a note on Claisen Condensation.

Ans. Esters containing at least one ∞ - hydrogen atom undergo self condensation in the presence of a strong base such as sodium ethoxide to form β -keto ester.

$$CH_{3}-C - OC_{2}H_{5} + H - CH_{2}-C - OC_{2}H_{5}$$

$$Ethyl \ acetate$$

$$CH_{3}-C - CH_{2}-C - OC_{2}H_{5} + C_{2}H_{5}ONa$$

$$CH_{3}-C - CH_{2}-C - OC_{2}H_{5} + C_{2}H_{5}OH$$

$$Ethyl \ aceto \ acetate$$

$$Ethyl \ alcohol$$

61. Amides are amphoteric in nature. Justify.

Ans. Amides behave both as weak acid as well as weak base and thus show amphoteric character. This can be proved by the following reactions.

Acetamide (as base) reacts with hydrochloric acid to form salt

$$\begin{array}{c} O \\ \parallel \\ CH_3-C-NH_2+HCl \longrightarrow CH_3-C-NH_3Cl^- \\ Acetamide & Acetamide hydrochloride \\ \end{array}$$

Acetamide (as acid) reacts with sodium to form sodium salt and hydrogen gas is liberated.

$$2CH_3 - C - NH_2 + Na \longrightarrow 2CH_3 - C - NH Na + H_2$$
Acetamide

Sodium acetamide

62. Name a chemical test to distinguish between the following.

- (i) 2-Pentanone, 3-Pentanone
- (ii) Acetone, acetaldehyde
- (iii) Benzaldehyde, butanal
- Ans. (i) Iodoform test
 - (ii) Tollens test
 - (iii) Bendicts test.

SHORT ANSWER

3 MARKS

1. How is acetaldehyde prepared by the ozonolysis of CH₃CH=CHCH₃?

Ans. Ozone forms addition product with olefin called ozonide, which on reductive cleavage gives aldehyde.

$$CH_3CH=CHCH_3+O_3 \longrightarrow CH_3CH CHCH_3 \xrightarrow{Zn/HCI} CHCH_3 \xrightarrow{Zn/HCI} CH_3CHO+CH_3CHO+H_2O$$

2. Explain Stephen's reaction.

Ans. When alkylcyanides are reduced using SnCl₂/HCl, imines are formed, which on hydrolysis gives corresponding aldehyde.

$$CH_3 - C \equiv N \xrightarrow{SnCl_2/HCl} CH_3 - CH = NH$$

$$\xrightarrow{H_3O^+} CH_3 - CHO$$

3. What is Rosenmund's reduction? What is the purpose of adding $BasO_4$ in it?

Ans. (i) When reduced with hydrogen in the presence of 'poisoned' palladium catalyst, they form aldehydes. This reaction is called Rosenmund reduction.

$$\begin{array}{c} CH_{3} - C - Cl + H - H \xrightarrow{Pd} CH_{3} - C - H + HCl \\ 0 \\ O \\ Acetyl chloride \end{array}$$

- (ii) BaSO₄ is used as a **catalytic poison** to stop the reduction at the stage of aldehyde.
- (iii) Otherwise, the aldehyde formed will be further reduced to primary alcohol.

4. Formaldehyde and benzaldehyde give Cannizaro reaction but acetaldehyde does not - account for this.

Ans. (i) Cannizzaro reaction is a redox reaction which takes place only in aldehydes which do not have α- hydrogen atom.

- (ii) Formaldehyde (HCHO) and benzaldehyde (C_6H_5 CHO) do not have α -hydrogen atom and so they undergo Cannizzaro reaction.
- (iii) But acetaldehyde CH₃CHO contains 3 α-H atoms and it does not undergo Cannizzaro reaction.

5. Explain the isomerism exhibited by carboxylic acids.

Ans. (i) Chain isomerism: This arises due to the difference in the carbon chain of alkyl group attached to carboxyl group. $C_5H_{10}O_2$

$$\begin{array}{c} \text{CH}_3\\ \mid\\ \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{COOH} \text{ and } \text{CH}_3-\text{CH} -\text{CH}_2-\text{COOH}\\ \text{Pentanoic acid} \end{array}$$

(ii) Functional isomerism: Carboxylic acids are functional isomers of esters. C₃H₆O₂

CH₃-CH₂-COOH and CH₃COOCH₃ HCOOC₂H₅

Propanoic acid Methyl acetate Ethyl formate

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$$CH_3 - C - Cl + H - NH_2$$
 $CH_3 - C - NH_2 + HC1$

Acetyl chloride Ammonia Acetamide

Reaction with Alcohols (Alcoholysis) gives esters.

Ammonia

$$CH_3 - C - Cl + HOC_2H_5 \longrightarrow CH_3 - C - OC_2H_5 + HCI$$
Acetyl chloride Ethyl alcohol Ethyl acetate

20. Give the IUPAC names for the following:

Crotonaldehyde (ii) Methyl *n*-propyl ketone (iii) Phenyl acetaldehyde.

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• •	••	•	۲	•

S. No.	Formula	Common name	IUPAC name
i.	CH ₃ -CH=CH-CHO	Crotonaldehyde	2-butenal
ii.	$\begin{array}{c} \operatorname{CH_3} - \operatorname{C} - \operatorname{CH_2} - \operatorname{CH_2} - \operatorname{CH_3} \\ \\ \operatorname{O} \end{array}$	Methyl n-propyl ketone	2-pentanone
iii.	C ₆ H ₅ CH ₂ CHO	Phenyl acetaldehyde	Phenyl ethanal

LONG ANSWER

5 MARKS

- How does formaldehyde react with

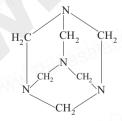
 - (ii) CH₂MgI followed by hydrolysis and
 - (iii) NaOH

Ans. (i) With NH₃:

Formaldehyde forms hexa m ethylenetetramine with NH₃.

$$6CH_2O + 4NH_3 \longrightarrow (CH_2)_6 N_4 + 6H_2O$$

Formaldehyde Hexamethylene tetramine



With CH₂MgI:

Formaldehyde gives primary alcohol.

(iii) With NaOH:

Cannizaro Reaction

$$\begin{array}{c} \text{HCHO} + \text{HCHO} & \xrightarrow{\text{NaOH}} & \text{HCOONa} + \text{CH}_3\text{OH} \\ \text{Formaldehyde} & \text{Sodium formate} & \text{Methanol} \end{array}$$

Illustrate the reducing property of acetaldehyde with examples.

Ans. (i) Clemmensen reduction: Aldehydes and Ketones when heated with zinc amalgam and concentrated hydrochloric acid gives hydrocarbons.

Example:

$$CH_{3} - C - H^{+}4(H) \xrightarrow{Zn^{-}Hg} CH_{3} - CH_{3} \pm H_{2}O$$

$$O$$
Acetaldehyde
$$CH_{3} - C - CH_{3} + 4(H) \xrightarrow{Zn^{-}Hg} CH_{3}CH_{2}CH_{3} + H_{2}O$$

$$O$$
Acetone
$$O$$
Propane

Wolff-Kishner Reduction:

Aldehydes and Ketones when heated with hydrazine (NH2NH2) and sodium ethoxide, hydrocarbons are formed Hydrazine acts as a reducing agent and sodium ethoxide as a catalyst.

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17. Explain the mechanism of esterification.

Ans. The Mechanism of esterification involves the following steps.

PROBLEMS FOR PRACTICE

1. An organic compound (A) of molecular formula C₇H₆O is not reduced by Fehling's solution but will undergo Cannizzaro reaction. Compound (A) reacts with aniline to give compound (B). Compound (A) also reacts with Cl₂ in the presence of catalyst to give compound (C). Identify (A), (B) and (C) and explain the reactions.

Ans. Solution:

(i) Compound A is identified as benzaldehyde C₆H₅CHO from its molecular formula. C₆H₅CHO undergoes Cannizzaro reaction and it does not reduce Fehling's solution.

$$C_6H_5CHO + C_6H_5CHO \xrightarrow{\text{NaOH}} C_6H_5CH_2OH + C_6H_5COONa$$

(ii) Benzaldehyde reacts with aniline to form shiff's base $C_6H_5CH=NC_6H_5$ and it is (B).

$$C_6H_5 - C = O + C_6H_5NH_2 \longrightarrow C_6H_5CH = NC_6H_5 + H_2O$$
Aniline Schiff's base(B)

(iii) Benzaldehyde reacts with chlorine in the presence of catalyst to give m-chlorobenzaldehyde and it is (C).

$$\begin{array}{c}
\text{CHO} \\
+ Cl_2 & FeCl_3
\end{array}$$

$$\begin{array}{c}
\text{CHO} \\
\text{(C)}
\end{array}$$

Compound	Compound Name	Formula
A	Benzaldehyde	C ₆ H ₅ CHO
В	Schiff's base	$C_6H_5CH = NC_6H_5$
C C	m-cholorobenzaldehyde	CHO

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UNIT TEST

Time: 40 min Marks: 25

- CHOOSE THE CORRECT ANSWER
- $CH_2 = CH_2 \xrightarrow{ii} O_3 X \xrightarrow{NH_3} Y$ 'Y' is
 - a) Formaldelyde
 - b) diacetoneammonia
 - c) hexamethylenetetraamine
 - d) oxime
- Which one of the following reduces tollens reagent
 - a) formic acid
- b) acetic acid
- c) benzophenone
- d) none of these
- **Assertion**: p N, N dimethylaminobenzaldehyde undergoes benzoin condensation

Reason: The aldehydic (-CHO) group is meta directing

- a) if both assertion and reason are true and reason is the correct explanation of assertion.
- b) if both assertion and reason are true but reason is not the correct explanation of assertion.
- c) assertion is true but reason is false
- d) both assertion and reason are false.
- Isopropyl alcohol vapours with air over silver catalyst at 520 K give
 - a) tert.butyl alcohol b) acetaldehyde
- - acetone
- d) 2-propanol
- Calcium acetate + calcium benzoate
 - a) benzophenone
- b) benzaldehyde
- acetophenone
- d) phenyl benzoate
- $(2\times 2=4)$ II. VERY SHORT ANSWER
- How is propanoic acid is prepared starting | IV. 1. Refer Sura's Guide Book back Q.No. 2. from an alkylhalide
- What is formalin? Write its use.

- $(5 \times 1 = 5)$ III. Short Answer
- $(2 \times 3 = 6)$
- Write the structure of the major product of the aldol condensation of benzaldehyde with acetone.
- Explain Stephen's reaction.
- LONG ANSWER

- $(2 \times 5 = 10)$
- 1. A Compound (A) with molecular formula C₂H₃N on acid hydrolysis gives(B) which reacts with thionylchloride to give compound(C). Benzene reacts with compound (C) in presence of anhydrous AlCl₃ to give compound(D). Compound (C) on reduction with gives (E). Identify (A), (B), (C) and (D). Write the equations.
- Discuss the mechanism of aldol condensation.

Answer Key

- 1. c) hexamethylenetetraamine
 - 2. a) formic acid
 - **3.** b) if both assertion and reason are true but reason is not the correct explanation of assertion.
 - 4. c) acetone
 - **5.** c) acetophenone
- 1. Refer Sura's Guide Page Book back Q.No. 1 (b).
 - 2. Refer Sura's Guide Additional 2 marks Q.No. 7.
- III. 1. Refer Sura's Guide Book back Q.No. 11.
 - 2. Refer Sura's Guide Additional 3 marks Q.No. 2.
- - 2. Refer Sura's Guide Additional 5 marks Q.No. 3.





