

The top half of the cover features a composite image. On the left, several pieces of laboratory glassware, including a beaker, a flask, and a funnel, are arranged on a surface. On the right, a ball-and-stick molecular model is shown against a blue background with glowing, ethereal lines. A red curved banner is positioned at the bottom of this image area.

CLASS-XII (CBSE)

Chemistry

Workbook Cum Question Bank with Answers



**SCHEDULED CASTES & SCHEDULED TRIBES
RESEARCH & TRAINING INSTITUTE (SCSTRI)
ST & SC DEVELOPMENT DEPARTMENT
BHUBANESWAR**

CHEMISTRY

Workbook Cum Question Bank with Answers

CLASS-XII (CBSE)

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2022

FOREWORD



The ST & SC Development Department, Government of Odisha has introduced an innovative education programme for the students appearing in +2 Science and Commerce examination pursuing studies in the ST & SC Development Department Schools (EMRS & HSS) to ensure quality education at +2 level. In this regard it is to mention that an Academic Performance Monitoring Cell (APMC) has been set up in SCSTRTI to monitor the Training and Capacity Building of Teachers of SSD Higher Secondary Schools and Ekalavya Model Residential Schools (EMRS) to enhance quality education for better performance of the students appearing +2 Science and Commerce examination.

Since March 2020 due to Covid-19 Pandemic Situation, the state government has closed all the HSS & EMRS and online classes were going on. The CBSE & CHSE Board were unable to conduct the offline examinations in 2020 and 2021. Since a few months, offline classes are going on. To combat the situation, the CBSE & CHSE Boards have introduced alternate comprehensive examination patterns such as 1st and 2nd Term End Examinations and Quarter End Examinations etc. to be operative from 2021-22 academic session. Accordingly the Question patterns have completely being changed by both Boards.

To face this situation, the APMC has designed Workbook-Cum-Question Bank with Answers as per the new direction of the Boards. The best of subject experts have been roped to formulate self-contained and self-explanatory "Workbook-Cum-Question Bank with Answers" as per the new pattern of examinations of CHSE & CBSE Boards. They have tried to make the material as far as activity based and solution based as feasible.

I would like to extend my sincere thanks to Prof. (Dr.) A. B. Ota, Advisor-Cum-Director and Special Secretary, SCSTRTI. I would also like to thank Dr. S. C. Das, SLPM, APMC and the team of subject experts for their sincere effort in bringing out the Question Bank in a very short time.

The Workbook-Cum-Question Bank with Answers will cater to the needs of students during this pandemic situation and will be extremely useful for students of Science and Commerce of CBSE and CHSE to face the new pattern of examination, as these are designed accordingly.

A handwritten signature in black ink, appearing to be 'Ranjana Chopra'.

Ranjana Chopra
Principal Secretary
ST & SC Development Department
Govt. of Odisha

From the Director's Desk ...



The ST and SC Development Department, Government of Odisha, has initiated an innovative effort by setting up an Academic Performance Monitoring Cell (APMC) in Scheduled Castes and Scheduled Tribes Research and Training Institute (SCSTRTI) to monitor the Training and Capacity Building of teachers of SSD Higher Secondary Schools and Ekalabya Model Residential Schools (EMRS) under the administrative control of the ST & SC Development Department. This innovative program is intended to ensure quality education in the Higher Secondary Level of the schools of the ST & SC Development Department.

All Ekalabya Model Residential Schools (EMRS) and Higher Secondary Schools (HSS) are closed since March 2020 due to Covid-19 pandemic situation. As a result, the CBSE Board was not able to conduct the final examinations in 2021. As an alternative, the CBSE Board has decided to conduct 1st & 2nd Term End Examinations in December 2021 & April 2022 respectively with new question pattern for both these examinations.

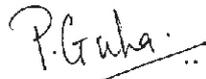
To cope up with this new situation & as per necessities of students, the Academic Performance Monitoring Cell has designed and prepared Workbook Cum Question Bank with Answers in Physics, Chemistry, Biology (Botany & Zoology), Mathematics, Computer Science and English for Class-XII of the Science stream as per the new pattern of examinations being adopted by CBSE Board.

The best of the subject experts in all subjects of the state have been roped to prepare the Workbook-Cum-Question Bank with Answers which are self-contained and self-explanatory.

The tireless efforts and futuristic vision of Prof. (Dr.) A. B. Ota, Advisor-cum-Director and Special Secretary for his guidance in preparation of these books and getting them published in very short time deserve special mention. He has been a bedrock of strength and wisdom to this team during the current pandemic as well.

Hope, these Workbooks will help students in developing their knowledge and skills to come out successful in the +2 Examinations.

I wish the publication all success.



Smt. Guha Poonam Tapas Kumar, IAS

Director (ST)

ST & SC Development Department

Govt. of Odisha

PREFACE



An innovative education programme has been initiated by setting up an Academic Performance Monitoring Cell (APMC) in Scheduled Castes and Scheduled Tribes Research and Training Institute (SCSTRTI) to monitor the Training and Capacity Building of Teachers of SSD Higher Secondary Schools and Ekalavya Model Residential Schools (EMRS) and to ensure quality education of students studying at +2 level under the administrative control of the ST & SC Development Department.

Due to Covid-2019 pandemic situation, all the schools under administrative control of ST & SC Development Department are closed since March 2020. As a result different Boards were not able to conduct offline examinations in 2020 and 2021. As an alternative, CBSE Board and CHSE Board have made comprehensive examination patterns in the form of 1st & 2nd Term End and 3rd Quarter End examinations respectively to be followed from 2021-22 academic session.

The present situation demands to fulfill the desire of students and designed new pattern of questions, which will cater to the need of students to face the examinations boldly without any fear and nervousness. The APMC under the banner of SCSTRTI has taken the initiative to prepare Workbook-Cum-Question Bank with Answers in Physics, Chemistry, Biology (Botany & Zoology), Mathematics, Information Technology / Computer Science, English and Odia of Science stream and Business Mathematics and Statistics, Business Studies and Management, Accounting, Cost Accountancy, Fundamentals of Management Accounting, Fundamentals of Entrepreneurship, Banking & Insurance etc. of Commerce stream as per the new pattern of questions to be adopted in both CBSE and CHSE Boards and prepared books separately.

The subject experts, who are the best in their respective subjects in the state have been roped in for this exercise. They have given their precious time to make the new pattern of Question Bank as activity and solution based as per the direction of both CBSE and CHSE Boards.

I hope this material will be extremely useful for the students preparing for the +2 examination in different subject of Science and Commerce streams.

A handwritten signature in black ink, appearing to be 'A. B. Ota'.

Prof. (Dr.) A. B. Ota

Advisor-Cum-Director & Special Secretary
SCSTRTI, Govt. of Odisha

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UNIT - I

SOLID STATE

I. Select the correct answer from the choices given under each bit :

- The number of atoms/molecules present in one bcc unit cell.**
(a) 1 (b) 2
(c) 4 (d) 6
- Wax is an example of _____ type of crystal.**
(a) ionic
(b) covalent
(c) molecular
(d) metallic
- In a crystal, the atoms are located at the position of _____ potential energy.**
(a) zero
(b) infinite
(c) minimum
(d) maximum
- In a solid lattice the cation has left a lattice site and is located at an interstitial position. The lattice defect is known as _____**
(a) Interstitial defect
(b) Vacancy defect
(c) Frenkel
(d) Schottky defect
- Ionic solids Schottky defect contain in their structure.**
(a) Equal number of cations and anions vacancies
(b) Interstitial anions and anion vacancies.
(c) Cation vacancies only
(d) Cation vacancies and interstitial cations.
- Which crystal has the largest lattice energy?**
(a) KCl (b) MgO
(c) LiBr (d) NaF
- A substance A_xB_y crystallises in fcc lattice in which atom A present in each corner of the cube and atom B occupies the centre of each face of the cube. The formula of the compound is _____.**
(a) AB_3 (b) A_4B_3
(c) A_3B (d) AB_2
- There are _____ primitive and _____ centred unit cells.**
(a) 6, 7 (b) 7, 7
(c) 6, 6 (d) 7, 6

9. The Bravais lattice where $a = b = c$, $\alpha = \beta = \gamma = 90^\circ$ is _____
- Cubic
 - Rhembohedral
 - Triclinic
 - None of these
10. In the orthorhombic crystal system the edge length and axial angles are _____ and _____ respectively.
- $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
 - $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$
 - $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma = 90^\circ$
 - $a = b = c$, $\alpha = \beta = \gamma \neq 90^\circ$
11. A unit cell consists of a cube in which there are 'A' atoms at the corners and 'B' atoms at the face centred and 'A' atoms are missing from 2-corners in each unit cell. The formula of the compound is_____.
- AB_3
 - A_3B
 - AB_4
 - A_3B_4
12. Octahedral voids are present/unit cell of ccp or fcc crystals at _____.
- at the body centre
 - at the centre of each edge
 - both (a) and (b)
 - no. of octahedral void = no. of tetrahedral void
13. In the ABAB ... pattern of packing (hcp) in which _____.
- tetrahedral voids of second layer is covered
 - fourth layer atom is aligned with 1st layer atom
 - octahedral voids of 2nd layer are covered in 3rd layer
 - both octahedral and tetrahedral voids are covered
14. ABC ABC ... type predicts _____ structure.
- hcp
 - ccp
 - scp
 - none of these
15. The co-ordination number in one dimensional close packing is
- two
 - four
 - six
 - zero
16. What type of solid is p-nitrophenol?
- ionic
 - covalent
 - molecular
 - H-bonded molecular solid
17. Which of the following material is not ferromagnetic
- Cobalt
 - Manganese
 - Iron
 - Nickel

18. Solid 'A' is very hard electrical insulator in solid as well as molten state. It melts at very high temperature. What type of solid is it?
- (a) Ionic
(b) Covalent network
(c) Molecular
(d) Metallic
19. The number of atoms per unit cell is _____, if cubic base unit cell having one atom on each corner and two atoms on each body diagonal.
- (a) 09 (b) 06
(c) 05 (d) 08
20. The number of voids in ccp unit cell is _____.
- (a) 08 (b) 04
(c) 12 (d) 06
21. Packing efficiency of ccp structure is _____.
- (a) 74% (b) 68%
(c) 52.4% (d) 60%
22. The type of cubic lattices to which iron crystal belongs if the cell has an edge of length 268 pm and density of the crystal is 7.86 g/cm³ (atomic weight of Fe=56, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$) is _____.
- (a) fcc
(b) cubic
(c) bcc
(d) end centred cubic
23. A compound forms hcp structure. The total number of voids per mole of it is _____.
- (a) 1.806×10^{24}
(b) 1.806×10^{23}
(c) 6.02×10^{23}
(d) 1.2×10^{24}
24. Which of the following is not a consequence of Frenkel defect ?
- (a) The electrical conductivity of crystal is expected to increase
(b) The presence of holes decreases the stability of the crystal
(c) Due to vacant sites the density decreases
(d) The dielectric constant is expected to increase
25. K^+Cl^- (s) on heating in an atmosphere of potassium vapour looks
- (a) violet (b) pink
(c) yellow (d) white
26. Which of the following does not occur on heating ZnO?
- (a) It turns yellow on heating and white when cold.
(b) This is a case of metal excess defect.
(c) Can function as n-type semiconductor.
(d) the crystal becomes diamagnetic on heating.

27. Choose the incorrect statement from the following :

- (a) \bar{e} in anion vacancy creates F - centre (F = Farbe).
- (b) In defective ZnO, the Zn^{2+} ions occupy certain interstitial sites.
- (c) Semiconductors are produced due to impurity defect.
- (d) Conductivity ionic solid can be explained by \bar{e} gas model.

28. 'K' crystallises in bcc lattice. Hence the coordination number of the element in the crystal structure is :

- (a) 0
- (b) 4
- (c) 6
- (d) 8

29. Defective Zinc Oxide can be represented with formula _____.

- (a) ZnO
- (b) $Zn_{1+x}O$
- (c) ZnO_{1+x}
- (d) ZnO_{1+y}

30. Nickel oxide has formula $Ni_{0.98}O_{1.00}$. The percentage of Ni^{2+} is _____.

- (a) 95.9
- (b) 4.1
- (c) 96.1
- (d) none of these

31. The existence of a substance in more than one solid modifications is known as :

- (a) isomorphism
- (b) polymorphism
- (c) amorphism
- (d) allotropy

32. Which of the following is an amorphous solid ?

- (a) Graphite
- (b) Quartz glass (SiO_2)
- (c) Potash alum ($K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$)
- (d) Diamond

33. Which of the following unit cells have all their sides equal (a=b=c)?

- (a) tetragonal
- (b) cubic
- (c) orthorhombic
- (d) hexagonal

34. The edge length of the unit cell in terms of radius of spheres constituting face centred cubic unit cell is

- (a) $a = 4r$
- (b) $a = \frac{4}{\sqrt{3}}r$
- (c) $a = 2r$
- (d) $a = 2\sqrt{2}r$

35. Which of the following has highest packing efficiency?

- (a) simple cubic
- (b) body centred cubic
- (c) hcp
- (d) fcc

36. The material used in solar cells contain -

- (a) Sn
- (b) Cs
- (c) Ti
- (d) Si

37. Schottky defect in crystals is observed when

- (a) unequal number of cations and anions are missing from the lattice
- (b) equal number of cations and anions are missing from the lattice
- (c) density of the crystal is increased
- (d) an ion leaves its normal site and occupies an interstitial site

38. Which of the following defects does not affect the density of a crystal?

- (a) Schottky defect
- (b) Interstitial defect
- (c) Frenkel defect
- (d) Both (b) and (c)

39. If we know the ionic radius ratio in crystal of ionic solid, what can be known of the following ?

- (a) magnetic property
- (b) nature of chemical bond
- (c) type of defect
- (d) geometrical shape of crystal

40. A semiconductor of Ge can be made p-type by adding

- (a) trivalent impurity
- (b) tetravalent impurity
- (c) pentavalent impurity
- (d) divalent impurity

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 11. (c) | 21. (a) | 31. (d) |
| 2. (c) | 12. (c) | 22. (c) | 32. (b) |
| 3. (c) | 13. (a) | 23. (a) | 33. (b) |
| 4. (c) | 14. (b) | 24. (c) | 34. (d) |
| 5. (a) | 15. (a) | 25. (a) | 35. (c) |
| 6. (b) | 16. (d) | 26. (d) | 36. (d) |
| 7. (a) | 17. (b) | 27. (d) | 37. (b) |
| 8. (b) | 18. (b) | 28. (d) | 38. (c) |
| 9. (a) | 19. (a) | 29. (b) | 39. (d) |
| 10. (a) | 20. (c) | 30. (a) | 40. (a) |

II. Short Questions

Q.1. What is co-ordination number of the body centred cubic cell?

Ans. The body centred cubic cell has 8 nearest atoms situated at 8 corners of the cube. Hence C. N. is 8.

Q.2. Why Frenkel defect is not found in the halides of alkali metals?

Ans. Frenkel defect occurs when ions (generally cations) are missing from lattice sites and occupied at interstitial positions. As alkali ions are larger in size and not fit to occupy interstitial positions, so do not show Frenkel defect.

Q.3. Calculate the number of ZnS units in the unit cell of Zinc blend.

Ans. $Zn^{2+} = 4$ (within the body)

$$S^2 = \left(8 \times \frac{1}{8}\right) + \left(6 \times \frac{1}{2}\right) = 4$$

(at corners) (face centres)

Q.4. Why is common salt sometimes yellow instead of being pure white?

Ans. Because the electrons present in some lattice sites in place of anions. This is called F centres, hence shows the colour.

Q.5. How does quartz glass differ from quartz ?

Ans. Quartz is a crystalline solid, constituents of SiO_4 - tetrahedra and arranged in a regular manner. But quartz glass SiO_4 is randomly joined and do not have long range order. It is also amorphous.

Q.6. Gold atomic radius (0.144 nm) crystallises in a face centred unit cell. What is the length of the side of the cell?

Ans. In fcc $a = 2\sqrt{2}r$, $r = 2 \times 1.414 \times 0.144 = 0.407$ nm

Q.7. Classify p-type and n-type semiconductors of the following ?

(i) Ge-doped with In (ii) B doped with Si.

Ans. (i) Ge is Gr 14 element and In is Gr 13 element. So, an electron deficit hole is created and hence is p-type.

(ii) B is Gr 13 element and Si is Gr 14 element, there will be free electron. Hence it is n-type.

Q.8. Gr 14 is to be converted into n-type semiconductor by doping it with a suitable impurity. To which group should this impurity belong ?

Ans. n-type conductor means conduction due to presence of negatively charged electrons. So, to convert Gr 14 element to n-type semiconductor, it should be doped with Gr 15 elements.

Q.9. Which of the following lattices has the highest packing efficiency ?

(i) Simple cubic, (ii) body centred cubic, (iii) hexagonal close packing lattice

Ans. Packing efficiency for : simple cubic = 52.4%, body centred cubic = 68% and hexagonal close packing lattice = 74%.

Q.10. Why does the window glass of the old buildings look milky and thick at bottom?

Ans. Glass is an amorphous solid but a super cold liquid. It has the property to flow but the flow is very very slow. Hence old glasses look milky and thick at bottom.

Q.11. Why urea has sharp melting point but glass does not ?

Ans. Urea is a crystalline solid having regular arrangement of atoms where as glass is an amorphous solid having no proper arrangement hence do not have sharp m.p.

Q.12. Explain why ionic solids conduct electricity in molten state but not in solid state.

Ans. Ions in solid state are held by strong electrostatic forces of attraction and are not free to move, so do not conduct electricity. Where as in molten state the ions become free to move and conduct electricity.

Q.13. What are the parameters that characterise a unit cell?

Ans. (i) The dimension of edges a , b and c which may or may not be mutually perpendicular.
(ii) Angles between the edges α , β and γ be mentioned, this unit cell is characterised by six parameters.

Q.14. What is meant by the term co-ordination numbers ?

Ans. The number of nearest neighbours in a packing is called coordination number.

Q.15. Explain metallic conduction in terms of band theory ?

Ans. The energy gap between valence band and conduction band is very small and there is overlapping between valence band and conduction band in the metals, is called conductor. If the gap is very large, is called insulator but the gap is small, is known as semiconductor.

UNIT - II

SOLUTIONS

I. Select the correct answer from the choices given under each bit :

- Molality is expressed in**
(a) g/L (b) L/md
(c) Mol L⁻¹ (d) Mol. Kg⁻¹
- The relative lowering vapour pressure is proportional to the ratio between the number of _____**
(a) solute molecules to solvent molecules
(b) solute molecules to the total number of molecules in solution
(c) solvent molecules to total number of molecules in solution
(d) solvent molecules to total number of ions in solution
- At 398 K, the highest osmotic pressure is expected by 0.1 M solution of _____**
(a) CaCl₂ (b) KCl
(c) Glucose (d) Urea
- Which of the following salts will have the same value of Van't Hoff factor i as that of potassium ferrocyanide ?**
(a) NaCl
(b) Aluminium Chloride
(c) Ferric sulphate
(d) Ferrous sulphate
- An elevation of boiling point of solution of 10% of solute (Mol. Mass = 100) in 100g of water is ΔT_b . The ebullioscopic constant for water is _____**
(a) 10 (b) $10 \Delta T_b$
(c) ΔT_b (d) $\Delta T_b / 10$
- Which of the following concentration term is not affected by temperature ?**
(a) Normality (b) Molality
(c) Molarity (d) Formality
- A 5% solution of canesugar (Molar Mass = 342 g/mol) is isotonic with 1% solution of a substance X. The molar mass of x is _____**
(a) 171.2 (b) 68.4
(c) 34.2 (d) 136.2
- Which of the following has highest b.p. under 1 atm pressure?**
(a) 0.1 M NaCl (b) 0.1 M sucrose
(c) 0.1 M BaCl₂ (d) 0.1 M glucose
- An aqueous solution freezes at -0.186°C ($K_f = 1.86 \text{ K. Kg Mol}^{-1}$, $K_b = 0.512 \text{ K.Kg. Mol}^{-1}$). The b.p. of the solution will be _____ $^\circ\text{C}$.**
(a) 100.186 (b) 100.512
(c) 100.86 (d) 100.512

10. For determination of molar mass of colloids, polymers and proteins, colligative property preferred is ____.
- diffusion pressure
 - relative lowering of vapour pressure
 - osmotic pressure
 - depression in freezing point
11. Colligative properties of solutions are those properties which depend on :
- shape of the particles
 - nature of solvent
 - nature of particles
 - number of particles
12. 2.5 L of 1 M NaOH is mixed 3L of 0.5 M HCl. The solution is ____ and molarity is ____.
- alkaline, 0.18 m.
 - acidic, 0.1 m.
 - alkaline, 1.8 m
 - alkaline, 0.018 m.
13. What is the concentration of KCl (aq) that could be used in blood stream to have the osmotic pressure 7.8 bar at 310K.
- 0.16 m
 - 0.32 m
 - 0.60 m
 - 0.45 m
14. The Van't Hoff factor for a solute that associates in solution is ____.
- Zero
 - 1.0
 - Less than 1.0
 - more than 1.0
15. For an ideal solution of two volatile liquids (1 and 2), the total vapour P_{total} is represented as :
- $P_{\text{total}} = x_1 p_1^0 + x_2 p_2^0$
 - $P_{\text{total}} = p_1^0 + (p_2^0 - p_1^0)x_2$
 - the total vapour pressure over the solution varies linearly with mole fraction of one component
 - all are collectively represented
16. Choose the incorrect statement :
- The composition of vapour phase i.e. above the solution obeys Daltons law
 - At equilibrium, vapour phase will be always rich in the component which is more volatile
 - When $x_2 = 0$, the vapour pressure represents p_2^0
 - Higher the value of K_H at a given pressure lower is the solubility of the gas in liquid
17. Increasing the temperature of an aqueous solution will cause
- molality to decrease
 - molarity to decrease
 - mole fraction to decrease
 - wt % to increase
18. The boiling point of equimolar aqueous solution will be minimum for
- benzene diazonium chloride
 - calcium nitrate
 - silver chloride
 - glucose

19. An X molal solution of a compound in benzene has mole fraction of solute equal to 0.2. The value of X is nearly ____.
- (a) 14 (b) 3.2
(c) 1.4 (d) 2
20. molarity of liquid HCl if density of solution is 1.17 g/mL is
- (a) 36.5 (b) 18.25
(c) 32.05 (d) 42.10
21. The depression in freezing point, ∇T_f is directly proportional to
- (a) mole fraction of the solution
(b) molarity of the solution
(c) molality of the solution
(d) moles of the solvent
22. Normality of 0.3 M phosphorous acid (H_3PO_3) is ____.
- (a) 0.5 (b) 0.6
(c) 0.9 (d) 0.1
23. An azeotropic solution of two liquids has boiling point lower than either of two when it.
- (a) shows a negative deviation from Raoult's law
(b) shows no deviation from Raoult's law
(c) shows positive deviation from Raoult's law
(d) is saturated
24. Benzoic acid undergoes dimerization in benzene solution. The Van't Hoff factor (i) is related to the degree of association (x) of the acid as
- (a) $i = 1 - x$ (b) $i = 1 + x$
(c) $i = 1 - \frac{x}{2}$ (d) $i = 1 + \frac{x}{2}$
25. Which of the following 0.1 m aqueous solution will have the lowest freezing point?
- (a) $Al_2(SO_4)_3$ (b) $C_6H_{12}O_6$
(c) Urea (d) KI
26. The volume of water to be added in 100 cc of 0.5 NH_2SO_4 to get decinormal solution is
- (a) 100 cc (b) 450 cc
(c) 400 cc (d) 500 cc
27. 18g glucose is dissolved in 1 kg of water in a saucepan, the boiling point of the solution is ____ K.
- (a) 373.052 (b) 100.052
(c) 101 (d) 273
28. The boiling point of benzene is 353.23 K. When 1.80g of non-volatile solute was dissolved in 90g benzene, the boiling point is raised to 354.11 K. The molar mass of the solute is _____. (K_b for benzene is 2.53 K. kg. mol⁻¹)
- (a) 57.5 (b) 56.5
(c) 5.75 (d) 157.5