Organic Nitrogen Compounds

N	

13.1	Nitro Co	ompounds	13.3	Properties of amines	
	13.1.1	Classification of		13.3.1	Chemical properties
		nitrocompounds	13.4	Diazonii	um Salts
	13.1.2	Nomenclature of		13.4.1	Introduction
	17/1/1/1/	nitroalkanes		13.4.2	Resonance structure
	13.1.3	Isomerism		13.4.3	Method of preparation of
	13.1.4				Diazonium salts
	13.1.5	alkanes Preparation of nitrocallyanes		13.4.4	Physical properties
	13.1.6	Preparation of nitroalkanes Preparation of Nitroarenes		13.4.5	Chemical reactions
	13.1.7	Physical properties of nitro	13.5		s and Isocyanides
	10.1.7	alkane	2010	13.5.1	Introduction
	13.1.8	Chemical properties of nitroalkanes		13.5.2	Methods of preparation of cyanides
13 2	Flectroly	ytic reduction		13.5.3	Properties of Cyanides
15.2	13.2.1	Reduction of catalytic and			9 *
	10.2.1	metal hydrides		13.5.4	Chemical properties
	13.2.2	Electrophilie substitution reaction		13.5.5	Alkyl Isocyanides (Carbylamines)
	13.2.3	Nomenclature		13.5.6	Methods of preparation of
	13.2.4	Structure of amines			isocyanides
	13.2.5	General methods of		13.5.7	Properties of isocyanides
		preparation Amines		13.5.8	Uses of organic nitrogne
	13.2.6	From alkyl halides			compounds
	13.2.7	Ammonolysis of hydroxyl compounds		13.5.9	cyanides and isocyanides



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EVALUATION

Choose The Correct

- Which of the following reagent can be used to convert nitrobenzene to aniline
 - a) Sn / HCl
- b) ZnHg/NaOH
- c) LiAlH₄
- d) All of these
 - [Ans. \star (a) and (c)]
- The method by which aniline cannot be prepared is
 - a) degradation of benzamide with Br₂ / NaOH
 - potassium salt of phthalimide treated with chlorobenzene followed by hydrolysis with aqueous NaOH solution.
 - c) Hydrolysis of phenylcyanide with acidic solution
 - d) reduction of nitrobenzene by Sn / HCl.

Ans. (b) potassium salt of phthalimide treated with chlorobenzene followed by hydrolysis with aqueous NaOH solution

- Which one of the following will not undergo Hofmann bromamide reaction
 - a) CH₃CONHCH₃ b) CH₃CH₂CONH₃
 - c) CH₃CONH₂
- d) $C_6H_5CONH_2$

[Ans. (a) CH₂CONHCH₂]

Assertion: Acetamide on reaction with KOH and bromine gives acetic acid

> Reason : Bromine catalyses hydrolysis of acetamide.

- if both assertion and reason are true and reason is the correct explanation of assertion.
- b) if both assertion and reason are true but reason is not the correct explanation of assertion.
- c) assertion is true but reason is false
- d) both assertion and reason are false.

[Ans. (d) both assertion and reason are false]

5.
$$CH_3CH_2Br \xrightarrow{aq \ NaOH} A \xrightarrow{KMnO_4/H^+} \Delta \rightarrow B \xrightarrow{NH_3} C \xrightarrow{Br_2/NaOH} D$$

'D' is

- a) bromomethane
- b) α bromo sodium acetate
- methanamine
- acetamide

[Ans. (c) methanamine]

- Which one of the following nitro compounds does not react with nitrous acid
 - a) CH₃ CH₂ CH₃ NO₃
 - b) (CH₃)₂ CH CH₂NO₂
 - c) $(CH_3)_3 C NO_2$
 - d) $CH_3 C CH NO_2$ O CH_3 [Ans. (c) $(CH_3)_3 C NO_2$]
- Aniline + benzoylchloride

 NaOH

 → C₆H₅ - NH - COC₆H₅ this reaction is known as
 - a) Friedel crafts reaction
 - b) HVZ reaction
 - c) Schotten Baumann reaction
 - d) None of these

Ans. (c) Schotten – Baumann reaction

- The product formed by the reaction an aldehyde with a primary amine (NEET)
 - a) carboxylic acid
- b) aromatic acid
- schiff's base
- d) ketone

Ans. (c) schiff's base

- Which of the following reaction is not correct.
 - $CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH + N_2$
 - $\frac{\text{NaNO}_2 / \text{HCl}}{} (\text{CH}_3)_2 \text{ N} \longrightarrow$
 - c) $CH_3CONH_2 \xrightarrow{Br_2/NaOH} CH_3NH_2$
 - d) none of these

[Ans. (b)
$$(CH_3)_2 N$$
 \longrightarrow $NaNO_2 / HCl$ $(CH_3)_2 N$ \longrightarrow $N = NCl$

- 10. When aniline reacts with acetic anhydride the product formed is
 - a) o aminoacetophenone
 - b) m-aminoacetophenone
 - c) p aminoacetophenone
 - d) acetanilide

[Ans. (d) acetanilide]

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- 22. Ammonium salt of benzoic acid is heated 725. The major product of the following reaction strongly with P2O5 and the product so formed is reduced and then treated with NaNO₂ / HCl at low temperature. The final compound formed is
 - a) Benzene diazonium chloride
 - b) Benzyl alcohol
 - c) Phenol
 - d) Nitrosobenzene [Ans. (b) Benzyl alcohol]
- **23**. Identify X in the sequence given below.

$$\begin{array}{c}
NH_2 \\
\hline
CHCl_3 \\
KOH
\end{array}$$
(Y) \xrightarrow{HCl} X + methanoic acid

a)
$$H_2N$$
—Cl

c)
$$N \equiv C - CI$$

d)
$$CH_3 - NH - CI$$

[Ans. (a)
$$H_2N$$
—C1]

24. Among the following, the reaction that proceeds through an electrophilic substitution is:

a)
$$N_2\tilde{Cl} \xrightarrow{Cu_2Cl_2} Cl+N_2$$

$$d)$$
 NH_2

SHORT ANSWER QUESTIONS

- Write down the possible isomers of the C₄H₉NO₂ give their IUPAC names.
- Ans. The compounds with molecular formula C₄H₉NO, are,
 - CH₂CH₂CH₂-NO, 1-nitrobutane
 - CH₃CHCH₂ NO₂ CH₂ 2-methyl -1-nitropropane
 - (iii) CH,CHCH,CH, 2-nitrobutane
 - CH, (iv) $CH_3 - C - NO_2$ CH₃ 2-methyl-2-nitro propane
 - $CH_3CH_2CH_2CH_3-O-N=O$ butyl nitrite

$$\begin{array}{c|c} & CH_3CI \\ \hline & AlCl_3 \end{array} \qquad A \begin{array}{c} & HNO_3 / H_2SO_4 \\ \hline & & & \\ & & \\ & & & \\$$

$$\begin{array}{c|c} Sn/HCl & C & \begin{array}{c} NaNO_2/HCl \\ \hline & 0^{\circ}C \end{array} & D & \begin{array}{c} CuCN \\ \hline \end{array}$$

(Major Product)

Ans.

$$\begin{array}{c|c} CH_3 & CH_3 \\ \hline CH_3Cl & Conc HNO_3 \\ \hline AlCl_3 & Conc H_2SO_4 \\ \hline Toluene & Ortho nitro \\ \hline Toluene & Toluene \\ \end{array}$$

$$\begin{array}{c} & & \text{Sn / HCl} \\ \hline \text{CH}_3 \\ \text{N = N-Cl} \\ \hline \text{OD} \\ \text{O - Toluenediazonium} \\ \text{Chloride} \\ \end{array}$$

- Write all possible isomers for the following compounds.

o - Cyanotoluene

- $C_{2}H_{5} NO_{2}$ (ii) $C_{3}H_{7} NO_{2}$
- Ans. (i) CH₃CH₂-NO₃ nitroethane CH₂- CH₂-O-N=O - ethylnitrite
 - (ii) CH₃CH₂CH₂-NO₂ 1-nitropropane $CH_3 - CH - CH_2 - 2nitropropane$ NO, CH₃-CH₂-CH₂-O-N=O - Propylnitrite

- Find out the product of the following reactions.
 - $CH_3CH(Cl)COOH \xrightarrow{i) NaNO_2} ?[X]$
 - (ii) $CH_3CH_2 Br + NaNO_2 \xrightarrow{alcohol/\Delta} [Y]$
- Ans. (i) $CH_3 CH$ (Cl) $COOH \xrightarrow{\text{(i) NaNO}_2}$ (ii) H_2O/Δ
 - $CH_3 CH_2NO_2 + CO_2 + NaCl$ nitroethane
 - (ii) $CH_3 CH_2 Br + NaNO_2 \xrightarrow{alcohol}$
 - $CH_3 CH_2NO_2 + CO_2 + NaBr$ nitroethane
- Predict the major product that would be obtained on nitration of the compounds
 - Con H₂ SO₄+Con.HNO₃ СООН
 - CH₃ NO2Con H2SO4+Con.HNO3_9
 - CH_3 i) acid Na₂Cr₂O₇ (iii) NO_2
- Ans. (i) CH, CH, Con.H,SO, + Con.HNO COOH 2, nitro - m- toluic acid
 - (ii) NO₂ Con H₂ SO₄ +Con.HNO₃

Additional Questions and Answers

CHOOSE THE CORRECT ANSWER

1 MARK

 $CH_{2}OH$ CH,OH

The above structure represents

- a) Vitamin B₁₂
- b) Vitamine B₆
- c) dopamine
- d) Histamine

[Ans. (b) Vitamin B₆]

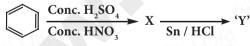
- Nitration of nitrobenzene results in
 - a) o-dinitrobenzene
 - b) 1,3,5 trinitrobenzene
 - c) m-dinitrobenzene
 - d) p-dinitrobenzene

[Ans. (c) m-dinitrobenzene]

- Which among the following reactions will give a secondary amine?
 - a) CH₃CONH₂ Br₂/KOH
 - b) CH₃CONH₂ LiAlH₄
 - c) CH₃CN Na/C₂H₅OH
 - d) $CH_3NC \xrightarrow{LiAlH_4}$

[Ans. (d) $CH_3NC \xrightarrow{LiAlH_4}$]

Identify product 'Y' in the following reaction

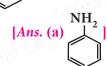












- **5**. Electrolytic reduction of nitrobenzene in strongly acidic medium gives
 - a) aniline
- b) p aminophenol
- c) m-nitroaniline
- d) azoxybenzene

[Ans. (b) p - aminophenol]

- $(CH_3)_2$ CH NO when boiled with HCIH,O gives compound 'X'. Identify 'X'.
 - a) CH₂COOH
- b) $(CH_3)_2C = O$
- c) CH₃CHO
- d) CH₃NO₂

[Ans. (b) $(CH_3)_2C=O$]

- Ethylamine on heating with CS, in the presence of HgCl, forms
 - a) C₂H₅NCS
- b) C₂H₅CN
- c) C_2H_5NS
- d) $(C_2H_5)_2S$

[Ans. (a) C₂H₅NCS]

- Which of the following cannot be prepared by Sandmeyer's reaction?
 - a) Iodobenzene
- b) Fluorobenzene
- c) both (a) and (b)
- d) neither (a) nor (b)

[Ans. (c) both (a) and (b)]

Identify the product of the following reaction. $CH_3Mg Br + Cl - CN \rightarrow \underline{?}$

a) ethanenitrile

- b) acetamide
- c) propanenitrile
- d) acetaldoxime

[Ans. (a) ethanenitrile]

- 10. Positive carbylamine test is not shown by?
 - a) methyl amine
- b) aniline
- c) N-ethyl aniline
- d) triethyl amine

[Ans. (d) triethyl amine]

- 11. The gas leaked from storage tank of the union Carbide plant in Bhopal gas tragedy was
 - a) Phosgene
 - b) methyl isocyanide
 - c) methyl isocyanate
 - d) methyl isothiocyanide

[Ans. (c) methyl isocyanate]

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6.