29. Which of the following is not the characteristic of ideal solution?
- $\Delta_{\text{mix}} H = 0$
 - $\Delta_{\text{mix}} V = 0$
 - A - A and B - B interaction \neq A - B interaction
 - Cohesive interaction is same as adhesive interaction
30. Which of the following is not an ideal solution?
- n-hexane, n-heptane
 - Bromoethane and Chloroethane
 - Benzene and toluene
 - Acetone and Chloroform
31. The molal depression constant depends upon
- nature of the solute
 - nature of the solvent
 - vapour pressure of the solution
 - heat of solution of the solute in the solvent
32. Equimolar solutions in the same solvent have
- same b.p (boiling point) but different freezing point
 - same freezing point but different boiling point
 - same boiling point and same freezing point
 - different boiling point and different freezing point.
33. Which of the following is a colligative property?
- boiling point
 - freezing point
 - osmotic pressure
 - vapour pressure
34. Which of the following expression represents Van't Hoff factor.
- $i = \frac{\text{normal molar mass}}{\text{abnormal molar mass}}$
 - $i = \frac{\text{abnormal molar mass}}{\text{normal molar mass}}$
 - $i = \frac{\text{normal colligative property}}{\text{observed colligative property}}$
 - None of the above
35. During osmosis, flow of water through a semipermeable membrane is
- from both sides of semipermeable membrane with unequal flow rates
 - from solution having higher concentration only
 - from solution having lower concentration only
 - from both sides of semipermeable membrane with equal flow rates
36. If an aqueous solution of glucose is allowed to freeze, then crystals of which will be separated out first.
- glucose
 - water
 - both of these
 - none of these

37. Concentrated aqueous H_2SO_4 is 98% by mass and has density of 1.80 g.mL^{-1} . Volume of the acid required to make 1 litre of 0.1 M H_2SO_4 is
- (a) 5.55 ml (b) 11.10 ml
(c) 16.65 ml (d) 22.20 ml
38. A solution of acetone in ethanol
- (a) behaves like a near ideal solution
(b) Obeys Raoult's law
(c) shows a negative deviation from Raoult's law
(d) shows positive deviation from Raoult's law
39. Comphor is often used in molecular mass determination because
- (a) it is readily available
(b) it has a very high cryoscopic constant
(c) it is volatile
(d) it is solvent for organic substance
40. A pressure cooker reduces cooking time because :
- (a) heat is more evenly distributed
(b) the higher pressure tenderises the food
(c) the boiling point of water inside the cooker is elevated
(d) the boiling point of water inside the cooker is depressed

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (d) | 11. (d) | 21. (c) | 31. (b) |
| 2. (b) | 12. (a) | 22. (b) | 32. (c) |
| 3. (a) | 13. (b) | 23. (c) | 33. (c) |
| 4. (c) | 14. (c) | 24. (c) | 34. (a) |
| 5. (b) | 15. (d) | 25. (a) | 35. (a) |
| 6. (b) | 16. (c) | 26. (c) | 36. (b) |
| 7. (b) | 17. (b) | 27. (a) | 37. (a) |
| 8. (c) | 18. (d) | 28. (a) | 38. (d) |
| 9. (d) | 19. (b) | 29. (c) | 39. (b) |
| 10. (c) | 20. (c) | 30. (d) | 40. (c) |

II. Short Questions

Q.1. Which out of molality, molarity and mole fraction of a solution will remain unchanged on raising the temperature and why?

Ans. Mole fraction and molality depend upon masses and do not change with temperature. Whereas molarity depends upon volume which changes with change in temperature.

Q.2. State Raoult's law. Derive its mathematical expression.

Ans. The vapour pressure of the solution containing non-volatile solute is directly proportional to the mole fraction of the solvent.

In a solution containing two components A (solvent) and B (solute-non-volatile). So the vapour pressure $P_A = P_A^0 X_A$ and $P_B = P_B^0 X_B$ where X_A and X_B are mole fractions and P_A^0, P_B^0 are vapour pressure at pure state of each component.

$$\begin{aligned} \text{Total } P &= P_A + P_B = P_A^0 X_A + P_B^0 X_B = P_A^0 (1 - X_B) + P_B^0 X_B \\ &= P_A^0 - P_A^0 X_B + P_B^0 X_B = P_A^0 - (P_A^0 - P_B^0) X_B \end{aligned}$$

So the total pressure is a linear function of mole fraction.

Q.3. Show that the relative lowering of vapour pressure for a solution is equal to the mole fraction of the solute in volatile solvent.

Ans. Vapour pressure of solution = mole fraction of the solvent x vapour pressure of pure solvent

$$\text{i.e. } P_s = X_1 P_0 \quad \text{or} \quad \frac{P_s}{P_0} = X_1 = \frac{n_1}{n_1 + n_2} \quad \text{or} \quad 1 - \frac{P_s}{P_0} = 1 - \frac{n_1}{n_1 + n_2} \quad \text{or} \quad \frac{P_0 - P_s}{P_0} = \frac{n_2}{n_1 + n_2}$$

(mole fraction of solute)

Q.4. Explain the term ideal solution.

Ans. The ideal solution in which

- (i) no change in volume on mixing the two components, $\Delta V_{\text{mix}} = 0$
- (ii) no change in enthalpy, $\Delta H_{\text{mix}} = 0$

Q.5. How does non-ideal solution differ from ideal solution ?

Ans. Ideal solution

Non-ideal solution

(i) Obey's Raoult's law i.e.
 $P_A = P_A^0 X_A$ and $P_B = P_B^0 X_B$

(i) $P_A \neq P_A^0 X_A, P_B \neq P_B^0 X_B$

(ii) $\Delta H_{\text{mix}} = 0$

(ii) $\Delta H_{\text{mix}} \neq 0$

(iii) $\Delta V_{\text{mix}} = 0$

(iii) $\Delta V_{\text{mix}} \neq 0$

Q.6. Define the term colligative property.

Ans. Those properties of ideal solutions which depend only on the number of particles of the solute dissolved in a definite amount of the solvent and do not depend on the nature of solute, are called colligative property.

Q.7. Show that relative lowering of vapour pressure is a colligative property.

Ans. $P_A = P_A^0 X_A$ Where $P_A =$ Vap. pr. of solvent $P_A^0 =$ vapour pressure of solvent at pure state and $X_A =$ molefraction of solvent.

$$\text{But mole fraction of solute} = X_B = \frac{n_B}{n_A + n_B}$$

$$\text{As } X_A + X_B = 1 \text{ or } X_A = 1 - X_B$$

$$\text{On substitution } P_A = P_A^0(1 - X_B) = P_A^0 - X_B P_A^0 \text{ or } P_A^0 - P_A = P_A^0 X_B \text{ or } \frac{P_A^0 - P_A}{P_A^0} = X_B$$

$$\text{Where } \frac{P_A^0 - P_A}{P_A^0} = \text{relative lowering of vapour pressure}$$

and X_B depends upon number of moles of solute.

Q.8. Define Osmosis and Osmotic pressure.

Ans. Osmosis : The spontaneous flow of solvent molecules from the solvent to the solution or from a less concentrated solution to a more concentrated solution through a semipermeable membrane is called osmosis.

Osmotic Pressure : The excess hydrostatic pressure that has to be applied on the solution to prevent the entry of solvent into the solution through the semipermeable membrane is called osmotic pressure.

Q.9. How the osmotic pressure depends upon the number of moles of the solute?

Ans. The osmotic pressure (π) is related to concentration and temperature i.e. $\pi \propto C \times T$ or $\pi = R'CT$ where $R' =$ solution constant.

$$\text{But } C = \frac{n}{V} \text{ where } n = \text{number of moles, } V = \text{volume of the solution}$$

$$\therefore \pi = R' \frac{n}{V} T \text{ or } \pi V = nR'T$$

This equation is known as Van't Hoff's solution equation.

Q.10. Explain why freezing point is lowered on dissolving a non-volatile solute into it.

Ans. When non-volatile solute is added to the solvent, the solute molecules occupy the space on the surface, so vapour pressure decreases. Hence freezing point is lowered.

Q.11. Why do electrolytes show abnormal molecular masses ? Name the factors responsible for abnormality.

Ans. In case of aqueous solutions of electrolyte; some acids and some inorganic bases like NaOH, KOH or salts like NaCl, KCl, KNO₃ dissociate and the number of particles in solution increases. Similarly certain substances associate such as CH₃COOH and benzoic acid in benzene. So number of particles decreases. As a result colligative property changes so as the molecular mass.

Q.12. What is Van't Hoff's factor?

Ans. It is the ratio of the experimental value of the colligative property to the calculated value of the colligative property, that is Van't Hoff's factor (i).

$$i = \frac{\text{Experimental Colligative Property}}{\text{Calculated Value of Colligative Property}}$$
$$= \frac{\text{Normal (Calculated) Molar Mass}}{\text{Observed (experimental) Molar Mass}}$$

Q.13. State Henry's Law what is its significance?

Ans. The solubility of a gas at a given temperature is directly proportional to the pressure of the gas at which it is dissolved. It is written as $P_A = K_H X_A$ (where P_A = Partial pressure, X_A = Mole fraction, K_H = Henry's constant)

At constant temperature for the same partial pressure of different gases, $X_A \propto \frac{1}{K_H}$. That is the solubility is inversely proportional to Henry's constant of the gas. Higher the value of K_H , lower is the solubility.

Q.14. What is molal elevation constant?

Ans. Molal elevation constant is the elevation in its boiling point when one mole of non-volatile solute is dissolved per kilogram of solvent. (Unit is K. Kg. Mol⁻¹)

Q.15. Derive the relationship between depression in freezing point and the molality.

Ans. The depression in freezing point is $\Delta T_f = K_f m$. Where K_f = molal depression constant.

$$\text{And } m \text{ (molality of the solution)} = \frac{W_B}{M_B} \frac{1000}{W_A}$$

Where W_A = Mass of solvent, W_B = Mass of solute. M_B = Molar mass of the solute.

$$\therefore M_B = \frac{K_f \times W_B \times 1000}{W_A \times \Delta T_f}$$

UNIT - III

ELECTROCHEMISTRY

I. Select the correct answer from the choices given under each bit :

- The unit of equivalent conductance is :**
 - $\text{Ohm}^{-1} \cdot \text{cm}^{-1}$
 - $\text{Ohm}^{-1} \cdot \text{cm}^{-2}$
 - $\text{Ohm}^{-1} \cdot \text{cm}^{-2}$
 - None of these
- Effect of dilution on conductance is :**
 - Specific conductance increases, molar conductance decreases
 - Specific conductance decreases, molar conductance increases
 - Both decrease in dilution
 - Both increase in dilution
- In Daniell cell, $\text{Zn}/\text{ZnSO}_4 \parallel \text{CuSO}_4/\text{Cu}$**
 - Zinc undergoes oxidation and copper undergoes reduction
 - Zinc undergoes reduction and copper undergoes oxidation
 - Oxidation reduction does not take place
 - Oxidation takes place both sides
- In the electrolytic cell, flow of electrons is from**
 - Cathode to anode in the solution
 - Anode to cathode through internal supply
 - Cathode to anode through external supply
 - Cathode to anode through internal supply
- The molar conductivity of a strong electrolyte :**
 - increases linearly with concentration
 - increases with square root of concentration in a linear fashion
 - decreases linearly with concentration
 - decreases with square root of concentration in a linear fashion
- Which of the following is false ?**
 - Saline water increases rusting
 - In Daniell cell, if concentrations of the solutions are doubled, the emf of the cell is also doubled
 - Emf of the cell is intensive quantity and free energy change is extensive quality
 - Galvanised iron sheets remain protected from rusting even if a crack is developed
- Conductivity of an electrolytic solution depends on :**
 - nature of electrolyte
 - concentration of electrolyte
 - power of AC source
 - distance between the electrodes

8. **Arrange the following metals in order of reactivity.**
Cu, Fe, Zn, Ag
- (a) Zn > Cu > Fe > Ag
(b) Zn > Fe > Ag > Cu
(c) Zn > Fe > Cu > Ag
(d) Fe > Zn > Cu > Ag
9. **The metal is used for cathodic protection of iron against rusting**
- (a) Zn (b) Cu
(c) Cd (d) Pb
10. **In an electrochemical cell**
- (a) Potential energy changes into electrical energy
(b) Chemical energy changes into electrical energy
(c) Kinetic energy decreases
(d) Potential energy decreases
11. **Which of the following decreases with dilution**
- (a) Conductance
(b) Specific conductance
(c) Equivalent conductance
(d) Molar conductance
12. **The standard electrode potential of Normal Hydrogen Electrode (NHE) is**
- (a) 1 (b) 1.5
(c) 100 (d) Zero
13. **The salt bridge is used in an electrochemical cell because :**
- (a) electrons flow from anode to cathode
(b) ions flow from one solution to the other
(c) it enhances the +ve ions in the solution
(d) it may be eliminated to achieve electrical neutrality
14. **If n-electrons are involved in the electrode reaction, the passage of electricity required to liberate one mole of the substance is :**
- (a) 24125 C (b) 96500 C
(c) $\frac{96500}{n}$ C (d) n x 96500 C
15. **For strong electrolytes, the plot of molar conductance vs \sqrt{c} is**
- (a) parabolic (b) circular
(c) linear (d) sinusoidal
16. **The best way to prevent rusting of iron is by**
- (a) making iron anode
(b) making iron cathode
(c) putting it in saline water
(d) none of these
17. **In which cell the free energy of chemical reaction is directly converted into electricity.**
- (a) Leclanche cell
(b) Concentration cell
(c) Fuel cell
(d) Lead storage battery