4.	LIST - I		LIST - II		
	A	Ethanamine	i)	azo dye test	
	В	Diethyl amine	ii)	Gabriel phthalimide reaction	
	C	Trimethyl amine	iii)	Liebermann nitroso reaction	
	D	Phenyl amine	iv)	Does not react with Grignand reagent	

- A B C
 (a) (ii) (iii) (iv)
- (a) (ii) (iii) (iv) (i) (b) (iii) (i) (iv) (ii)
- (c) (iv) (i) (iii) (ii)
- (d) (i) (iv) (ii) (iii) (iii)

[Ans. (a) (ii), (iii), (iv), (i)]

CILIE TO

5.

. (LIST - I	LIST - II		
A	$\begin{array}{c} NO_2 \\ CH_3 - CH - CH_3 \end{array}$	i)	2-nitro- 2-methyl propane	
В	CH ₃ - CH - CH ₂ - NO ₂	ii)	1-nitro-2- 2-dimethyl propane	
C	CH ₃ CH ₃ CH ₂ - NO ₂ CH ₃	iii)	1-nitro- 2-methyl propane	
D	CH ₃ CH ₃ CH ₃ - C - CH ₃ NO ₂	iv)	2-nitro propane	

- A B C D
- **(a)** (iv) (iii) (ii) (i)
- **(b)** (ii) (iv) (i) (iii)
- (c) (iii) (ii) (iv) (i)
- (d) (iv) (i) (iii) (ii)

[Ans. (a) (iv), (iii), (ii), (i)]

LIST - I		LIST - II		
A	$CH_3 - NO_2$	i)	2-amino propane	
В	CH ₃ – CH – CH ₃ NH ₂	ii)	Benzyl amine	
C	C ₆ H ₅ - CH ₂ - NH ₂	iii)	Propane nitrile	
D	CH ₃ CH ₂ CN	iv)	Nitro methane	

- A B C D
- (a) (iv) (iii) (ii) (i)
- **(b)** (iii) (ii) (i) (iv)
- (c) (ii) (iv) (iii) (i)
- (d) (iv) (i) (ii) (iii)

[Ans. (d) (iv), (i), (ii), (iii)]

- LIST I LIST - II **7**. Diazonium **TNT** i) Acrylonitrile ii) Azo dyes PAN Aniline iii) D Nitro benzene iv) Sulpha drugs
 - A B C D
 - (a) (ii) (iii) (iv) (i) (b) (iv) (iii) (ii) (i)
 - (c) (ii) (iv) (i) (iii)
 - (d) (iii) (ii) (iv) (i)

[Ans. (a) (ii), (iii), (iv), (i)]

2 MARKS

VERY SHORT ANSWER

1. Give the IUPAC name of the following compounds.

ii)
$$CH_2 - CH_2 - NO_2$$

Ans. (i) 2 – nitro – 1– methyl benzene

(ii) 2 – Phenyl – 1 – nitroethane

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60. In the given set of reactions, 2 bromopropane

$$\xrightarrow{\text{Alc. AgCN}} \text{'X'} \xrightarrow{\text{LiAlH}_4} \text{'Y'. Identify}$$

the product Y and give its IUPAC name.

SHORT ANSWER

3 MARKS

1. Write a note on acidic nature of nitroalkanes. Ans. Acidic nature of nitro alkanes:

- (i) The α-H atom of 1° & 2° nitroalkanes show acidic character because of the electron with drawing effect of NO₂ group.
- (ii) These are more acidic than aldehydes, ketones, ester and cyanides.
- (iii) Nitroalkanes dissolve in NaOH solution to form a salt.
- (iv) Aci nitro derivatives are more acidic than nitro form.
- (ν) When the number of alkyl group attached to α carbon increases, acidity decreases, due to +I effect of alkyl groups.

$$CH_3 - NO_2 > CH_3CH_2 - NO_2 > CH_3 > CH-NO_2$$
 4.

2. How are nitro alkanes prepared for the following

- i) alkyl bromides
- ii) methane
- Ans. (i) Alkyl bromides (or) iodides on heating with ethanolic solution of potassium nitrite gives nitroethane.

$$\begin{array}{c} \text{CH}_{3}\text{CH}_{2} - \text{Br} + \text{KNO}_{2} \xrightarrow{\text{ethanol}/\Delta} \\ \text{Ethyl bromide} \\ \text{CH}_{3}\text{CH}_{2} - \text{NO}_{2} + \text{KBr} \\ \text{Nitroethane} \end{array}$$

The reaction follows SN₂ mechanism.

(ii) Gaseous mixture of methane and nitric acid passed through a red hot metal tube to give nitromethane.

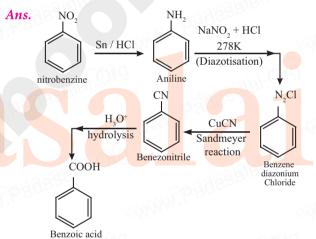
$$CH_{4(g)}^{+} + HNO_{3(g)} \xrightarrow{Red \text{ hot Si tube}} CH_{3}^{-} - NO_{2}^{+} + H_{2}O$$

Methane

Except methane, other alkanes (upto n– hexane) give a mixture of nitroalkanes due to C-C cleavage. The individual nitro alkanes can be separated by fractional distillation.

$$CH_3 - CH_3 + HNO_3 \xrightarrow{675 \text{ K}} CH_3 CH_2 - NO_2 + -$$
Ethane
Nitroethane(73%)
$$CH_3NO_2 \xleftarrow{}$$
Nitromethane (27%)

3. How will convert nitrobenzene to benzoic acid?



4. Write a note on the basicity of amines.

- Ans. (i) The nitrogen in amines possess an unshared pair of electrons (Lone Pair).
 - (ii) The lone pair of electrons is available for the formation of a new bond with a proton or lewis acid.
 - (iii) Thus amines are basic in nature and they react with acids to form salts.
 - (iv) The greater is the number of electron releasing alkyl groups, the greater the availability of nitrogen's lone pair and stronger the base.

$$NH_3 < CH_3 - NH_2 < CH_3 - NH - CH_3$$

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- 13. Starting from the following reagents, how will your prepare ethanenitrile.
 - i) CH₂Br
 - ii) CH₃CONH₂
 - iii) CH₃CH=NOH
- Aryl cyanide cannot be prepared in this method because of their less reactivity towards nucleophilic substitution. Aryl cyanides are prepared using Sandmeyers reactions.

$$\begin{array}{ccc} KCN & + CH_3 - Br & \longrightarrow & CH_3 - CN + KBr \\ & & & \text{methyl bromide} \end{array}$$

By dehydration of primary amides and aldoximes with P2O5

$$\begin{array}{c} \text{CH}_3 - \text{CONH}_2 \xrightarrow{P_2O_5} & \text{CH}_3 - \text{CN} \\ \text{Acetamide} & -\text{H}_2O & \text{Ethanenitrile} \end{array}$$

(iii)
$$CH_3-CH=NOH \xrightarrow{P_2O_5} CH_3-CN$$
Acetaldoximes $-H_2O$
Ethanenitrile

14. An organic compound 'A' on reduction gives compound 'B' which on reaction with trichloromethane and caustic potash forms 'C'. Compound 'C' on catalytic reduction given N-methyl benzenamine. Identify A, B and C and write the reactions involved.

Ans.

- $A C_6H_5NO_2$ Nitro benzene
- (ii) $B C_6H_5NH_2 Aniline$
- (iii) C C₆H₅NC Phenyl Carbylamine

Long Answer

5 MARKS

- Write a note on the 'reduction of nitro benzene under different conditions.
- Ans. (i) Strongly Acidic Medium: When reduced with tin and hydrochloric acid, aromatic nitro compounds are converted to aryl

$$C_6H_5NO_2 + 6[H] \xrightarrow{Sn/con.HCl} C_6H_5NH_2 + 2H_2O$$
Fe/con.HCl
Aniline

Neutral Medium: When reduced with a neutral, reducing agents like zinc dust and aqueous ammonium chloride, aromatic nitro compounds form aryl hydroxylamines.

$$\begin{array}{c} {\rm C_6H_5NO_2+4[H]} \xrightarrow{Zn/{\rm NH_4Cl}} {\rm C_6H_5NHOH+H_2O} \\ \\ {\rm Phenyl\ hydroxylamine} \end{array}$$

(iii) Alkaline Medium: In alkaline medium, Nitro benzene on reduction forms the intermediate products nitrosobenzene (C₆H₅NO) and phenyl hydroxylamine (C₆H₅NHOH). These undergo bimolecular condensation reaction. According to the appropriate reducing agent in alkaline medium different products are obtained.

$$C_{6}H_{5}NO_{2} \xrightarrow{Na_{3}AsO_{3}/NaOH} C_{6}H_{5} - N = N - C_{6}H_{5}$$
or glucose + NaOH
$$C_{6}H_{5}NO_{2} \xrightarrow{azoxy benzene} C_{6}H_{5} - N = N - C_{6}H_{5}$$

$$C_{6}H_{5}NO_{2} \xrightarrow{azo benzene} C_{6}H_{5} - NH - NH - C_{6}H_{5}$$

$$C_{6}H_{5} - NH - NH - C_{6}H_{5}$$

Catalytic Reduction Lithium **Aluminium hydride** is a powerful hydride ion donor. So it reduces nitro benzene to Aniline. This reduction can also be carried out by H₂/Ni.

$$\begin{array}{c} C_6H_5NO_2 \xrightarrow{\quad LiAlH_4\quad} C_6H_5NH_2 \text{ [Aniline]} \\ \\ C_6H_5NO_2 \xrightarrow{\quad H_2/Ni\quad} C_6H_5NH_2 \\ \xrightarrow{\quad LiAlH_4\quad} C_6H_5NH_2 \end{array}$$

Electrolytic Reduction: When nitro benzene is reduced electrolytically in presence of concentrated sulphuric acid,

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$$\begin{array}{c} \stackrel{NH_2}{\longrightarrow} \stackrel{NH_3}{\longrightarrow} \stackrel{NO_2^+}{\longrightarrow} \stackrel{NNO_3^+}{\longrightarrow} \stackrel{NO_2^+}{\longrightarrow} \stackrel{NO_2^+}{\longrightarrow} \stackrel{NO_2^-}{\longrightarrow} \stackrel$$

p-nitro aniline is prepared in the following three stages.

$$\begin{array}{c|c}
NH_2 & NHCOCH_3 & NHCOCH_3 \\
\hline
CH_3COCI & HNO_3/H_2SO_4 & NO_2
\end{array}$$

$$\begin{array}{c|c}
NH_2 & NHCOCH_3 & NHCOCH_3 \\
\hline
NO_2 & NH_2 & NO_2
\end{array}$$

Aniline reacts with acetyl chloride and acetic anhydride to form corresponding amides called anilides.

$$\begin{split} &C_6H_5NH_2 + CICOCH_3 \longrightarrow C_6H_5NHCOCH_3 + HCl\\ &Aniline \quad Acetylchloride \qquad Acetanilide \\ &C_6H_5NH_2 + CH_3COOCOCH_3 \longrightarrow C_6H_5NHCOCH_3\\ &\quad Acetanilide \\ &\quad + CH_3COOH \end{split}$$

HOTS

Cu SO₄ on mixing with NH₃ (1:4 ratio) does not give test for Cu2+ ions but gives test for SO_4^{2-} ions. Why?