- 18. The electrolysis of aqueous NaCl solution gives.**
- (a) Na and Cl₂ (b) Na & Cl
(c) H₂ and Cl₂ (d) Na and H₂
- 19. For measuring electrolytic conductance, the current is used**
- (a) Only AC (b) Only DC
(c) Both AC & DC (d) None of these
- 20. Conductance is**
- (a) directly proportional to resistance
(b) inversely proportional to resistance
(c) equal to the resistance
(d) none of these
- 21. Each ion makes a definite contribution to the total molar conductivity of an electrolyte at infinite dilution, is**
- (a) Ohm's Law
(b) Arrhenius Rule
(c) Nernst Rule
(d) Kohlrausch's Rule
- 22. The relationship between free energy ΔG and EMF of the cell is**
- (a) $\Delta G = nFE$ (b) $\Delta G = -nFE$
(c) $E = \frac{\Delta G}{n}F$ (d) $\Delta G = \frac{EF}{n}$
- 23. Zinc reacts with dilute H₂SO₄ to give gas but copper does not, because**
- (a) Zinc has higher oxidation potential than hydrogen
(b) Zinc has lower oxidation potential than hydrogen
(c) Copper has higher oxidation potential than hydrogen
(d) none of these
- 24. The EMF of the cell is**
- (a) The difference between electropotentials of two half cells
(b) The difference between potentials of two cells
(c) The electrode potential of two cells
(d) The electrode potential of different cells
- 25. The reduction potential of an electrode increases.**
- (a) with decrease in concentration of the ions
(b) with addition of other salt solution
(c) with increase in concentration of ions
(d) with the removal of power supply to the cell
- 26. The EMF of the cell, when the cell attains equilibrium is :**
- (a) 1 (b) Zero
(c) Maximum (d) 0.0591
- 27. Which metal can be used in cathodic protection of iron.**
- (a) Na (b) Cd
(c) Li (d) Zn

- 28. Which type of cell is used in hearing aids ?**
- Zn/MnO₂ Cell
 - Zn / HgO
 - Lead Storage Battery
 - Fuel Cell of H₂ - O₂
- 29. An electrochemical cell stops working after sometime because.**
- one of the electrodes is consumed
 - electrode potentials of both electrodes go on decreasing
 - electrode potential of both the electrodes becomes equal in magnitude
 - electrode potential of both the electrodes go on increasing
- 30. Which of the following statement is true for Daniell Cells**
- Current flows from Zn electrode to Cu electrode
 - Cations move towards Cu electrode
 - Electrons flow from Cu electrode to Zn electrode
 - Cations move towards Zn electrode
- 31. Which of the following materials are used in making mercury cell**
- Mercury - Zinc oxide
 - Zinc - Zinc oxide
 - Zinc - Mercuric oxide
 - Mercury - ammonium chloride
- 32. The unit of conductance is**
- S m² Mol⁻¹
 - S m⁻¹
 - m⁻¹
 - S (Siemens)
- 33. Specific conductance**
- decreases with dilution
 - decreases with increase in concentration
 - shows no variation with dilution
 - has no effect on concentration
- 34. When lead storage battery is discharged**
- SO₂ is evolved
 - lead sulphate is consumed
 - lead is formed
 - sulphuric acid is consumed
- 35. In which cell, the free energy of a chemical reaction is directly converted into electricity ?**
- Leclanche cell
 - Concentration Cell
 - Fuel Cell
 - Lead storage battery
- 36. A standard hydrogen electrode has zero electrode potential because**
- hydrogen is easier to oxidise
 - this electrode potential is assumed to be zero
 - hydrogen atom has only one electron
 - hydrogen is the lightest element

37. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3 because

- (a) Zn acts as an oxidising agent when reacts with HNO_3
- (b) HNO_3 is weaker acid than H_2SO_4 and HCl
- (c) In electrochemical series, Zn is above hydrogen
- (d) NO_3^- is reduced in preference to hydronium ion

38. Saturated solution of KNO_3 is used to make 'salt bridge' because

- (a) Velocity of K^+ is greater than that of NO_3^-
- (b) Velocity of NO_3^- is greater than that of K^+ .
- (c) Velocities of both K^+ and NO_3^- are nearly the same
- (d) KNO_3 is highly soluble in water

39. The conductivity of strong electrolyte

- (a) increases slightly on dilution
- (b) decreases on dilution
- (c) does not change with dilution
- (d) depends upon the density of electrolyte

40. The molar conductivities Λ_{NaOAc}^0 and Λ_{HCl}^0 at infinite dilution in water at $25^\circ C$ are 91.0 and $426.2 \text{ Ohm}^{-1} \cdot \text{cm}^2 \cdot \text{Mol}^{-1}$ respectively. To calculate Λ_{HOAc}^0 the additional value required is

- (a) Λ_{NaOH}^0
- (b) Λ_{NaCl}^0
- (c) $\Lambda_{H_2O}^0$
- (d) Λ_{KCl}^0

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (c) | 11. (b) | 21. (d) | 31. (c) |
| 2. (b) | 12. (d) | 22. (b) | 32. (d) |
| 3. (a) | 13. (b) | 23. (a) | 33. (a) |
| 4. (d) | 14. (d) | 24. (a) | 34. (d) |
| 5. (d) | 15. (c) | 25. (c) | 35. (b) |
| 6. (b) | 16. (b) | 26. (b) | 36. (b) |
| 7. (b) | 17. (b) | 27. (d) | 37. (d) |
| 8. (c) | 18. (c) | 28. (b) | 38. (c) |
| 9. (a) | 19. (a) | 29. (c) | 39. (a) |
| 10. (b) | 20. (b) | 30. (b) | 40. (b) |

II. Short Questions

Q.1. Illustrate the differences between electrochemical cell and electrolytic cell.

Ans. Electrochemical Cell

Electrolytic Cell

(i) It is the device to convert chemical energy into electrical energy.

(i) It is the device to convert electrical energy to chemical energy.

(ii) It is spontaneous redox reaction

(ii) It is non-spontaneous redox reaction.

(iii) Salt bridge is used

(iii) No salt bridge is used

Q.2. What is the relationship between Gibb's free energy ΔG and electrical energy E_{Cell} ?

Ans. $-\Delta G = nFE_{\text{Cell}}$ where $\Delta G =$ Gibb's free energy. (Work done)

Electrical work done where $n =$ number of electrons.

$F =$ Faraday, $E_{\text{Cell}} =$ EMF for the Cell

Q.3. Calculate E_{Cell}^0 of the cell $\text{Zn}/\text{Zn}^{2+} \parallel \text{Cu}^{2+}/\text{Cu}$.

Where $E_{\text{Zn}, \text{Zn}^{2+}}^0 = -0.76$ Volt, $E_{\text{Cu}, \text{Cu}^{2+}}^0 = 0.34$ Volt

Ans. $E_{\text{Cell}}^0 =$ Standard Electrode Potential of Right hand side - Standard Electrode Potential of Left hand side
 $=$ Reduction potential of Cu electrode - Reduction Potential of Zn electrode
 $= 0.34$ Volt - (- 0.76) Volt
 $= 1.10$ Volt

Q.4. State Kohlrausch's law. How will you calculate λ^0 of $\text{Ba}(\text{OH})_2$ with the help of this law?

Ans. Kohlrausch law for $\text{AxBy} = x\lambda_+^0 + y\lambda_-^0$

For $\text{Ba}(\text{OH})_2 \rightarrow \text{Ba}^{2+} + 2\text{OH}^-$

$$\Lambda_{\text{Ba}(\text{OH})_2}^0 = \lambda_{\text{Ba}^{2+}}^0 + 2\lambda_{\text{OH}^-}^0$$

Q.5. Define the terms : specific conductance and equivalent conductance.

Ans. Specific Conductance = Conductance of one centimeter cube of the solution of the

electrolyte i.e. $K = \frac{1}{\rho} \times \frac{l}{a}$

Equivalent Conductance $\Lambda_{\text{eq}} = K \times \frac{1000}{\text{Normality}}$

Q.6. Write notes on reduction and oxidation potential.

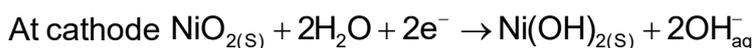
Ans. Oxidation potential, if oxidation takes place at the electrode with respect to standard hydrogen electrode.

Reduction potential, if reduction takes place at the electrode with respect to standard hydrogen electrode.

Q.7. What is secondary cell? Give the cell reaction of Nickel-Cadmium storage cell.

Ans. The secondary cells are those which can be recharged by passing an electric current through them and then can be used over and over again.

Nickel - Cadmium cell consists of a cadmium electrode (as anode) and a metal containing Nickel (IV) oxide (as cathode) immersed in KOH solution.



Q.8. Why a dry cell becomes dead after a long time even if it has not been used ?

Ans. In dry cell NH_4Cl is used. This corrodes the zinc container even if not used for long time.

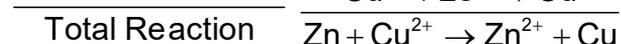
Q.9. Explain the terms specific, equivalent and molar conductivity. How they are inter-related?

Ans. $\Lambda_{\text{eq}}^0 = K \times \frac{1000}{\text{Normality}}$ and $\Lambda_{\text{m}}^0 = K \times \frac{1000}{\text{Normality}}$, $K = \text{Specific conductivity}$

Q.10. Describe the construction of Daniell Cell and the reaction involved. How is it represented ?

Ans. Daniel Cell : The Zinc electrode dipped into Zinc sulphate solution and copper electrode dipped into copper sulphate solution. Oxidation takes place at Zn electrode and reduction takes place at Cu electrode. Both solutions are connected with salt bridge.

The reactions are:



The cell is represented as. $\text{Zn/ZnSO}_4 \parallel \text{CuSO}_4 \mid \text{Cu}$.

Q.11. Give short notes of corrosion ? How it can be prevented ?

Ans. Corrosion : The process of slowly eating away of the metal due to attack of the atmospheric gases on the surface of the metal resulting into the formation of compound. It can be protected :

- (i) By coating with paint
- (ii) The metal is covered with more active metal
- (iii) Making cathodic protections
- (iv) Using anti rust solution

Q.12. What is difference between Galvanic Cell (electrochemical cell) and electrolytic cell?

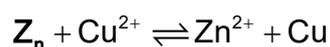
Ans. Galvanic cell is an electrochemical cell and Electrolytic cell is the conversion of electrical energy to chemical energy.

Q.13. Why is it necessary to use salt bridge in a galvanic cell?

Ans. Salt bridge is used to complete the inner circuit and maintain the electrical neutrality in the solution.

Q.14. Equilibrium constant is related to E_{Cell}^0 but not E_{Cell} . Explain why?

Ans. When equilibrium is reached in the cell reaction, E_{Cell} becomes zero. Hence applying Nernst equation at the cell reaction.



$$E_{\text{Cell}} = E_{\text{Cell}}^0 - \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} \text{ or } E_{\text{Cell}}^0 = \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = \frac{RT}{nF} \ln K_c$$

Q.15. Why a mercury cell gives a constant voltage throughout its life ?

Ans. Because the electrolyte KOH is not consumed in the reaction.

Q.16. Which type of Cells are rechargeable?

Ans. The rechargeable cell in which the product formed during discharge are deposited on the electrodes and these can be decomposed when electrical energy is supplied.

Q.17. Give the relationship between molar conductivity and specific conductivity.

Ans. $\Lambda_m^0 = K \times \frac{1000}{\text{Molarity}}$ Where K = specific conductivity.

Q.18. What is EMF of a Cell?

Ans. The difference between the electrode potentials of the two half cells is known as EMF of the cell.

Q.19. How Nernst equation can be applied in the calculation of equilibrium constant of any cell reaction?

Ans. Let us take the cell as $\text{Zn}/\text{ZnSO}_4 \parallel \text{CuSO}_4/\text{Cu}$

At equilibrium the flow of electrons from Zn to Cu stops.