Ans. It is because when NH₃ coordinates to Cu²⁺ ions and it forms the complex [Cu (NH₃)₄]SO₄ copper ions are present in coordination sphere, therefore they are non-ionisable whereas SO_4^{2-} ions are counter ions which are ionisable.

UNIT TEST

Marks: 25 Time: 40 min

CHOOSE THE CORRECT ANSWER

1.
$$C_6H_5NO_2 \xrightarrow{Fe/HC1} A \xrightarrow{NaNO_2/HC1} B \xrightarrow{H_2O} C$$

'C' is

a) C₆H₅ - OH b) C₆H₅ - CH₂OH c) C₆H₅ - CHO d) C₆H₅NH₂

$$\begin{array}{c}
C \longrightarrow N \\
+ CH_3MgBr \xrightarrow{H_3O^+} P
\end{array}$$

Product 'P' in the above reaction is

Assertion(A): Methyl cyanide has higher boiling point than methyl isocyanide.

Reason (R): Dipole moment of methyl cyanide is higher than that of methyl iso cyanide.

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

Choose the incorrect statement among the following

- a) Primary amine show intermolecular bond
- b) Isopropyl amine is a secondary amine
- c) Amines are basic in nature
- d) Tertiary amines do not show intermolecular hydrogen bonds

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Match the list - I with list - II and select the TIII. SHORT ANSWER correct answer using the code given below the list:

12	LIST - I	مرد	LIST - II
A	CH ₃ NO ₂	i)	2–Phenyl–1 nitro ethane
В	$CH_2 - CH_2 - NO_2$	ii)	Phenyl Carbylamine
C	CH ₂ NH ₂	iii)	2-nitro-1-methyl benzene
D	NC	iv)	Phenyl methanamine

- C A B D
- (a) (iv) (i) (ii) (iii)
- **(b)** (iii) (i) (iv) (ii)
- (c) (iv) (iii) (ii)(i)
- **(d)** (iii) (ii)(i) (iv)
- VERY SHORT ANSWER

$$(2 \times 2 = 4)$$

- How will you convert diethylamine into
 - N, N diethylacetamide
 - ii) N nitrosodiethylamine
- Complete the following:

 $(2 \times 3 = 6)$

- How can the following conversion be effected?
 - Nitrobenzene to anisole i)
 - chloro benzene to phenyl hydrazine
 - Aniline to benzoic acid iii)
 - Benzene diazonium chloride to ehtyl benzene.
- How will you distinguish between primary secondary and tertiary alphatic amines.

IV. Long Answer

 $(2 \times 5 = 10)$

- Write a note on (i) Carbylamine reaction (ii) Mustard oil reaction (iii) Acetylation of benzylamine (iv) Formation of Schiff's base (v) Diazotisation reaction.
- Account for the following
 - Aniline does not undergo Friedel -Crafts reaction
 - Diazonium salts of aromatic amines ii. are more stable than those of aliphatic
 - pK_b of aniline is more than that of iii. methylamine
 - Gabriel phthalimide synthesis preferred for synthesising primary amines.
 - Ethylamine is soluble in water whereas aniline is not
 - Amines are more basic than amides vi.
 - vii. Although amino group is o and p - directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m - nitroaniline.

Answer Key

$$\begin{array}{c|c} & & \\ & C & - CH_3 \end{array}$$

- 1. (a) $C_6H_5 OH$
 - **3.** (a) (A) and (R) are true and (R) is the correct explanation of (A)
 - **4.** (b) Isopropyl amine is secondary amine
- **5.** (b) (iii), (i), (iv), (ii)
- 1. Refer Sura's Guide Page Book back Q.No. 12.
- 2. Refer Sura's Guide Additional 2 marks Q.No. 7.
- III. 1. Refer Sura's Guide Additional 3 marks Q.No. 8.
- 2. Refer Sura's Guide Book back Q.No. 7.
- IV. 1. Refer Sura's Guide Additional 5 marks Q.No. 10.
- 2. Refer Sura's Guide Book back Q.No. 8.
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BIOMOLECULES

CHAPTER SNAPSHOT

14.1	Carbohy	drates		14.2.9	Enzymes
	14.1.1	Configuration of		14.2.10	Mechanism of enzyme
		carbohydrates			action
	14.1.2	Classification of carbohydrates	14.3	Lipids	
	14.1.3	Glucose		14.3.1	Classifi cation of lipids
	14.1.4			14.3.2	Biological importance of
		Disaccharides	70~		lipids
	14.1.6	Polysaccharides	14.4	Vitamin	
	14.1.7	Importance of		14.4.1	Classification of vitamins
		carbohydrates	14.5	Nucleic	
14.2	Proteins			14.5.1	Composition and structure of nucleic acids
	14.2.1	Amino acids		1450	
	14.2.2	Classification of α-amino		14.5.2	Double strand helix structure of DNA
	1422	acids		14.5.3	
	14.2.3	Properties of amino acid			Types of RNA molecules
	14.2.4 14.2.5	Peptide bond formation Classification of proteins		14.5.4	DNA fi nger printing
	14.2.6	Structure of proteins		14.5.5	Biological functions of nucleic acids
	14.2.7	Denaturation of proteins		1456	
	Milana a a	Importance of proteins		14.5.6	Hormones



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EVALUATION

Choose The Correct

Which one of the following rotates the plane polarized light towards left?

(NEET Phase – II)

- a) D(+) Glucose
- b) L(+) Glucose
- c) D(-) Fructose
- d) D(+) Galactose

[Ans. (c) D(-) Fructose]

- The correct corresponding order of names of four aldoses with configuration given below Respectively is (NEET Phase – I)
 - a) L-Erythrose, L-Threose, L-Erythrose, D-Threose
 - b) D-Threose, D-Erythrose, L-Threose, L-Erythrose,
 - c) L-Erythrose, L-Threose, D-Erythrose, D-Threose
 - d) D-Erythrose, D-Threose, L-Erythrose, L-Threose [Ans. (d) D-Erythrose, D-Threose, L-Erythrose, L-Threose
- Which one given below is a non-reducing sugar? (NEET Phase – I)
 - a) Glucose
- b) Sucrose
- c) maltose
- d) Lactose

[Ans. (b) Sucrose]

- (HCN) **Product** (hydrolysis) Glucose Product (HI + Heat) A, the compound A is
 - a) Heptanoic acid
- b) 2-Iodohexane
- Heptane
- d) Heptanol

[Ans. (a) Heptanoic acid]

A solution of sucrose in **Assertion:** water is dextrorotatory. hydrolysis But on the presence of little hydrochloric acid,

becomes

(AIIMS)

levorotatory.

Reason : Sucrose hydrolysis gives unequal amounts of glucose and fructose. As a result of this change in sign of rotation is observed.

- a) If both assertion and reason are true and reason is the correct explanation of assertion
- b) If both assertion and reason are true but reason is not the correct explanation of assertion
- c) If assertion is true but reason is false.
- d) If both assertion and reason are false.

[Ans. (c) assertion is true but reason is false.

- The central dogma of molecular genetics states that the genetic information flows from (NEET Phase – II)
 - a) Amino acids, Protein, DNA
 - b) DNA, Carbohydrates, Proteins
 - c) DNA, RNA, Proteins
 - d) DNA, RNA, Carbohydrates

[Ans. (c) DNA, RNA, Proteins]

- In a protein, various amino acids linked together by (NEET Phase - I)
 - a) Peptide bond
- b) Dative bond
- c) α Glycosidic bond d) β Glycosidic bond [Ans. (a) Peptide bond]
- Among the following the achiral amino acid is (AIIMS)
 - a) 2-ethylalanine
 - b) 2-methylglycine
 - c) 2-hydroxymethylserine
 - d) Tryptophan

[Ans. (c) 2-hydroxymethylserine]

- The correct statement regarding RNA and DNA respectively is (NEET Phase – I)
 - the sugar component in RNA is an arabinos and the sugar component in DNA is ribose
 - sugar component in RNA 2'-deoxyribose and the sugar component in DNA is arabinose

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- 20. Glucose is an aldose. Which one of the following reactions is not expected with glucose?
 - a) It does not form oxime
 - b) It does not react with Grignard reagent
 - c) It does not form osazones
 - d) It does not reduce tollens reagent

[Ans. (b) It does not react with Grignard reagent]

- 21. If one strand of the DNA has the sequence 'ATGCTTGA', then the sequence of complementary strand would be
 - a) TACGAACT
- b) TCCGAACT
- c) TACGTACT
- d) TACGRAGT

[Ans. (a) TACGAACT]

- 22. Insulin, a hormone chemically is
 - a) Fat
- b) Steroid
- c) Protein
- d) Carbohydrates

[Ans. (c) Protein]

- **23**. α -D (+) Glucose and β -D (+) glucose are
 - a) Epimers
 - b) Anomers
 - c) Enantiomers
 - d) Conformational isomers

[Ans. (b) Anomers]

- **24.** Which of the following are epimers
 - a) D(+)-Glucose and D(+)-Galactose
 - b) D(+)-Glucose and D(+)-Mannose
 - c) Neither (a) nor (b)
 - d) Both (a) and (b)

Ans. (a) D(+)-Glucose and D(+)-Galactose

- 25. Which of the following amino acids are achiral?
 - a) Alanine
- b) Leucine
- c) Proline
- d) Glycine

[Ans. (d) Glycine]

SHORT ANSWER QUESTIONS

- 1. What type of linkages hold together monomers of DNA?
- **Ans.** The DNA double helix or duplex is held together by two forces,
 - (i) Hydrogen bonding between complementary base pairs
 - (ii) Base-stacking interactions

The complementary between the DNA strands is attributable to the hydrogen bonding between base pairs but the base stacking interactions are largely non-specific, make the major contribution to the stability of the double helix.

2. Give the differences between primary and secondary structure of proteins.

Ans.

•		
	Primary structure	Secondary structure
	The relative	The amino acids in
	arrangement of the	the polypeptide chain
	amino acids in the	forms highly regular
	polypeptide chain	shapes (α-Helix and
		β-strands)
	Primary structure of	Sub structures are
	a protein is started	formed through
	from the amino	the hydrogen bond
	terminal (N) end to	between the carbonyl
	the carboxyl terminal	oxygen and the
	(C) end.	neighboring aminl
	19.20.	hydrogen.

Name the Vitamins whose deficiency cause.
 i) rickets ii) scurvy

Ans.

0,00	Diseases	Deficiency		
i)	Rickets	Vitamin D		
ii)	Scurvy	Vitamin C		

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Additional Questions and Answers

CHOOSE THE CORRECT ANSWER

1 MARK

- Which among the following is called fruit sugar?
 - a) Glucose
- b) Fructose
- c) Sucrose
- d) Maltose

[Ans. (b) Fructose]

- Disaccharides have general formula
 - a) $C_n(H_2O)_n$
- b) $(CO_2)_n H_n$
- c) $C_n(H_2O)_{n-1}$
- d) $C_n(H_2O)_{2n-1}$

[Ans. (c) $C_n(H_2O)_{n-1}$]

- Name the base present only in RNA
 - adenine
- b) guanine
- uracil
- d) thymine

[Ans. (c) uracil]

- Which is a monosaccharide among the following?
 - a) Sucrose
- b) Cellulose
- Maltose
- d) Glucose

[Ans. (d) Glucose]

- Identify the reducing sugar.
 - Sucrose
- b) Cellulose
- Starch
- d) Glucose

[Ans. (d) Glucose]

- Sucrose is not
 - a) a di-saccharide
 - b) a non-reducing sugar.
 - c) hydrolysed to only glucose
 - d) hydrolysed to glucose & fructose

[Ans. (c) hydrolysed to only glucose]

- Sucrose contains glucose and fructose linked
 - a) $C_1 C_1$
- b) $C_1 C_2$
- c) $C_1 C_4$

d) $C_1 - C_6$ [Ans. (b) $C_1 - C_2$]

- Glucose is not oxidised to gluconic acid by
 - a) Br₂/H₂O
- b) Fehling's solution
- c) Tollen's reagent
- d) Conc. HNO₃

[Ans. (d) Conc. HNO₃]

- Inversion of sucrose refers to
 - a) oxidation of sucrose
 - b) reduction of sucrose
 - c) hydrolysis of sucrose to glucose and fructose
 - d) polymerisation of sucrose.

[Ans. (c) hydrolysis of sucrose to glucose and fructose

- 10. The amino acid without chiral carbon is
 - a) Glycine
- b) Alanine
- Proline c)
- d) Tyrosine

[Ans. (a) Glycine]

- 11. The building block of proteins are
 - a) α hydroxy acids b) α amino acids
 - c) β hydroxy acids
 - d) β amino acids

[Ans. (b) α - amino acids]

- 12. Which is not true of amino acid?
 - a) amino acid forms zwitter ion
 - b) has isoelectric point
 - c) dual behaviours
 - amino acid is insoluble in NaOH solution

[Ans. (d) amino acid is insoluble in NaOH solution

- 13. Two amino acids say A, B react to give
 - a) two dipeptides
- b) three dipeptides
- c) four dipeptides
- d) only one

[Ans. (d) only one]

- **14.** A dipeptide does not have
 - a) two peptide units
 - b) portions of two amino acids
 - an amino group
 - salt like structure

[Ans. (a) two peptide units]

Biomolecules

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7 .	LIST - I		LIST - II	
	A	Glucose	i)	Cell walls
	В	Fructose	ii)	Barley sugar
	C	Sucrose	iii)	Grape sugar
	D	Cellulose	iv)	Fruit sugar

- A B C D
- (a) (iv) (iii) (ii) (i)
- **(b)** (iii) (iv) (ii) (i)
- (c) (iii) (i) (iv) (ii)
- (d) (ii) (iv) (i) (iii)

[Ans. (b) (iii), (iv), (ii), (i)]

VERY SHORT ANSWER

2 MARKS

- List the expected products of hydrolysis of lactose.
- **Ans.** Lactose is a dissaccharide so on hydrolysis gives two monosaccharides.

$$\begin{array}{c} C_{12}H_{22}O_{11}+H_2O \xrightarrow{\quad H^+ \quad} C_6H_{12}O_6 + C_6H_{12}O_6 \\ \\ Lactose \quad D(+)Glucose \quad D(+)Galactose \end{array}$$

2. $6CO_2 + 6H_2O \xrightarrow{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$ Name the above process.

Ans. Photosynthesis.

3. Identify whether the following compounds are D or L isomers.

- Ans. (i) D isomer
 - (ii) L isomer.

- 4. A sugar contains 4 carbon atoms and the functional group is -CHO group. Identify the type of sugar and give an example for it.
- *Ans.* The type of sugar that contains 4 carbon atoms and –CHO group is Aldotetrose. Example of Aldotetrose is Erythrose.
- **5.** What is epimerisation?
- **Ans.** The process by which one epimer is converted into other is called **epimerisation** and it requires the enzymes epimerase. Galactose is converted to glucose by this manner in our body.
- 6. Give the major and minor product when glucose is reduced with Conc. HI/P.
- Ans. On reduction with concentrated HI and red phosphorus at 373K, glucose gives a mixture of n hexane and 2, iodohexane indicating that the six carbon atoms are bonded linearly.

Glucose
$$\xrightarrow{\text{HI}/P}$$
 CH₃ \leftarrow CH₂ $\xrightarrow{1}$ CH₃ + CH₂ \leftarrow CH₂ $\xrightarrow{1}$ CH \rightarrow CH₃

I

n-hexane

Major product

2-iodohexane

Minor product

- 7. What is meant by blood sugar?
- Ans. Human blood contains about 100 mg/ dL of glucose, hence it is also known as blood sugar.
- 8. What are anomers? Give example.
- Ans. Anomers are cyclic monosaccharide differing from each other in the configuration of C_1 if they are aldoses or in the configuration of C_2 if they are ketoses.

E.g. α and β D - glucose.

- 9. What are epimers?
- *Ans.* Sugar differing in configuration at an asymmetric centre is known as **epimers**.
- **10.** How is fructose prepared from inulin?
- *Ans.* Fructose is prepared commercially by hydrolysis of Inulin (a polysaccharide) in acidic medium.

$$(C_6H_{12}O_5)_n + nH_2O \xrightarrow{H^+} nC_6H_{12}O_6$$
Inulin Fructose

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SHORT ANSWER

3 MARKS

- Explain the reaction which indicates the presence of ketonic group in fructose.
- Oxidation of fructose yields a mixture of glycollic acid and tartaric acid.
 - When fructose is treated with HCN, it forms an addition product which upon hydrolysis and subsequent reduction with hydroiodic acid and red phosphorous gives 2-methyl-hexanoic acid.

This indicates that the ketone group is adjacent to one of the terminal carbon

- 2. What are amino acid? Explain essential and non-essential amino acids.
- Ans. (i) An amino acid is bifunctional organic molecule that contains both a carboxyl group, -COOH as well as an amine group, -NH₂.
 - Those amino acids that cannot be synthesised by the body and must be supplied in the diet are called essential amino acids.
 - The amino acids that can be synthesised from other compounds by the tissues of the body are called non-essential amino acids.
- 3. Write the product formed when HCN reacts with glucose.
- *Ans.* Glucose reacts with HCN to form cyanohydrin.

- Write a reaction that indicates the presence of an aldehyde group in glucose.
- **Ans.** Glucose gets oxidized to gluconic acid with mild oxidizing agents like bromine water suggesting that the carbonyl group is an aldehyde group.

$$\begin{array}{c|cccc}
O & O & O & O \\
C - H & C - OH \\
H - OH & H - OH \\
H - OH & H - OH \\
H - OH & H - OH \\
CH_2OH & CH_2OH \\
D-Glucose & Gluconicacid \\
\end{array}$$

- Complete the following reaction.
 - Glucose + acetic anhydride → _
 - (ii) What does the above reaction suggest?

- Glucose forms penta acetate with acetic anhydride suggesting the presence of five alcohol groups.
- 6. Give the structure of α - D - glucose and β -D - glucose.

Ans.
$$CH_2OH$$
 CH_2OH CH CH_2OH CH_2OH

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23. Name the two components starch is made up of. How do they differ from each other.

Ans. Starch consist of two components amylose and amylopectin.

Amylose	Amylopectin	
It is linear condensation polymer	It is a highly branched polymer	
It is composed of unbranched chains of upto 4000 α -D glucose molecules	It contains chains upto 10000 α-D glucose molecules	
Water soluble	Insoluble in water	
With Iodine, it give blue colour	With Iodine, it gives a purple colour.	

24. Name two water soluble vitamins, their sources, function and diseases caused due to their deficiency in diet.

Ans.

Vitamin	Sources	Functions	Deficiency Disease	
Vitamin B ₁₂ (Cobalamin)	Egg, Meat, Fish	Co-enzyme in amino acid metabolism, Red blood cells maturation		
Vitamin C (Ascorbic acid)	Citrus fruits (Orange Lemon etc), Tomato Amla, Leafy Vegetables	Coenzyme in Antioxidant, building of collagen	Scurvy (bleeding gums)	

LONG ANSWER

5 MARKS

1. Give the uses of carbohydrates.

Ans. Importance of carbohydrates:

- (i) Carbohydrates, widely distributed in plants and animals, acts mainly as energy sources and structural polymers.
- (ii) Carbohydrate is stored in the body as glycogen and in plant as starch.
- (iii) Carbohydrates such as cellulose which is the primary components of plant cell wall, is used to make paper, furniture (wood) and cloths (cotton)
- (iv) Simple sugar glucose serves as an instant source of energy.
- (v) Ribose sugars are one of the components of nucleic acids.
- (vi) Modified carbohydrates such as hyaluronate (glycosaminoglycans) act as shock absorber and lubricant.

2. Elucidate the structure of glucose.

Ans. Structure of glucose: Glucose is an aldohexose. It is optically active with four asymmetric carbons. Its solution is dextrorotatory and hence it is also called as dextrose. The proposed structure of glucose is shown in the figure which was derived based on the following evidences.

D - (+)Glucose

Structure of D(+) glucose

- (i) Elemental analysis and molecular weight determination show that the molecular formula of glucose is $C_6H_{12}O_6$.
- (ii) On reduction with concentrated HI and red phosphorus at 373K, glucose gives a mixture of n hexane and 2, iodohexane indicating that the six carbon atoms are bonded linearly.

- I. Choose the Correct Answer $(5 \times 1 = 5)$
- 1. The central dogma of molecular genetics states that the genetic information flows from
 - a) Amino acids, Protein, DNA
 - b) DNA, Carbohydrates, Proteins
 - c) DNA, RNA, Proteins
 - d) DNA, RNA, Carbohydrates
- 2. Which of the following vitamin is water soluble?
 - a) Vitamin E
 - b) Vitamin K
 - c) Vitamin A
 - d) Vitamin B
- 3. The pyrimidine bases present in DNA are
 - a) Cytosine and Adenine
 - b) Cytosine and Guanine
 - c) Cytosine and Thiamine
 - d) Cytosine and Uracil
- 4. A dipeptide does not have
 - a) two peptide units
 - b) portions of two amino acids
 - c) an amino group
 - d) salt like structure
- **5.** Sugars that yield two to ten monosaccharide molecules on hydrolysis is
 - a) monosaccharides
 - b) disaccharides
 - c) oligosaccharides
 - d) polysaccharides

- II. VERY SHORT ANSWER
- $(2\times 2=4)$
- **1.** Write the Zwitter ion structure of alanine.
- **2.** What are hormones? Give examples.
- III. SHORT ANSWER

- $(2\times3=6)$
- **1.** Write a note on formation of α -helix.
- **2.** Write a short note on peptide bond.
- IV. Long Answer

- $(2 \times 5 = 10)$
- **1.** Give any three difference between DNA and RNA.
- **2.** Elucidate the structure if fructose.

Answer Key

- I. 1. c) DNA, RNA, Proteins
 - 2. d) Vitamin B
 - 3. c) Cytosine and Thiamine
 - **4.** a) two peptide units
 - **5.** c) oligosaccharides
- II. 1. Refer Sura's Guide Book back Q.No. 4.
 - 2. Refer Sura's Guide Book back Q.No. 13.
- III. 1. Refer Sura's Guide Book back Q.No. 18.
 - 2. Refer Sura's Guide Book back Q.No. 6.
- IV. 1. Refer Sura's Guide Book back Q.No. 5.
 - 2. Refer Sura's Guide Additional Q.No. 3.