When $E_{\text{Zn}^{2+}/\text{Zn}}$ equals with $E_{\text{Cu}^{2+}/\text{Cu}}$.

Applying Nernst equation for the cell potential

$$E_{\text{Cell}} = E_{\text{Cell}}^0 + \frac{RT}{nF} \ln \frac{[\text{Cu}^{2+}]}{[\text{Zn}^{2+}]} = E_{\text{Cell}}^0 - \frac{RT}{nF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$$

Taking $\frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = K_c$ then the equation is $0 = E_{\text{Cell}}^0 - \frac{RT}{nF} \ln K_c$

$$\text{or } E_{\text{Cell}}^0 = \frac{RT}{nF} \ln K_c.$$

Q.20. Why does galvanic cell become dead after sometime?

Ans. During lapse of time concentrations of electrolytic solutions change so as electrode potentials. When the electrode potentials of the two half cells becomes equal, the cell stops working.

Q.21. Why rusting of iron is more in saline water than in pure water.

Ans. In saline water Na^+ and Cl^- ions are more which increases the conductance of the solution in contact with metal surface. This accelerates the formation of Fe^{2+} ion and helps for rusting.

UNIT - IV

CHEMICAL KINETICS

I. Select the correct answer from the choices given under each bit :

- The rate at which a substance reacts depends upon its**
 - atomic mass
 - equivalent mass
 - molecular mass
 - active mass
- The rate of reaction that does not involve gases is not dependent on**
 - pressure
 - temperature
 - concentration
 - catalyst
- According to collision theory**
 - all collisions are sufficiently violent
 - all collisions are responsible for product formation
 - all collisions are effective
 - only a fraction of collisions are effective which have enough energy to form products
- Activation energy of the reaction is**
 - the energy released during the reaction
 - the energy evolved when activated complex is formed
 - minimum amount of energy needed to overcome the potential energy barrier
 - the energy needed to form one mole of the product
- Which one of the following is not a first order reaction?**
 - $\text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{CH}_3\text{COOH} + \text{CH}_3\text{OH}$
 - $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{C}_2\text{H}_5\text{OH}$
 - $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
 - $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$
- For a reaction $2\text{A} + \text{B} \rightarrow \text{C} + \text{D}$, the concentration of B is kept constant and that of A is tripled, the new rate of reaction will be**
 - nine times
 - three times
 - same
 - zero
- For the reaction $\text{A} \rightarrow \text{B}$, the rate of the reaction is quadrupled when the concentration of A is doubled, the rate of the reaction is $r = k[\text{A}]^n$, the value of 'n' is**
 - 1
 - zero
 - 3
 - 2
- A zero order reaction is one**
 - in which the reactants do not react
 - in which one of the reactants is in large excess
 - whose rate is uniform and not affected by time
 - whose rate increases with time

9. For which of the following, the units of rate and rate constant of the reaction are identical ?
- first order reaction
 - zero order reaction
 - second order reaction
 - fractional order reaction
10. 75% of a first order reaction was completed in 32 minutes, when was 50% of the reaction completed?
- 4 minutes
 - 8 minutes
 - 24 minutes
 - 16 minutes
11. In a first order reaction, the concentration of reactant decreases from 1.0 M to 0.25 M in 20 minutes. The value of specific rate is
- 69.32
 - 6.932
 - 0.6932
 - 0.06932
12. If the rate expression for a reaction is
- $$\frac{dx}{dt} = K[A]^{1/2}[B]^{3/2}$$
- the overall order of the reaction is
- 2
 - $\frac{1}{2}$
 - $\frac{3}{2}$
 - 1
13. Which of the following statements regarding molecularity of the reaction is wrong?
- it may be either whole number or fractional
 - it is calculated from the reaction mechanism
 - it depends on the rate determining step
 - it is number of molecules of reactants taking part in a single step chemical reaction
14. A graph between time (t) and the substance consumed at any time is found to be a straight line passing through the origin. This indicates that the reaction is of
- Second order
 - First order
 - Zero order
 - Fractional order
15. In pseudo-unimolecular reactions
- one of the reactants is present in large excess
 - both the reactants have same concentration
 - both the reactants are present in low concentration
 - one of the reactants is less reactive

16. Which plot can give us the value of activation energy?
- K versus T
 - $\frac{1}{K}$ versus T
 - Log K versus $\frac{1}{T}$
 - C versus T
17. The rate of a reaction can be increased in general by all the following factors except
- by increasing the temperature
 - using a suitable catalyst
 - by increasing the concentration of reactants
 - by an increase in activation energy
18. Radioactive disintegration is an example of
- zero order reaction
 - first order reaction
 - second order reaction
 - third order reaction
19. The half life period of a first order reaction $A \rightarrow$ products is 10 minutes. In what period of time is the concentration of A is reduced to 10% of the original concentration ?
- 26 minutes
 - 71 minutes
 - 33 minutes
 - 90 minutes
20. The number of molecules of the reactants taking part in a single step of the reaction tells about
- Molecularity of the reactoin
 - Mechanisms of the reaction
 - Order of reaction
 - All of the above
21. For a first order reaction, the half life is independent of
- initial concentration
 - cube root of initial concentration
 - first power of final concentration
 - square root of final concentration
22. Activation energy of a chemical reaction can be determined by
- changing the concentration of reactants
 - evaluating rate constant at standard temperature
 - evaluating rate constants at two different temperatures
 - evaluating velocities of reaction at two different temperatues
23. For a first order reactives $A \rightarrow$ Prodcuts, the half life time is 100 seconds. The rate constant of the reaction is
- $6.93 \times 10^{-3} \text{ Sec}^{-1}$
 - $6.9 \times 10^{-2} \text{ Sec}^{-1}$
 - $6.93 \times 10^{-4} \text{ Sec}^{-1}$
 - $6.93 \times 10^{-1} \text{ Sec}^{-1}$

24. In a first order reaction, the concentration of the reactant decreases from 0.8 M to 0.4M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is
- (a) 30 minutes
 (b) 15 minutes
 (c) 7.5 minutes
 (d) 60 minutes
25. Which of these does not influence the rate of reaction ?
- (a) Nature of the reactants
 (b) Concentration of the reactants
 (c) Temperature of the reaction
 (d) Molecularity of the reaction
26. $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
 What is the ratio of the rate of decomposition of N_2O_5 to the rate of formation of NO_2 ?
- (a) 1 : 2 (b) 2 : 1
 (c) 1 : 4 (d) 4 : 1
27. The time required for 100% completion of a zero order reaction is
- (a) ak (b) $\frac{a}{2k}$
 (c) $\frac{a}{k}$ (d) $\frac{2k}{a}$
28. A first order reaction has a rate constant $1.15 \times 10^{-3} \text{ s}^{-1}$. How long will 5 gm of this reactant take to reduce to 3 gm?
- (a) 444 s
 (b) 402 s
 (c) 442 s
 (d) None of these
29. The half-life period of a first order chemical reaction is 6.93 min. The time required for the completion of 99% of the chemical reaction will be ($\log 2=0.301$)
- (a) 230.3 min.
 (b) 23.03 min.
 (c) 46.06 min.
 (d) 460.6 min.
30. By increase in temperature by 10K, the rate of reaction becomes double. How many times the rate of reaction will be if the temperature is increased from 303K to 353 K?
- (a) 4 (b) 8
 (c) 16 (d) 32
31. Activation energy of a reaction
- (a) is independent of temperature
 (b) increases with temperature
 (c) gets doubled for every 10 degree rise of temperature
 (d) decreases with the rise in temperature

32. Which one of the following statement for order of reaction is not correct ?

- (a) order can be determined experimentally
- (b) order of a reaction is equal to sum of the power of concentration terms in differential rate law
- (c) it is not affected with stoichiometric coefficient of the reactants
- (d) order can not be fractional

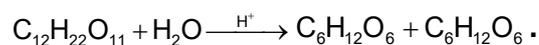
33. The minimum energy required to the reacting molecules to undergo reaction is

- (a) Potential energy
- (b) Kinetic energy
- (c) Thermal energy
- (d) Activation energy

34. A reaction involving two different reactants can never be

- (a) bimolecular reaction
- (b) second order reaction
- (c) first order reaction
- (d) unimolecular reaction

35. The inversion of cane sugar is represented by



It is a reaction of

- (a) second order
- (b) unimolecular
- (c) pseudo unimolecular
- (d) zero order

36. For the reaction $A \rightarrow B$, the rate law is, $\text{rate} = K[A]$. Which of the following statements is incorrect ?

- (a) the reaction follows first order kinetics
- (b) the $t_{\frac{1}{2}}$ of the reaction depends on initial concentration
- (c) K is constant for the reaction at a constant temperature
- (d) the rate law provides a simple way of predicting the concentration of reactions at any time after the start of the reaction

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|--------|---------|---------|---------|
| 1. (d) | 10. (d) | 19. (c) | 28. (a) |
| 2. (a) | 11. (d) | 20. (a) | 29. (c) |
| 3. (d) | 12. (a) | 21. (a) | 30. (d) |
| 4. (c) | 13. (a) | 22. (c) | 31. (d) |
| 5. (b) | 14. (c) | 23. (a) | 32. (d) |
| 6. (a) | 15. (a) | 24. (a) | 33. (d) |
| 7. (d) | 16. (c) | 25. (d) | 34. (d) |
| 8. (c) | 17. (d) | 26. (b) | 35. (c) |
| 9. (b) | 18. (b) | 27. (c) | 36. (b) |

II. Short Questions

Q.1. Powdered sugar dissolves faster than crystalline sugar, explain.

Ans. Powdered sugar has greater surface area than crystalline sugar. Sugar molecules come closer to water molecules with greater ease and thus dissolve faster than crystalline sugar.

Q.2. Hydrogen and oxygen do not react at room temperature. Explain.

Ans. At room temperature, there is no reaction between hydrogen and oxygen as the activation energy of the reaction is very high.

Q.3. State average rate of reaction.

Ans. The rate measured over a long time interval is called the average rate.

Average rate of reaction =

$$-\frac{\text{decrease in conc. of reactant}}{\text{Time taken}} = \frac{\text{+ increase in conc. of product}}{\text{Time taken}}$$

Q.4. What is half-life period of a reaction ?

Ans. The time taken to react half of the initial concentration or it is the time required for the completion of half of the reaction.

Q.5. What do you mean by Pseudo unimolecular reaction ?

Ans. Some reactions involve two molecules, but the concentration of one molecule changes with time. But the conc. change of the second molecule has little effect on the reaction. Hence the rate only depends upon the conc. of the molecule which changes with respect to time. This is Pseudo unimolecular reaction.

Q.6. Write the rate equation for a zero order reaction.

Ans.
$$K = -\frac{d[A]}{dt} = \frac{a_0 - a}{t}$$

Where A = reactant molecule, a_0 = initial conc. of A and a = conc. at time 't'.

Q.7. What is specific reaction rate ?

Ans. The specific reaction rate of the reaction when the molar conc. of each reactant is unity. The rate K when either conc. of each reactant is 1 Mol. L⁻¹ or order with respect to each reactant is zero, i.e. reaction is zero order.

Q.8. What is temperature co-efficient?

Ans. The ratio of rate constants of a reaction at two temperatures differing by 10°C is known as temperature co-efficient.

Q.9. What do you mean by threshold energy ?

Ans. The minimum amount of energy which must be associated with molecules so that their mutual collisions result in chemical reaction is called threshold energy.

Q.10. What is rate determining step ?

Ans. The slowest step is called the rate determining step.

UNIT - V

SURFACE CHEMISTRY

I. Select the correct answer from the choices given under each bit :

1. The adsorption is :

- (a) endothermic (b) exothermic
(c) neutral (d) none of these

2. Smoke is a colloidal sol of :

- (a) solid dispersed in liquid
(b) solid dispersed in gas
(c) gas dispersed in solid
(d) gas dispersed in liquid

3. Which of the following has maximum value of flocculation power?

- (a) Pb^{2+} (b) Sr^{2+}
(c) Na^+ (d) Pb^{4+}

4. The minimum concentration of an electrolyte which is able to cause coagulation of a sol is termed as its :

- (a) gold number
(b) saponification value
(c) flocculation value
(d) emulsification value

5. Milk is :

- (a) Fat dispersed in water
(b) Fat dispersed in oil
(c) Water dispersed in oil
(d) Water dispersed in fat

6. Adsorption is more :

- (a) on crystal surface
(b) finely divided surfaces
(c) on perfect solid surface
(d) on regular size of solid surface

7. When electric field is applied to colloidal solution

- (a) colloidal particles move towards the oppositely charged electrode
(b) movement of particles is seized
(c) multimolecular colloids are formed
(d) none of the above

8. Peptisation is a process of

- (a) purification of colloids
(b) precipitation of colloidal particles
(c) movement of colloidal particles in the electrical field
(d) dispersing precipitate into colloidal sols.