CHEMISTRY IN EVERYDAY LIFE

CHAPTER SNAPSHOT

15.	Drug

15.1.1 Classification of drugs

15.1.2 Drug-target Interaction

15.2 Food additives

15.2.1 Important categories of food additives

15.2.2 Preservatives

15.2.3 Antioxidants

15.2.4 Sugar Substituents

15.2.5 Artificial sweetening agents

15.3 Cleansing agents

15.3.1 Soaps

15.3.2 Detergents

15.4 Polymers

15.4.1 Classification of Polymers

15.4.2 Types of polymerisation

15.4.3 Preparation of some important addition polymers

15.4.4 Co-polymers

15.4.5 Natural and Synthetic rubbers

15.4.6 Biodegradable Polymers

15.4.7 Co-polymers



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MUST KNOW DEFINITIONS

~~AA		navo navo
Drug	P.P	A drug is a substance that is used to modify or explore physiological systems or pathological states for the benefit of the recipient. It is used for the purpose of diagnosis, prevention, cure/relief of a disease.
Chemotherapy	:	The specific treatment of a disease using medicine is known as chemotherapy.
Antibiotics	P.P	The medicines that have the ability to kill the pathogenic bacteria are grouped as antibiotics.
Drug targets	:	The drug molecule interacts with biomolecules such as enzymes, receptors etc., which are referred as drug targets.
Competitive inhibitors	P.P	When a drug molecule that has a similar geometry (shape)as the substrate is administered, it can also bind to the enzyme and inhibit its activity. In other words, the drug acts as an inhibitor to the enzyme catalyst. This type of inhibitors are often called competitive inhibitors.
Allosteric inhibitors	P.P	In certain enzymes, the inhibitor molecule binds to a different binding site, which is commonly referred to as allosteric site, and causes a change in its active site geometry (shape). As a result, the substrate cannot bind to the enzyme. This type of inhibitors are called allosteric inhibitors.
Antagonists	:	A drug that binds to the receptor site should inhibit its natural function. Such drugs are called antagonists.
Agonists	00	Drugs which mimic the natural messenger by switching on the receptor. These type of drugs are called agonists.
Tranquilizers	N.T	They are neurologically active drugs.
Analgesics (Non – narcotic)	:	Analgesics reduce the pain without causing impairment of consciousness.
Local anaesthetics	:	It causes loss of sensation, in the area in which it is applied without losing consciousness. They block pain perception that is transmitted via peripheral nerve fibres to the brain
General anaesthetics	P.P	Cause a controlled and reversible loss of consciousness by affecting central nervous system
Antacids	:	Neutralize the acid in the stomach that causes acidity.
Antihistamines	03	Block histamine release from histamine-1 receptors.
Antimicrobials	: N .7	Inhibits bacterial cell wall biosynthesis

Targets bacterial ribosomes and prevent protein production

Macrolides



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EVALUATION

Choose The Correct

- Which of the following is an analgesic?
 - Streptomycin
- b) Chloromycetin
- Asprin
- d) Penicillin

[Ans. (c) Asprin]

- Dettol is the mixture of
 - a) Chloroxylenol and bithionol
 - b) Chloroxylenol and α-terpineol
 - c) phenol and iodine
 - d) terpineol and bithionol

[Ans. (b) Chloroxylenol and α-terpineol]

- Antiseptics and disinfectants either kill or prevent growth of microorganisms. Identify which of the following statement is not true.
 - a) dilute solutions of boric acid and hydrogen peroxide are strong antiseptics.
 - b) Disinfectants harm the living tissues.
 - c) A 0.2% solution of phenol is an antiseptic while 1% solution acts as a disinfectant.
 - Chlorine and iodine are used as strong disinfectants.

Ans. (a) dilute solutions of boric acid and hydrogen peroxide are strong antiseptics

- artificial Saccharin, an sweetener is manufactured from
 - cellulose
- b) toluene
- b) cyclohexene
- d) starch

[Ans. (b) toluene]

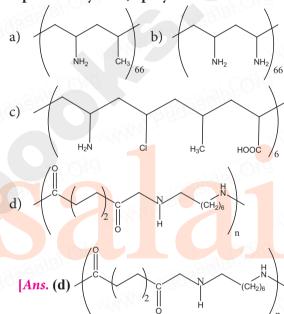
- Drugs that bind to the receptor site and inhibit its natural function are called
 - antagonists
- b) agonists
- enzymes
- d) molecular targets

[Ans. (a) antagonists]

- Aspirin is a/an
 - a) acetylsalicylic acid
 - b) benzoyl salicylic acid
 - chlorobenzoic acid
 - anthranilic acid

[Ans. (a) acetylsalicylic acid]

7. Which one of the following structures represents nylon 6,6 polymer?



- Natural rubber has
 - a) alternate cis- and trans-configuration
 - b) random cis- and trans-configuration
 - c) all cis-configuration
 - all trans-configuration

[Ans. (c) all cis-configuration]

- Nylon is an example of
 - a) polyamide
- b) polythene
- c) polyester
- d) poly saccharide

[Ans. (a) polyamide]

- **10.** Terylene is an example of
 - a) polyamide
- b) polythene
- c) polyester
- d) polysaccharide

[Ans. (c) polyester]

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SHORT ANSWER **O**UESTIONS

Which chemical is responsible for the antiseptic properties of dettol.

Ans. Dettol is a mixture of chloroxylenol and terpineol which imparts antiseptic properties to it.

What are antibiotics?

Ans. The medicines that have the ability to kill the pathogenic bacteria are grouped as antibiotics.

Examples:

Amoxicillin, ampicillin, cefixime, cefpodoxime, erythromycin, tetracycline etc..

Name one substance which can act as both analgesic and antiphyretic.

Ans. Aspirin act as both analgesic and antipyretic.

Write a note on synthetic detergents.

Ans. Synthetic detergents are products containing either sodium salts of alkyl hydrogen sulphates or sodium salts of long chain alkyl benzene sulphonic acids. There are three types of detergents.

Detergent Type	Example
Anionic detergent	Sodium Lauryl sulphate (SDS)
Cationic detergent	n-hexaadecyltrimethyl ammonium chloride
Non-ionic detergent	Pentaerythrityl stearate.

How do antiseptics differ from disinfectants?

Ans. (i) Antiseptics and disinfectants are chemicals which kill or present the growth of microorganisms.

The difference between them is antiseptics are applied to living tissues, such as wound, cuts etc whereas disinfectants are applied to in animate objects such as floors, drainage etc.

What are food preservatives?

Ans. (i) Preservatives are capable of inhibiting, retarding or arresting the process of fermentation, acidification or other decomposition of food by growth of microorganisms.

- (ii) Organic acids such as benzoic acid, sorbic acid and their salts are potent inhibitors of a number of fungi, yeast and bacteria.
- metasulphite (iii) Sodium is used preservatives for fresh vegetables and fruits.

Why soaps do not work in hard water?

Ans. Hard water contains salts of calcium and magnesium. When soaps are dissolved in hard water, these ions displace sodium and potassium from their salts and form insoluble calcium and magnesium salts of fatty acids. These insoluble salts separate as scum, Thus soaps do not work in hard water.

What are drugs? How are they classified.

A drug is a substance that is used to Ans. (i) modify or explore physiological systems or pathological states for the benefit of the recipient.

- It is used for the purpose of diagnosis, prevention, cure/relief of a disease.
- (iii) Drugs are classified based on their properties such as chemical structure, pharmacological effect, target system, site of action etc.

How the tranquilizers work in body?

Ans. Tranquilizers: They are neurologically active drugs. They act on the central nervous system by blocking the neurotransmitter dopamine in the brain

E.g. Haloperidol, clozapine.

10. Write the structural formula of aspirin.

Ans. Structural formula of aspirin (Acetyl salicylic acid) $C_0H_8O_4$

17. How is terylene prepared?

Ans. When ethylene glycol and terepathalic acid (or) dimethylterephthalate are mixed and heated at 500K in the presence of zinc acetate and antimony trioxide catalyst, terylene is formed.

Terylene (an polyester)

It is used in blending with cotton or wool fibres and as glass reinforcing materials in safety helmets.

18. Write a note on vulcanization of rubber.

Ans. (i) The process of mixing natural rubber with sulphur is called vulcanization.

- (ii) Natural rubber is mixed with 3-5% sulphur and heated at 100-150°C causes cross linking of the cis-1,4-polyisoprene chains through disulphide (-S-S-) bonds.
- (iii) The physical properties of rubber can be altered by controlling the amount of sulphur that is used for vulcanization.
- (iv) In sulphur rubber, made with about 1 to 3% sulphur is soft and stretchy.
- (*v*) When 3 to 10% sulphur is used the resultant rubber is somewhat harder but flexible.

19. Classify the following as linear, branched or cross linked polymers

- a) Bakelite b) Nylon c) polythene
- Ans. a) Bakelite Cross linked polymer
 - b) Nylon Linear polymer
 - c) polythene Linear or straight chain polymer.

20. Differentiate thermoplastic and thermosetting.

Ans. (i) Thermoplastic: They become soft on heating and hard on cooling. They can be remolded

E.g. polythene, PVC, polystrene

- (ii) Thermo setting: Do not be come soft on heating set to an infusible mass upon heating.
 - **E.g.** bakelite, melamine, formaldehyde

Additional Questions and Answers

CHOOSE THE CORRECT ANSWER 1 MARK

- 1. Ampicillin is an example of _____ drugs.
 - a) anaesthetic
- b) antibiotic
- c) tranquilizer
- d) none of the above

[Ans. (b) antibiotic]

- 2. Mental diseases like schizophrenia are treated using drugs.
 - a) tranquilizers
- b) antacid
- c) opioids
- d) NSAID

[Ans. (a) tranquilizers]

- 3. Antacids are
 - a) aluminium hydroxide
 - b) magnesium hydroxide
 - c) both (a) and (b)
 - d) neither (a) or (b)

[Ans. (c) both (a) and (b)]

- 4. Which among the following is a modification of penicillin?
 - a) amoxicillin
- b) catecholamine
- c) Crythromycin
- d) all the above

[Ans. (a) amoxicillin]

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5. Monomer and select the correct answer 2. using the code given below the lists.

8	E	xtra Mathch Polymer	Monomer		
Ī	A	HDPE	i)	Tetrafluoroethene	
Γ	В	Neoprene	ii)	Ethene	
Γ	C	Teflon	iii)	Vinyl cyanide	
9	D	PAN	iv)	Chloro prene	

- A B C D
- (a) (iii) (iv) (ii) (i)
- **(b)** (iv) (ii) (i) (iii)
- (c) (ii) (iv) (i) (iii)
- (d) (ii) (iii) (iv) (i)

[Ans. (c) (ii), (iv), (i), (iii)]

LIST - I LIST - II 6. Analgesics Treatment of stress B ii) Inhibits the Antacids growth of microorganisms C iii) **Tranquillisers Painkillers** iv) **Antibiotics** To treat the burning sensation of stomach

- A B C D
- (a) (iii) (i) (ii) (iv)
- **(b)** (iii) (iv) (i) (ii)
- (c) (iv) (ii) (i) (iii)
- (d) (iv) (iii) (i) (ii)

[Ans. (b) (iii), (iv), (i), (ii)]

VERY SHORT ANSWER

2 MARKS

1. What are competitive inhibitors?

- Ans. (i) When a drug molecule that has a similar geometry (shape)as the substrate is administered, it binds to the enzyme and inhibits its activity.
 - (ii) In other words, the drug acts as an inhibitor to the enzyme catalyst. These type of inhibitors are often called competitive inhibitors.

2. What are allosteric inhibitors?

- Ans. (i) In certain enzymes, the inhibitor molecule binds to a different binding site, which is commonly referred to as allosteric site, and causes a change in its active site geometry (shape).
 - (ii) As a result, the substrate cannot bind to the enzyme. This type of inhibitors are called allosteric inhibitors.

3. Explain the term target drug action used in medicinal chemistry?

Ans. Classification of drugs based on biological system or process, that target the recipient is called target drug action.

4. Give an example of a macromolecule chosen as drug targets.

Ans. Proteins.

5. Define the term chemotherapy.

Ans. The specific treatment of a disease using medicine is known as chemotherapy.

6. What are drug targets?

- Ans. The drug molecule interacts with biomolecules such as enzymes, receptors etc., which are referred as drug targets.
- 7. Name any two forces that are involved in holding the drugs to the active site of enzyme.
- *Ans.* (i) Hydrogen bonding
 - (ii) Vander waals force.

8. Explain the terms.

- (i) Antagonists drugs
- (ii) Agonist drugs.
- Ans. (i) Antagonists drugs: The drug that binds to the receptor site and inhibits its natural function are called antagonists.
 - (ii) Agonist drugs: The drugs which mimic the natural messenger by switching on the receptor are called agonist.

9. Name the substance used as an antiseptic as well as disinfectant.

Ans. Phenol is used as an antiseptic as well as a disinfectant. 0.2% of phenol is an antiseptic whereas 1% solution is a disinfectant.

41. Why lodoform and phenolic solutions are 3. called antiseptic?

- **Ans.** Because they render micro organisms innoccous by killing them or preventing their growth.
- **42.** Explain why chloroform is not used as an anaesthetic.
- **Ans.** With oxygen it forms a toxic carbonyl chloride. Hence it is not used an an anaesthetic.
- **43.** Explain the action of morphine as a pain killer.
- Ans. The agonist drug, morphine, is used as a pain killer, binds to the opioid receptors and activates them. This supress the neuro transmitters that causes pain.
- **44.** Name the antioxidant commonly used to increase the storage life of fats and oils.
- Ans. BHA (Butylated Hydroxy Anisole)

SHORT ANSWER

3 MARKS

- 1. Name some important categories of food additives.
- Ans. (i) Aroma compounds
 - (ii) Food colours
 - (iii) Preservatives
 - (iv) Stabilizers
 - (v) Artificial Sweeteners
 - (vi) Antioxidants
 - (vii) Buffering substances
 - (viii) Vitamins and minerals
- 2. Give some of the advantages of using food additives.

Ans. Advantages of food additives:

- (i) Uses of preservatives reduce the product spoilage and extend the shelf-life of food
- (ii) Addition of vitamins and minerals reduces the mall nutrient
- (iii) Flavouring agents enhance the aroma of the food
- (iv) Antioxidants prevent the formation of potentially toxic oxidation products of lipids and other food constituents.

3. Write a short note on Antioxidants.

- **Ans.** (i) Antioxidants are substances which retard the oxidative deteriorations of food.
 - (ii) Food containing fats and oils is easily oxidised and turn rancid.
 - (iii) To prevent the oxidation of the fats and oils, chemical BHT(butylhydroxy toluene), BHA(Butylated hydroxy anisole) are added as food additives.
 - (iv) They are generally called antioxidants. These materials readily undergo oxidation by reacting with free radicals generated by the oxidation of oils, thereby stop the chain reaction of oxidation of food.

4. How is Low density polyethene prepared?

Ans. LDPE is formed by heating ethene at 200° to 300°C under oxygen as a catalyst. The reaction follows free radical mechanism. The peroxides formed from oxygen acts as a free radical initiator.

$$n CH_2 = CH_2$$
 $\xrightarrow{200^{\circ} - 300^{\circ}C}$ $\xrightarrow{-(-CH_2 - CH_2)_n}$

ethene

5. Give the structure of melamine formaldehyde resin.

Ans.

Melamine-formaldehyde polymer

5. The monomer is capro lactam

Identify the polymer when the monomer is heated at 533K.

Ans. Capro lactam (monomer) on heating at 533K in an inert atmosphere with traces of water gives ∈ amino carproic acid which polymerises to give nylon − 6

13. Identify the monomers of the following polymers.

(ii) $(NH (CH_2)_6 NHCO (CH_2)_4 CO)n$

(iii)
$$CH_2 - C = CH - CH_2)_n$$

|
Cl

Ans. Monomers are

(i)
$$HO - CH_2 - CH_2 - OH$$
 and $(ethyleneglycol)$ $HO OC - (Terephthalic acid)$

(ii) $H_2 N - (CH_2)_6 - NH_2$ and (Hexa methylene telramine)

(iii)
$$CH_2 - C = CH - CH_2$$
)

2 - Chloro buta - 1, 3 - diene (Chloroprene)

LONG ANSWER

5 MARKS

1. Write a note on drug target interaction.

- Ans. (i) The biochemical processes such as metabolism, cell-signaling etc... are essential for the normal functioning of our body.
 - (ii) These routine processes may be disturbed by any external factors such as microorganism, chemicals etc..
 - (iii) Under such conditions medicines restore the normal functioning of the body.
 - (iv) These drug molecules interact with biomolecules such as proteins, lipids, etc.. that are responsible for different functions of the body.
 - (v) The drug interacts with these molecules and modify the normal biochemical reactions either by modifying the enzyme activity or by stimulating/suppressing certain receptors.

2. Explain Receptor as drug targets.

- Ans. (i) Many drugs exert their physiological effects by binding to a specific molecule called a receptor whose role is to trigger a response in a cell.
 - (ii) The chemical messengers, bind to the active site of these receptors. This brings about the transfer of message into the cell.
 - (iii) The chemical messengers bind to the active site of these receptors.
 - (iv) This brings about the transfer of message into the cell.
 - (*v*) These receptors show high selectivity.
 - (vi) If we want to block a message, a drug that binds to the receptor site should inhibit its natural function.
 - (vii) Such drugs are called antagonists.
 - (viii) In contrast, there are drugs which mimic the natural messenger by switching on the receptor. These type of drugs are called agonists.

3. Explain the classification of polymers based on their structure and mode of synthesis.

Ans. (i) Structure:

- (a) Linear polymers (long continuous chain) E.g. HDPE, PVC.
- (b) Branched polymers (one main chain with small chains as branches) **E.g.** polypropylene, LDPE.
- (c) Cross linked polymers (linking of chain polymers) E.g. bakelite, melamine, formaldehyde

(ii) Mode of synthesis:

- (a) Addition polymers. Formed by polymerisation of monomers without the elimination of byproduct.E.g. polyethylene, PVC, teflon.
- (b) Condensation Polymer formed by the condensation of two or more monomers with the elimination of simple molecules like H₂O, NH₃, etc., E.g. Nylon-66, polyester.



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Explain the prepareation of Bakelite and Give its use.

Ans. The monomers are phenol and formaldehyde. The polymer is obtained by the condensation polymerization of these monomers in presence of either an acid or a base catalyst.

Phenol reacts with methanal to form ortho or para hydroxyl methylphenols which on further reaction with phenol gives linear polymer called novolac. Novalac on further heating with formaldehyde undergo cross linkages to form Bakelite.

$$\begin{array}{c|c} OH & CH_2+OH & OH & OH \\ \hline & & CH_2+OH & CH_2 & CH_2 \\ \hline & & Novolac & \\ \end{array}$$

(Bakelite)

Uses:

Navolac is used in paints. Soft bakelites are used for making glue for binding laminated wooden planks and in varinishes, Hard bakelites are used to prepare combs, pens etc..

Govt. Model Question Paper - 2019-20

CHEMISTRY (With Answers)

TIME ALLOWED: 15 MINUTES 2.30 HRS MAXIMUM MARKS: 70

Instructions:

- 1. Check the question paper for fairness of printing. It there is any lack of fairness, inform the Hall Supervisor immediately.
- 2. Use Blue or Black ink to write and underline and pencil to draw diagrams:

Note: Draw a diagrams and write equations wherever necessary.

PART - I

 $(15 \times 1 = 15)$ 6. **Note** : (i) Answer all the questions:

- Choose the most suitable answer from the given four alternatives and write the option code and the corresponding answer.
- 1. Which one of the following ore is best concentrated by froath - floatation method?
 - a) Magnetite
- b) Haematite
- c) Galena
- d) Cassiterite
- 2. Which compound is used as flux in metallurgy?
 - a) Boric acid
- b) Borax
- c) Diborane
- d) BF₂
- The shape of XeOF₄ is
 - a) T Shaped
- b) Pyramidal
- c) Square planar
- d) Square pyramidal
- How many moles of acidified KMn04 required to oxidise one mole of oxalic acid?
- c) 1.5
- b) 0.6
- d) 0.4
- The type of isomerism exhibited by $[Pt(NH_3),Cl_3]$?
 - a) coordination isomerism
 - b) linkage isomerism
 - c) optical isomerism
 - d) geometrical isomerism

- The fraction of the total volume occupied by the atoms in a fcc is

- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3\sqrt{2}}$ (c) $\frac{\pi}{4}$ (d) $\frac{\sqrt{3}\pi}{8}$
- The half life period of a radioactive element is 140 days. After 280 days 1g of element will be reduced to which amount of the following?

 - a) $\frac{1}{4}$ b) $\frac{1}{16}$ c) $\frac{1}{8}$ d) $\frac{1}{2}$
- Which is not a Lewis base? 8.
 - a) BF₃
- b) PF₃
- c) CO
- d) F
- During electrolysis of molten copper chloride, the time required to produce 0.2mole of chlorine gas using a current of 2A is
 - a) 32.66 min
- b) 321.66 min
- c) 378 min
- d) 260 min
- 10. Smoke is a colloidal solution of
 - a) Solid in gas
- b) Gas in gas
- c) liquid in gas
- d) Gas in liquid
- 11. Iso propyl benzene on oxidation in presence of air and dilute acid gives

 - a) C₆H₅COOH b) C₆H₅COCH₃
 - c) $C_6H_5COC_6H_5$
 - d) C₆H₅OH

GOVT. MODEL QUESTION PAPER 2019-20

Sura's 🛶 XII Std - Chemistry 🛶 Volume - II

38. (a)

(i) For the first order reation

$$k = \left(\frac{2.303}{t}\right) \log \left(\frac{a}{a-x}\right)$$

When
$$x = \left(\frac{40}{100}\right) a = 0.4 a$$

$$t = 50 \text{ m}$$

$$\therefore k = \left(\frac{2.303}{50}\right) \log \left(\frac{a}{a - 0.4a}\right)$$

$$k = \left(\frac{2.303}{50}\right) \log \left(\frac{1}{0.6}\right)$$
$$= 0.010216 \,\mathrm{min}^{-1}$$

t = ? when x = 0.8 a

From above $K = 0.010216 \text{ min}^{-1}$

$$\therefore t = \left(\frac{2.303}{0.010216}\right) \log \left(\frac{a}{a - 0.8a}\right)$$

$$\left(\frac{2.303}{0.010216}\right) \log \left(\frac{1}{0.2}\right) = 157.58 \text{ min}$$

The time at which the reaction will be 80% complete is 157.58 min.