9. Alum purify muddy water by

- (a) Dialysis
(b) Coagulation
(c) Adsorption
(d) Forming true solution

- 10. Blood may be purified by**
- Dialysis
 - Electroosmosis
 - Coagulation
 - Filtration
- 11. The blue colour of water in sea is due to :**
- Refraction of blue light by impurities in sea water
 - Scattering of light by water
 - Refraction of blue sky by water
 - None of these
- 12. Reversible adsorption is :**
- Chemical adsorption
 - Physical adsorption
 - Both
 - None
- 13. Fog is an example of colloidal system of :**
- liquid dispersed in gas
 - gas dispersed in gas
 - solid dispersed in gas
 - solid dispersed in liquid
- 14. Which of the following is correct about lyophilic sols?**
- they are irreversible
 - they are readily coagulated by addition of electrolytes
 - they are self stabilised
 - they are formed by inorganic substances
- 15. A plot of $\log x/m$ versus $\log p$ for the adsorption of a gas on a solid gives a straight line with slope equal to**
- $\log K$
 - $1/n$
 - n
 - $-\log K$
- 16. Which of the following is a false statement :**
- butter is an example of gel
 - haircream is an example of emulsion
 - whipped cream is an example of foam
 - Cheese is an example of emulsion
- 17. The presence of electric charge on colloidal particles is indicated by the property called**
- dialysis
 - osmosis
 - electrophoresis
 - solubility
- 18. The formation of Micelles which occurs only beyond a certain temperature is called**
- Critical temperature
 - Critical sol. temperature
 - Kraft temperature
 - Consulate temperature
- 19. Gelatine is mostly used in making ice creams in order to**
- prevent crystallisation and stabilise the mixture
 - prevent forming the colloidal sol.
 - enrich the fragrance
 - Modify the test

- 20. Colloidal sol is :**
- true solution
 - heterogeneous sol.
 - suspension
 - homogeneous sol.
- 21. The experimental observation shows Freundlich adsorption isotherm valid**
- at low temperature
 - at high temperature
 - at high pressure
 - at low pressure
- 22. Which one of the following electrolyte is most effective for the coagulation of $\text{Fe}(\text{OH})_3$ sol.**
- NaCl , Na_2SO_4 , Na_3PO_4 .**
- NaCl
 - Na_2SO_4
 - Na_3PO_4
 - None of these
- 23. Ferric Chloride is applied to stop bleeding due to a cut because :**
- Fe^{3+} ion coagulates blood which is a negatively charged sol.
 - Fe^{3+} ion coagulates blood which is a positively charged sol.
 - Cl^- ion coagulates blood which is a positively charged sol.
 - Cl^- ion coagulates blood which is a negatively charged sol.
- 24. The size of colloidal particles lies in the range.**
- 10 mm to 1000 mm
 - 1 nm to 1000 nm
 - 10 $\text{m}\mu$ to 1000 $\text{m}\mu$
 - 10^{-5} cm to 10^{-7} cm
- 25. A catalyst increases the rate of reaction because it.**
- increases the activation energy
 - lowers the energy barrier of reaction
 - decreases the collision of atoms or molecules
 - increases the temperature co-efficient
- 26. Reversible adsorption is**
- chemical adsorption
 - physical adsorption
 - both
 - none
- 27. The ability of an ion to bring about coagulation of a given colloid depends upon :**
- the size of the ion
 - the sign of charge alone
 - the magnitude of charge
 - both magnitude and charge

28. An arsenious sulphide sol carries a negative charge. The maximum precipitating power of this sol is possessed by
- (a) K_2SO_4 (b) $CaCl_2$
(c) $AlCl_3$ (d) Na_3PO_4
29. Cellulose dispersed in ethanol is called :
- (a) Emulsion
(b) Micelle
(c) Colloid
(d) Hydrophillic sol.
30. A colloidal system in which gas bubbles are dispersed in a liquid is known as :
- (a) foam (b) aerosol
(c) sol (d) emulsion
31. The coagulation power of an electrolyte for arsenious sulphide sol decreases in the order.
- (a) $Na^+ > Al^{3+} > Ba^{2+}$
(b) $Al^{3+} > Ba^{2+} > Na^+$
(c) $PO_4^{3-} > SO_4^{2-} > Cl^-$
(d) $Cl^- > SO_4^{2-} > PO_4^{3-}$
32. The rate of physical adsorption increases with
- (a) decrease in temperature
(b) increase in temperature
(c) decrease in pressure
(d) decrease in surface area
33. Which gas is readily adsorbed by activated charcoal ?
- (a) N_2 (b) SO_2
(c) H_2 (d) O_2
34. In coagulating the Colloidal solution of As_2S_3 which has the minimum coagulating value ?
- (a) $NaCl$ (b) $BaCl_2$
(c) $AlCl_3$ (d) KCl
35. Absorption of gases on solid surface is generally exothermic because
- (a) enthalpy is positive
(b) entropy decreases
(c) entropy increases
(d) free energy increases
36. An example of autocatalyst is
- (a) Oxidation of NO to NO_2
(b) Oxidation of SO_2 to SO_3
(c) Decomposition of $KClO_3$ to KCl & O_2
(d) Oxidation of oxalic acid by acidified $KMnO_4$
37. Which acts as autocatalyst during titration of $KMnO_4$ and oxalic acid in presence of H_2SO_4 ?
- (a) H_2SO_4
(b) $KMnO_4$
(c) Oxalic acid
(d) $MnSO_4$

38. Which of the following are aerosols?

- (a) smoke and fog
- (b) smoke and butter
- (c) fog and milk
- (d) milk and butter

39. Which of the following is correctly matched ?

- (a) Butter-aerosol
- (b) Milk-emulsion
- (c) Fog-gel
- (d) Butter-solid sol.

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 11. (a) | 21. (d) | 31. (b) |
| 2. (b) | 12. (b) | 22. (c) | 32. (a) |
| 3. (d) | 13. (a) | 23. (a) | 33. (b) |
| 4. (c) | 14. (c) | 24. (b) | 34. (c) |
| 5. (a) | 15. (b) | 25. (b) | 35. (b) |
| 6. (b) | 16. (d) | 26. (b) | 36. (d) |
| 7. (a) | 17. (c) | 27. (d) | 37. (d) |
| 8. (d) | 18. (c) | 28. (c) | 38. (a) |
| 9. (b) | 19. (a) | 29. (c) | 39. (b) |
| 10. (a) | 20. (b) | 30. (a) | |

II. Short Questions

Q.1. Derive Freundlich adsorption isotherm equation.

Ans. $x/m = KP^n$

where $n > 1$, x is mass of adsorbate, m is mass of adsorbent, P = pressure of the gas and K, n are constants.

Q.2. What are lyophobic and lyophilic sols. Write the differences between them.

Ans. Lyophilic (liquid loving) - In this type of colloidal sols, the dispersed phase has great affinity for the dispersion medium.

Lyophobic (liquid hating) - In this type of colloidal sols, the dispersed phase has very little affinity for the dispersion medium.

Q.3. What are the factors which influence the adsorption?

- Ans.**
- (i) Nature and surface area of the adsorbent
 - (ii) Temperature
 - (iii) Nature of the gas being adsorbed
 - (iv) Pressure
 - (v) Activation of the solid adsorbent

Q.4. What are emulsions ? Discuss different types with one example each.

- Ans.**
- (i) Oil in water
 - (ii) Water in oil

Example -

Milk : liquid fat dispersed in water for oil in water.

Butter & Cream : Water is the dispersed phase and oil in dispersed medium for water in oil.

Q.5. Write a note on multimolecular colloids ?

Ans. Multi molecular colloids in which colloidal particles are aggregates of atoms or small molecules with molecular size less than 1 nm.

Example : Sol of sulphur is the aggregates of S_8 .

Q.6. How are the colloidal solutions purified by (i) Dialysis (ii) Ultrafiltration ?

Ans. Dialysis : The process of separating the particles of colloids from those of crystalloids by diffusion of mixture through a parchment or an animal membrane is known as dialysis.

Ultrafiltration : The colloidal solutions are purified by carrying out filtration through special type of Grade B filters called ultrafilters. By using a series of these graded filters, solute impurities of different sizes can be effectively removed.

Q.7. What is Tyndal effect ? Explain with the help of diagram.

Ans. Tyndal effect may be defined as the scattering of light by the colloidal particles present in a colloidal sol.

Q.8. Write the differences of physical adsorption and Chemical adsorption (four points).

Ans. Physical adsorption in which the gas is held at the surface by Vander Waals forces (weak intermolecular force).

Chemical adsorption in which the gas is held on to the surface of a solid by forces similar to that of chemical bond, the type of adsorption is called chemical adsorption.

Q.9. What are Micells ? How do they differ from normal colloidal solution?

Ans. The substances when dissolved in a medium at low concentrations behave as normal, strong electrolytes but at higher concentrations exhibit colloidal state due to formation of aggregated particles. These aggregated particles are called micelles. Each micelle contains at least 100 molecules.

Q.10. Describe briefly the cleaning action of soap.

Ans. When grease or oil of the cloth comes in contact with soap solution, the stearate ions arrange themselves around it in such a way that the hydrophobic parts of the stearate ions are in the oil and the hydrophilic parts project outside the grease droplet. As a result the oil droplet is pulled away from the cloth to the water form ionic micelle which then washed away with excess water.

Q.11. What are the differences between absorption and adsorption?

Ans.	Adsorption	Absorption
(i)	Surface phenomena	(i) Bulk phenomena
(ii)	Conc. at the surface is different from that of bulk	(ii) Conc. is same throughout.
(iii)	Rate slowly decreased till equilibrium achieved	(iii) Rate remains same throughout the process.

Q.12. Why adsorption is always exothermic ?

Ans. When adsorption takes place, surface energy decreases. This appears in the form of heat called heat of adsorption. Hence adsorption is an exothermic process.

Q.13. What are two classes of emulsion? Give one example of each.

Ans. See Question No. 4.

Q.14. Why are powdered substances more effective adsorbent than their crystalline forms ?

Ans. Adsorption is a surface phenomena, depends upon surface area. Powdered substances have more surface area than crystalline forms hence more effective.

Q.15. What are the factors which influence the adsorption of a gas on solid ?

Ans. See Question No. 3.

(i) Nature and surface area of adsorbents, (ii) Temperature, (iii) Nature of the gas being adsorbed, (iv) Pressure, (v) Activation of solid adsorbent.

Q.16. What is the difference between multimolecular and macromolecular colloids?

Ans. As layers of the gas is adsorbed one over the other by Vander Waal's force of attraction, multimolecular layers are formed under high pressure. Macromolecular such as protein molecules present in egg (white part) are macromolecules.

Q.17. What is main cause of charge on a colloidal solution ?

Ans. The main cause due to adsorption of common ions of the electrolyte on the surface of colloidal particles.

Q.18. Describe the terms (i) Brownian movement, (ii) Tyndal effect.

Ans. (i) Brownian Movement : Continuous Zigzag movement of the colloidal particles in a colloidal sol.

(ii) See question No. 7.

Q.19. What is Coagulation ? Discuss on protective colloids.

Ans. The precipitation of Colloids through induced aggregation by the addition of suitable electrolyte is called coagulation or flocculation.

Protective Colloids : Addition of certain lyophilic colloids like gum, soap, gelatine etc. to lyophobic colloids like a metal sol show difficult to coagulate by the addition of electrolyte. The process is known as 'protection' and the lyophilic colloids are termed as 'protective colloids'. The protective action of the lyophilic colloids is due to covering up of particles of the lyophobic colloids.

Q.20. Write notes on (i) Gold number, (ii) Hardy - Schultz rule.

Ans. (i) **Gold Numbers** of a protective colloid is the minimum weight of it in milligrams which must be added to 10 mL of a standard red gold sol (containing 0.5 to 0.06 g of gold per litre) so that no coagulation of the gold sol (i.e. change of colour from red to blue) takes place when 1 mL of 10% sodium chloride solution is rapidly added to it.

(ii) **Hardy - Schultz Rule** : The quantity of the electrolyte which is required to coagulate a definite amount of a colloidal solution depends upon the valency of the coagulating ion (having charge opposite to that of the colloidal particles). This is known as Hardy-Schultz Rule.

Q.21. Why does physical adsorption decreases with increase in temperature?

Ans. Physical adsorption is always accompanied by formation heat. So increase in temperature leads to desorption.

Q.22. How do you obtain a colloidal sol of arsenious sulphide ?

Ans. A colloidal sol of arsenious sulphide is obtained by passing H_2S into a solution of arsenious oxide in distilled water. $\text{As}_2\text{O}_3 + 3\text{H}_2\text{S} \rightarrow \text{As}_2\text{S}_3 + 3\text{H}_2\text{O}$

Q.23. What is artificial rain ?

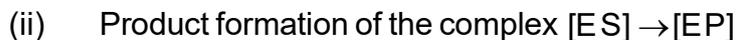
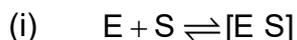
Ans. Artificial rain is caused by spraying oppositely charged colloidal dust or sand particles over the clouds by aeroplane. The colloidal water particles of the clouds get neutralised and coagulate to bigger water drops which cause artificial rain.

Q.24. What are enzymes ? Write brief mechanism of enzyme catalysis.

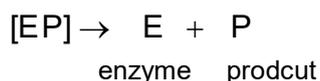
Ans. Enzymes are complex proteinous substances produced by living bodies. Such as plants and animals. They are high molecular mass ranging from 15,000 to 1,000,000 g mol^{-1} . They can be obtained in the pure crystalline state from the living cells.

Mechanism of Enzyme Catalysis :

Enzyme first bind with a substrate (S) to form [ES] complex.



(iii) Dissociation of complex to form products



UNIT - VII

p-BLOCK ELEMENTS (GROUP 15 & GROUP 16)

I. Select the correct answer from the choices given under each bit :

- The reddish brown colour gas formed when nitric oxide is oxidised by air is**
(a) N_2O_5 (b) N_2O_4
(c) NO_2 (d) N_2O_3
- Among trihalides of nitrogen, which one is the least basic**
(a) NF_3 (b) NCl_3
(c) NBr_3 (d) NI_3
- Nitrogen does not form pentahalide because**
(a) small in size
(b) having high ionisation energy
(c) No d-orbital is available
(d) having high electronegativity
- Which of the following oxides is the most acidic ?**
(a) N_2O_5 (b) P_2O_5
(c) As_2O_5 (d) Sb_2O_5
- The oxidation number of sulphur in S_8 , S_2F_2 and H_2S respectively are**
(a) 0, +1 and -2
(b) +2, +1 and -2
(c) 0, +1 and +2
(d) -2, +1 and -2
- Polyphosphates are used as water softening agents because they**
(a) form soluble complexes with anionic species
(b) precipitate anionic species
(c) form soluble complexes with cationic species
(d) precipitate cationic species
- The number of hydrogen atoms attached to hypophosphorus acid is**
(a) Zero (b) Two
(c) One (d) Three
- The basic nature of NH_3 and PH_3 shows**
(a) $\text{NH}_3 > \text{PH}_3$ (b) $\text{PH}_3 > \text{NH}_3$
(c) $\text{PH}_3 = \text{NH}_3$ (d) Zero
- Which substance of the following has the highest proton affinity?**
(a) PH_3 (b) H_2O
(c) H_2S (d) NH_3
- On boiling phosphorus with KOH solution, produces**
(a) Potassium sulphate
(b) Phosphorus pentoxide
(c) Phosphorus hydroxide
(d) Phosphine

11. The element which forms oxides in all oxidation states +I to +V is
 (a) N (b) P
 (c) As (d) Sb
12. Which of the following oxides of nitrogen is solid ?
 (a) NO_2 (b) N_2O
 (c) N_2O_3 (d) N_2O_5
13. The Nitrogen forms variety of compounds in all oxidation states ranging from.
 (a) -3 to +5 (b) -3 to +3
 (c) -3 to +4 (d) -3 to +6
14. A gas dissolved in FeSO_4 solution giving brown ring. The gas is
 (a) N_2O_3 (b) NO_2
 (c) N_2O (d) NO
15. The general configuration of electronic arrangement in group 15 elements
 (a) ns^2np^2 (b) ns^2np^1
 (c) ns^1np^3 (d) ns^2np^3
16. The bond angle of ppp in P_4 has
 (a) 90° (b) 60°
 (c) 120° (d) 75°
17. Lead reacts with cold dilute HNO_3 , gives
 (a) NH_4NO_3 (b) N_2O
 (c) NO (d) NO_2
18. SO_2 differs from CO_2 in that it :
 (a) does not turn lime water milky
 (b) dissolves in water to form an acid
 (c) combines with O_2
 (d) supports is burning of Mg
19. Aqua regia is
 (a) 3 parts conc HNO_3 + 1 part conc HCl
 (b) 3 parts conc H_2SO_4 + 1 part conc HCl
 (c) 3 parts conc HNO_3 + 1 part conc H_2SO_4
 (d) 3 parts conc HCl + 1 part conc HNO_3
20. Ortho phosphoric acid has the formula of
 (a) H_3PO_4 (b) HPO_3
 (c) H_3PO_2 (d) H_3PO_3
21. What are the oxidation states of S in the following compounds PbS , SO_2 , SF_6 and H_2SO_3
 (a) -2, +2, +1, +4
 (b) -1, +2, +1, +4
 (c) -2, +4, +6, +4
 (d) -2, +4, +1, +4
22. The order of thermal stability of the following compounds H_2S , H_2Se , H_2Te , H_2O
 (a) $\text{H}_2\text{O} > \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$
 (b) $\text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te} > \text{H}_2\text{O}$
 (c) $\text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{O}$
 (d) $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$

23. Sulphuric acid is a covalent molecule having hexavalent sulphur atom. Its structure is
- (a) Planar (b) Tetrahedral
(c) Octahedral (d) Trigonal
24. H_2SO_4 is a dibasic acid but the ionisation constants slow
- (a) $\frac{1}{K_{a_1}} > \frac{1}{K_{a_2}}$ (b) $K_{a_1} < K_{a_2}$
(c) $K_{a_2} < K_{a_1}$ (d) $K_{a_1} = K_{a_2}$
25. H_2O is liquid but H_2S is gas, because
- (a) Hydrogen bonding takes place in H_2O
(b) Hydrogen bonding takes place in H_2S
(c) Electronegativity of sulphur is more than oxygen
(d) Small size of sulphur atom
26. The maximum covalency of Sulphur is
- (a) 2 (b) 4
(c) 8 (d) 6
27. Which of the following halides is most acidic
- (a) PCl_3 (b) SbCl_3
(c) BiCl_3 (d) CCl_4
28. The cyclic Metaphosphoric acid is having P-O-P bonds
- (a) Zero (b) Three
(c) Two (d) Four
29. In NO_3^- ion, the number of bond pair and lone pair of electrons on nitrogen atom are
- (a) 2, 2 (b) 3, 1
(c) 1, 3 (d) 4, 0
30. Among the acids of phosphorus H_3PO_4 , H_3PO_2 , H_3PO_3 , the acidity is
- (a) $\text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_4$
(b) $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$
(c) $\text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_4$
(d) $\text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_2$
31. Water is oxidised to oxygen by
- (a) ClO_2 (b) KMnO_4
(c) H_2O_2 (d) Fluorine
32. For H_3PO_3 and H_3PO_4 , the correct choice is
- (a) H_3PO_3 is dibasic and reducing
(b) H_3PO_3 is dibasic and non-reducing
(c) H_3PO_4 is tribasic and reducing
(d) H_3PO_3 tribasic and non-reducing
33. Which of following isomers of phosphorus is thermodynamically more stable ?
- (a) red (b) black
(c) yellow (d) white
34. Which of the following oxides of nitrogen is thermally most stable ?
- (a) N_2O (b) N_2O_5
(c) NO (d) N_2O_3

- 35. The brown ring test of nitrates depend upon**
- oxidation of nitric oxide to nitrogen dioxide
 - reduction of ferrous sulphate to iron
 - oxidising action of sulphuric acid
 - the reduction of nitrate to nitric oxide
- 36. The gases produced in the reaction $\text{Pb}(\text{NO}_3)_2 \xrightarrow{\Delta}$ and $(\text{NH}_4)\text{NO}_3 \xrightarrow{\Delta}$ are respectively.**
- $\text{N}_2\text{O}, \text{NO}$
 - $\text{N}_2\text{O}, \text{NO}_2$
 - NO, NO_2
 - $\text{NO}_2, \text{N}_2\text{O}$
- 37. Ozone is a powerful oxidising agent due to**
- paramagnetic nature
 - diamagnetic nature
 - presence of nascent oxygen
 - none of these
- 38. N_2O passed over sodamide forms**
- NH_3
 - N_2
 - NaN_3
 - HNO_2
- 39. When conc H_2SO_4 is heated with copper turning gives ?**
- SO_3
 - SO_2
 - HSO_3^-
 - None of these
- 40. The bond angle of SO_2 is**
- 119.5°
 - 109.5°
 - 125°C
 - 90°
- 41. In the test of SO_2 with the reaction of $\text{K}_2\text{Cr}_2\text{O}_7$ in presence of dil. H_2SO_4 is green due to**
- dichromate changes to Chromate
 - formation of $\text{Cr}_2(\text{SO}_4)_3$
 - formation of K_2SO_4
 - none of these
- 42. The brown ring in nitrate test is the formation of**
- $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$
 - $[\text{Fe}(\text{H}_2\text{O})_5\text{SO}_4]\text{NO}$
 - FeSO_4
 - none of these
- 43. Dioxygen is gas but sulphur is solid is due to**
- Oxygen forms $\text{P}\pi\text{-P}\pi$ multiple bond
 - Sulphur forms $\text{P}\pi\text{-P}\pi$ multiple bond
 - Sulphur has weak Vander Waals force
 - S - S bond is weaker
- 44. The depletion of O_3 by CFC's because of**
- F free radicals
 - Cl free radical
 - formation of F_2 molecule
 - none of these

- 45. Nitrogen shows catenation properties less than phosphorous because**
- P-P bond is weaker than N-N bond
 - N-N bond is weaker than P-P bond
 - Due to Metallic property of phosphorus
 - Nitrogen electronegativity is less than phosphorus
- 46. In the reaction of P_4 with SO_2Cl_2 forms**
- PCl_3
 - PCl_5
 - $POCl_3$
 - S_2Cl_2
- 47. PCl_5 can acts as reducing agent as:**
- P has 5 electrons in its valence cell
 - P can increase its valene cell
 - dicrese the oxidation state +5 to +3
 - it can not act as reducing agent
- 48. The electronic configuration of $nS^2 nP^4$ is placed in periodic table of**
- Gr 6
 - Gr 2
 - Gr 16
 - Gr 8
- 49. The compounds of florine with oxygen is called**
- fluerides of oxygen
 - oxides of fluorine
 - oxofluro compounds
 - none of the above
- 50. Nitric Oxide (NO) when released in air becomes**
- Green
 - Yellow
 - Orange
 - Brown
- 51. Hydride of oxygen is liquid because**
- Both the atoms are small in size
 - Forms hydrogen bonding
 - Gives Sp^3 hybridisation
 - Gives bond pair repulsion
- 52. The boiling point of PH_3 and NH_3 is**
- $PH_3 > NH_3$
 - $NH_3 > PH_3$
 - $NH_3 = PH_3$
 - None of these
- 53. N_2 is less reactive because**
- it is inert gas
 - it is gas at room temperature
 - it has high bond disassociation energy
 - N - N bond in weak
- 54. Ozone reacts with $KMnO_4$ to give**
- permanganate to manganate ion
 - violet colour changes to colourless
 - black precipitate
 - does not react

55. How the aqueous solution of nitrate can be tested ?

- (a) Nessler's reagent test
- (b) ring test
- (c) potassium dichromate test
- (d) adding HNO_3 to form block ppt

56. The chemical compound formed in the ring test of NO_3^- ions is

- (a) Pentaquanitrosyliron (II) sulphate
- (b) Nitrosylpentaquairon (II) sulphates
- (c) Pentaquanitrosoniumiron (I) sulphate
- (d) Nitrosoniumpentaquairon (I) sulphate