(ii)
$$Ag_2CrO_4 \xrightarrow{} 2Ag^+ + CrO_4^{2-}$$

x is the solubility of Ag₂CrO₄ in 0.1M K₂CrO₄

$$K_2CrO_4 \Longrightarrow 2K^+ + CrO_4^{2-}$$

$$[Ag^+] = 2x$$

$$[CrO_4^{2-}] = (x + 0.1) \approx 0.1$$
 : $x << 0.1$

$$K_{sp} = [Ag^+]^2 [CrO_4^{2-}]$$

$$1.1 \times 10^{-12} = (2x)^2 (0.1)$$

$$1.1 \times 10^{-12} = 0.4 \text{ x}^2$$

$$x^2 = \frac{1.1 \times 10^{-12}}{0.4}$$

$$x = \sqrt{\frac{1.1 \times 10^{-12}}{0.4}}$$

$$x = \sqrt{2.75 \times 10^{-12}}$$

$$x = 1.65 \times 10^{-6} M.$$

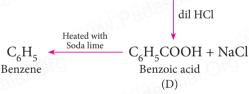
(or)

(b) Compound A of molecular formula C₇H₆O reduces Tollen's reagent when A reacts with 50% NaOH gives compound B of molecular formula C₇H₈O and C of molecular formula C₇H₅O₂ Na. Compound C on treatment with dil HCI gives compound D of molecular formula C₇H₆O₂. When D is heated with sodalime gives compound E. Identify A, B, C, D & E. Write the corresponding equations.

C₆H₅CHO Benzaldehyde (A)

50% NaOH C₆H₅CH₂OH Benzyl alcohol (B)

C₆H₅COONa Sodium benzoate



Compound A - Benzaldehyde

Compound B - Benzyl alcohol

Compound C - Sodium benzoate

Compound D - Benzoic acid

Compound D - Benzene



Sura Model Question Paper - 1

CHEMISTRY

(With Answers)

TIME ALLOWED: 15 MINUTES 2.30 HRS

Volume 1 & 2

MAXIMUM MARKS: 70

Instructions:

- 1. Check the question paper for fairness of printing. It there is any lack of fairness, inform the Hall Supervisor immediately.
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Note:

Draw a diagrams and write equations wherever necessary.

PART - I

Note : (i) Answer all the questions: $(15 \times 1 = 15)$

- Choose the most suitable answer from the given four alternatives and write the option code and the corresponding answer.
- The metal oxide which cannot be reduced to metal by carbon is
- b) Al₂O₃ c) ZnO
- The basic structural unit of silicates is
 - a) $(SiO_3)^{2-}$
- $(SiO_4)^{2-}$ b)
- c) (SiO)⁻ d)
- $(SiO_4)^{4-}$
- In which of the following, NH, is not used?
 - a) Nessler's reagent
 - b) Reagent for the analysis of IV group basic
 - c) Reagent for the analysis of III group basic radical
 - d) Tollen's reagent
- Which of the following statements is not true?
 - a) on passing H₂S, through acidified K₂Cr₂O₇ solution, a milky colour is observed.
 - b) Na₂Cr₂O₇ is preferred over K₂Cr₂O₇ in volumetric analysis
 - c) K₂Cr₂O₇ solution in acidic medium is orange in colour
 - d) K₂Cr₂O₇ solution becomes yellow on increasing the PH beyond 7

- Which kind of isomerism is possible for a complex [Co (NH₃)₄ Br₂]Cl?
 - a) geometrical and ionization
 - b) geometrical and optical
 - c) optical and ionization
 - d) geometrical only
- In calcium fluoride, having the fluorite structure the coordination number of Ca²⁺ ion and F- Ion are
 - a) 4 and 2
- b) 6 and 6
- c) 8 and 4
- d) 4 and 8
- 7. What is the activation energy for a reaction if its rate doubles when the temperature is raised from 200 K to 400 K?

 $(R = 8.314 \text{ JK}^{-1}\text{mol}^{-1})$

- a) $234.65 \text{ kJ mol}^{-1}\text{K}^{-1} \text{ b}$) $434.65 \text{ kJ mol}^{-1}\text{K}^{-1}$
- c) $434.65 \text{ J mol}^{-1}\text{K}^{-1}$ d) $334.65 \text{ J mol}^{-1}\text{K}^{-1}$
- Which of the following fluoro compounds is most likely to behave as a Lewis base?
 - a) BF₂
- b) PF₃ c) CF₄
- How many faradays of electricity are required for the following reaction to occur $MnO_4^- \longrightarrow Mn^{2+}$
 - a) 5F
- b) 3F
- c) 1F

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- (iii) To balance the negative charge, there are extra framework cations for example, H⁺ or Na⁺ ions.
- (iv) Zeolites carrying protons are used as solid acids, catalysis and they are extensively used in the petrochemical industry for cracking heavy hydrocarbon fractions into gasoline, diesel,etc., Zeolites carrying Na⁺ ions are used as basic catalysis.
- (v) One of the most important applications of zeolites is their shape selectivity.
- (vi) In zeolites, the active sites namely protons are lying inside their pores.
- (vii) So, reactions occur only inside the pores of zeolites.

37. (a)

- (i) Let us consider sodium palmitate an example of a soap. The cleansing action of soap is directly related to the structure of carboxylate ions (palmitate ion) present in soap. The structure of palmitate exhibit dual polarity. The hydrocarbon portion is non polar and the carboxyl portion is polar.
- (ii) The nonpolar portion is hydrophobic while the polar end is hydrophilic.
- (iii) The hydrophobic hydro carbon portion is soluble in oils and greases, but not in water. The hydrophilic carboxylate group is soluble in water.
- (iv) The dirt in the cloth is due to the presence of dust particles intact or grease which stick.
- (v) When the soap is added to an oily or greasy part of the cloth, the hydrocarbon part of the soap dissolve in the grease, leaving the negatively charged carboxylate end exposed on the grease surface. At the same time the negatively charged carboxylate groups are strongly attracted by water, thus leading to the formation of small droplets called micelles and grease is floated away from the solid object.

- (vi) When the water is rinsed away, the grease goes with it. As a result, the cloth gets free from dirt and the droplets are washed away with water.
- (vii) The cleansing ability of a soap depends upon its tendency to act as a emulsifying agent between water and water insoluble greases.

(OR)

(b) Compound with molecular formula C_2H_3N is $CH_3CN(A)$ acetonitrile or Methyl cyanide.

$$\begin{array}{ccc}
CH_3CN & \xrightarrow{H_2O} & CH_3COOH \\
(A) & (B) \\
Methyl cyanide & Acetic acid
\end{array}$$

Acid hydrolysis of nitriles give the corresponding carboxylic acid.

$$CH_{3}COOH + SoCl_{2} \longrightarrow CH_{3}COCl + SO_{2} + HCl$$

$$(B) \quad Thionyl \quad (C)$$

$$Acetic acid \quad chloride \quad Acetyl chloride$$

$$COCH_{3} \longrightarrow C_{6}H_{5}CHOHCH_{3}$$

$$(D) \quad Na/C_{2}H_{5}OH \quad E)$$

$$Acetophenone$$

$$\begin{array}{c} \underline{4[H]} \\ \hline Zn/Hq/HCl-Clemmenson\ reduction \\ or \\ N_2H_4\ /\ C_2H_5OH-Wolff\ Kishner\ reduction \end{array} \right) C_6H_5CH_2CH_3$$

- (A) CH₃CN acetonitrile
- (B) CH₃COOH acetic acid
- (C) CH₃COCl acetyl chloride
- (D) C₆H₅COCH₃ acetophenone
- (E) Depending upon the reducing agent
- (E) is $C_6H_5CHOHCH_3 \rightarrow Phenylmethyl carbinol$ (OR)

 $C_6H_5CH_2CH_3 \rightarrow Ethyl Benzene$





Sura Model Question Paper - 2

CHEMISTRY

(With Answers)

TIME ALLOWED: 15 MINUTES 2.30 HRS

Volume 1 & 2

MAXIMUM MARKS: 70

Instructions:

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- 2. Use Blue or Black ink to write and underline and pencil to draw diagrams:

Note:

Draw a diagrams and write equations wherever necessary.

PART - I

Note : (i) Answer all the questions:

- Choose the most suitable answer from the given four alternatives and write the option code and the (ii) corresponding answer.
- Which of the following reduction is not thermodynamically feasible?
 - a) $Cr_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Cr$

 - b) $Al_2O_3 + 2Cr \longrightarrow Cr_2O_3 + 2Al$ c) $3TiO_2 + 4Al \longrightarrow 2 Al_2O_3 + 3Ti$
 - d) none of these
- The compound that is used in nuclear reactors as protective shields and control rods is
 - a) Metal borides
- b) Metal oxides
- c) Metal carbonates
- d) Metal carbide
- On hydrolysis, PCl, gives
 - a) H₃PO₃
- b) PH₂
- c) H₃PO₄
- d) POCl,
- Which one of the following statements related to lanthanons is incorrect?
 - a) Europium shows +2 oxidation state.
 - The basicity decreases as the ionic radius decreases from Pr to Lu.
 - All the lanthanons are much more reactive than aluminium.
 - d) Ce4+ solutions are widely used as oxidising agents in volumetric analysis.

- IUPAC name of the complex K_3 [Al(C_2O_4)₃] is
 - a) potassiumtrioxalatoaluminium(III)
 - b) potassiumtrioxalatoaluminate(II)
 - potassiumtrisoxalatoaluminate(III)
 - d) potassiumtrioxalatoaluminate(III)
- The yellow colour in NaCl crystal is due to
 - a) excitation of electrons in F centers
 - b) reflection of light from Cl⁻ ion on the surface
 - c) refraction of light from Na⁺ ion
 - d) all of the above
- Assertion: rate of reaction doubles when concentration of the reactant is doubles if it is a first order reaction.

Reason: rate constant also doubles

- a) Both assertion and reason are true and reason is the correct explanation of assertion.
- b) Both assertion and reason are true but reason is not the correct explanation of assertion.
- c) Assertion is true but reason is false.
- Both assertion and reason are false.

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- (b) An alkene (A) on ozonolysis gives propanone and aldehyde (B). When (B) is oxidised (C) is obtained. (C) is treated with Br₂/P gives (D) which on hydrolysis gives (E). When propanone is treated with HCN followed by hydrolysis gives (E). Identify A, B, C, D and E.
- **37.** (a) Predict the major product, when 2-methyl but -2-ene is converted into an alcohol in each of the following methods.
 - (i) Acid catalysed hydration
 - (ii) Hydroboration
 - (iii) Hydroxylation using Bayer's reagent (or)
 - (b) The conductivity of a 0.01M solution of a 1:1 weak electrolyte at 298K is $1.5 \times 10^{-4} \,\mathrm{S \, cm^{-1}}$.

- i) molar conductivity of the solution
- ii) degree of dissociation and the dissociation constant of the weak electrolyte

Given that
$$\lambda_{cation}^{\circ} = 248.2 \text{ S cm}^2 \text{ mol}^{-1}$$

 $\lambda_{anion}^{\circ} = 51.8 \text{ S cm}^2 \text{ mol}^{-1}$

- **38.** (a) Write short notes on the following
 - i) Gabriel phthalimide synthesis
 - ii) Schotten Baumann reaction
 - iii) Diazotisation
 - iv) Gomberg reaction

(or)

- (b) How is propanoic acid is prepared starting from
 - (i) an alcohol (ii) an alkylhalide
 - (iii) an alkene

ANSWERS

- 1. b) $Al_2O_3 + 2Cr \longrightarrow Cr_2O_3 + 2Al$
- **2.** a) Metal borides
- 3. a) H_3PO_3
- 4. c) All the lanthanons are much more reactive than aluminium.
- **5.** d) potassiumtrioxalatoaluminate(III)
- **6.** a) excitation of electrons in F centers
- **7.** c) Assertion is true but reason is false.
- **8.** d) 12.65
- 9. a) I and IV
- **10.** a) (iv), (i), (ii), (iii)
- 11. a) 4 chloro 2,3 dimethyl pentan 1 ol
- **12.** d) nucleophilic addition
- **13.** b) pentan 2- amine
- **14.** c) Denaturation makes protein more active
- **15.** d) PHBV