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (c) | 15. (d) | 29. (d) | 43. (a) |
| 2. (a) | 16. (b) | 30. (b) | 44. (b) |
| 3. (c) | 17. (c) | 31. (d) | 45. (b) |
| 4. (a) | 18. (a) | 32. (a) | 46. (b) |
| 5. (a) | 19. (d) | 33. (b) | 47. (d) |
| 6. (c) | 20. (a) | 34. (c) | 48. (c) |
| 7. (b) | 21. (c) | 35. (d) | 49. (a) |
| 8. (a) | 22. (a) | 36. (d) | 50. (d) |
| 9. (d) | 23. (b) | 37. (c) | 51. (b) |
| 10. (d) | 24. (c) | 38. (c) | 52. (b) |
| 11. (a) | 25. (a) | 39. (b) | 53. (c) |
| 12. (d) | 26. (d) | 40. (a) | 54. (d) |
| 13. (a) | 27. (a) | 41. (b) | 55. (b) |
| 14. (d) | 28. (b) | 42. (a) | 56. (c) |

p-BLOCK ELEMENTS (GROUP 17 & GROUP 18)

I. Select the correct answer from the choices given under each bit :

- In halogen group which element has highest electron affinity ?
 - F
 - Cl
 - Br
 - I
- Which of the following is used to prepare Cl_2 gas at room-temperature from conc HCl?
 - MnO_2
 - H_2S
 - KMnO_4
 - Cr_2O_3
- Which one is the anhydride of HClO_4 ?
 - ClO_2
 - Cl_2O_7
 - Cl_2O
 - Cl_2O_6
- Correct order of electron affinities of halogens is
 - $\text{F} > \text{Cl} > \text{Br} > \text{I}$
 - $\text{I} > \text{Br} > \text{Cl} > \text{F}$
 - $\text{Cl} > \text{F} > \text{I} > \text{Br}$
 - $\text{Cl} > \text{F} > \text{Br} > \text{I}$
- When chlorine reacts with dil. NaOH under cold condition, the oxidation state of chlorine changes from zero to
 - 1 to +5
 - +1 and +4
 - +5 and +3
 - 1 and +1
- Identify the incorrect statement among the following :
 - Ozone reacts with SO_2 to give SO_3
 - Silicon reacts with $\text{NaOH}(\text{aq})$ in the presence of air to give Na_2SiO_3 and H_2O
 - Cl_2 reacts with excess of NH_3 to give N_2 and HCl .
 - Br_2 reacts with hot and strong NaOH solution to give NaBr , NaBrO_4 and H_2O
- Which among the following factors is the most important in making fluorine the strongest oxidising agent?
 - Electron affinity
 - Ionisation enthalpy
 - Hydration enthalpy
 - Bond dissociation energy
- Iodine readily dissolves in potassium iodide solution giving :
 - I^-
 - KI^-
 - KI_2^-
 - KI_3
- Which one of the following reacts with glass ?
 - H_2SO_4
 - HF
 - HNO_3
 - $\text{K}_2\text{Cr}_2\text{O}_7$

10. Which one of the following can be purified by sublimation ?
- (a) F_2 (b) Cl_2
(c) Br_2 (d) I_2
11. Fluorine exhibits an oxidation state of -1 only because
- (a) It can readily accept an electron
(b) it is very strongly electronegative
(c) it is a non-metal
(d) it belongs to halogen family
12. Which of the following chloride is water insoluble?
- (a) HCl
(b) AgCl
(c) Both (a) and (b)
(d) None of the above
13. When chloride is passed through concentrated solution of KOH, the compound formed is :
- (a) $KClO_4$ (b) $KClO_3$
(c) $KClO_2$ (d) KClO
14. Which one will liberate bromine (Br_2) from KBr?
- (a) I_2 (b) SO_2
(c) HI (d) Cl_2
15. Which one of the following has lowest bond dissociation energy ?
- (a) Cl - Cl (b) F - F
(c) Br - Br (d) I - I
16. The correct order of thermal stability of hydrogen - halides (H - X) is :
- (a) $HI > HCl < HF > HBr$
(b) $HCl < HF > HBr > HI$
(c) $HF > HCl > HBr > HI$
(d) $HI > HBr > HCl > HF$
17. Which one of the following is most volatile ?
- (a) HF (b) HCl
(c) HBr (d) HI
18. What is the oxidising agent in chlorine water ?
- (a) HCl (b) $HClO_2$
(c) HOCl (d) None of these
19. The correct order of acidity of halogen acids is
- (a) $HF < HCl < HBr < HI$
(b) $HI > HBr < HCl < HF$
(c) $HI < HCl < HBr < HF$
(d) $HF < HBr < HI < HCl$
20. When KBr is treated with conc. H_2SO_4 , reddish brown gas evolves, the gas is
- (a) Mixture of bromine and HBr
(b) HBr
(c) Bromine
(d) None of the above
21. The strongest reducing agent among the following
- (a) F^- (b) Cl^-
(c) Br^- (d) I^-

- 22. Iodine is formed when KI reacts with a solution of**
- (a) CuSO_4 (b) $(\text{NH}_4)_2\text{SO}_4$
(c) ZnSO_4 (d) FeSO_4
- 23. Molecules of a noble gas do not possess vibrational energy become a noble gas**
- (a) is monoatomic
(b) is chemically inert
(c) has completely filled shells
(d) is diamagnetic
- 24. Which of the following is the life saving mixture for an asthma patient?**
- (a) Mixture of helium and oxygen
(b) Mixture of neon and oxygen
(c) Mixture of xenon and nitrogen
(d) Mixture of organ and oxygen
- 25. The noble gas used in atomic reactors is**
- (a) Krypton (b) Oxygen
(c) Neon (d) Helium
- 26. Which of the following noble gases is most reactive?**
- (a) He (b) Ne
(c) Ar (d) Xe
- 27. Helium is used in balloons in place of hydrogen because it is**
- (a) Incombustible
(b) Lighter than hydrogen
(c) Radiative
(d) More abundant than hydrogen
- 28. The inert gases producing maximum number of compounds are**
- (a) He and Ne (b) Ar and Ne
(c) Kr and Ne (d) Ar and Xe
- 29. The noble gas which is not found in atmosphere is**
- (a) Ne (b) Ar
(c) Rn (d) Kr
- 30. The oxidation state of Xe in XeO_3 and the bond angle in it respectively are**
- (a) +6, 109° (b) +8, 103°
(c) +6, 103° (d) +8, 120°
- 31. Which group is called buffer group of the periodic table ?**
- (a) Gr. - I (b) Gr. - VII
(c) Gr. - VIII (d) Gr. Zero
- 32. Most acidic oxide among the following is**
- (a) Cl_2O_5 (b) Cl_2O
(c) Cl_2O_3 (d) Cl_2O_7
- 33. What products are expected from the disproportionation reaction of hypochlorous acid?**
- (a) HClO_3 and Cl_2O
(b) HClO_2 and HClO_4
(c) HCl and Cl_2O
(d) HCl and HClO_3

34. The deficiency of iodine in diet causes
- rickets
 - night blindness
 - beri-beri
 - goitre
35. Among the halogens, the one which is oxidised by nitric acid is
- Fluorine
 - Iodine
 - Chlorine
 - Bromine
36. SO_2 acts as temporary bleaching agent but Cl_2 acts as permanent bleaching agent, why ?
- Cl_2 bleaches due to reduction but SO_2 due to oxidation
 - Cl_2 bleaches due to oxidation but SO_2 due to reduction
 - Both of the above
 - None of the above
37. Which of the following is more oxidic in nature ?
- HClO
 - HClO_2
 - HClO_3
 - HClO_4
38. The weakest acid among the following is
- HI
 - HBr
 - HCl
 - HF
39. Xenon hexafluoride reacts with silica to form a Xenon compound 'X'. The oxidation state of Xenon in 'X' is
- +2
 - +4
 - +6
 - 0
40. Which one of the following represents noble gas configuration?
- $\rightarrow 5s^2 5p^6 5d^6 6s^2$
 - $\rightarrow 5s^2 5p^6 5d^1 6s^2$
 - $\rightarrow 5s^2 5p^6$
 - $\rightarrow 5s^2 5p^6 5d^1$
41. The gas not absorbed by coconut charcoal is
- He
 - Ne
 - Ar
 - Kr
42. For advertisement, the coloured discharged tubes contain.
- He
 - Ne
 - Ar
 - Kr
43. If the Valency shell electronic configuration for an element is $ns^2 np^5$, this element will belong to the group of
- alkali metals
 - inert metals
 - noble gases
 - halogens
44. Which one is the correct order of the size of the iodine species ?
- $I > I^+ > I^-$
 - $I > I^- > I^+$
 - $I^+ > I^- > I$
 - $I^- > I > I^+$
45. Atomic number of next inert gas discovered is
- 87
 - 104
 - 118
 - 132

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 12. (b) | 23. (a) | 34. (d) |
| 2. (c) | 13. (b) | 24. (a) | 35. (b) |
| 3. (b) | 14. (d) | 25. (d) | 36. (b) |
| 4. (d) | 15. (d) | 26. (d) | 37. (d) |
| 5. (d) | 16. (c) | 27. (a) | 38. (d) |
| 6. (d) | 17. (d) | 28. (d) | 39. (c) |
| 7. (c) | 18. (c) | 29. (c) | 40. (c) |
| 8. (d) | 19. (a) | 30. (c) | 41. (a) |
| 9. (b) | 20. (c) | 31. (d) | 42. (b) |
| 10. (d) | 21. (d) | 32. (d) | 43. (d) |
| 11. (b) | 22. (a) | 33. (d) | 44. (d) |
| | | | 45. (c) |

II. Short Questions

Q.1. Though nitrogen exhibit + 5 oxidation state it does not form pentahalide. Give reason.

Ans. Nitrogen has three half filled p-orbitals, hence it can form trihalides. It has no 'd' orbitals, so it can not expand its valence shell to show covalency 5. So it does not form pentahalides.

Q.2. Why PH_3 has lower boiling point than NH_3 ?

Ans. The electronegativity of N is more than P. Ammonia undergoes intermolecular H-bonding. To break these H-bonds a large amount of energy is required. But PH_3 does not undergo H-bonding and exist as discrete molecule. Therefore PH_3 has lower b.p. than NH_3 .

Q.3. Why does NH_3 act as Lewis base?

Ans. The N of NH_3 has one lone pair of electrons, which is available for donation. It donates this lone pair to the proton (H^+) to form NH_4^+ ion. Hence it acts as a Lewis base.

Q.4. Why Nitric oxide becomes brown when released in air?

Ans. Nitric oxide is oxidised in air to form NO_2 which is brown in colour.

Q.5. H_2S is less acidic than H_2Te . Why?

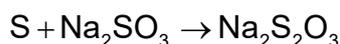
Ans. As the size of element increases down the group of the periodic table E-H bond distance increases. So E-H bond dissociation energy increases i.e. H-S bond dissociation energy is higher than that of H-Te bond dissociation energy. Hence H_2S is weaker acid than H_2Te .

Q.6. Why is H_2S acidic while H_2O is neutral?

Ans. The S-H bond is weaker than O-H bond because size of S is bigger than O-atom. Hence H_2S can dissociate to give H^+ in water therefore acidic.

Q.7. Sulphur disappears when boiled with an aqueous solution of sodium sulphite. Why?

Ans. Sulphur reacts with Na_2SO_3 to form $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thio sulphate), hence S disappears.



Q.8. Why N_2 is less reactive at room temperature ?

Ans. Due to presence of triple bond between two nitrogen atoms. The bond dissociation energy is very high. Therefore N_2 is less reactive at room temperature.

Q.9. Why is H₂O a liquid and H₂S a gas?

Ans. Due to greater electronegativity of O than S, H₂O undergoes intermolecular H-bonding. As a result, H₂O exists as an associated molecule in which the oxygen is tetrahedrally surrounded by four water molecules. A large amount of energy is required to break this bond. So H₂O is a liquid at room temperature. On the other hand H₂S does not undergo H-bonding. To break the bond small amount of energy is required. Hence H₂S is a gas at room temperature.

Q.10. What is laughing gas ?

Ans. N₂O (nitrous oxide)

Q.11. Name the allotropes of oxygen.

Ans. Dioxygen (O₂) and Ozone (O₃).

Q.12. What type of hybridisation is involved in PCl₅?

Ans. sp³d

Q.13. Name the structure of ammonia.

Ans. Pyramidal

Q.14. Write the structural formula of PCl₅.

Ans. PCl₅ exists in ionic solid as [PCl₄]⁺ [PCl₆]⁻ in which cation is tetrahedral and anion is octahedral.

Q.15. Explain the anomalous behaviour of oxygen.

Ans. Due to small size, higher electronegativity and non-availability of 'd' orbitals oxygen shows anomalous behaviour i.e., it is a gas, diatomic molecule, forms H-bond and is paramagnetic.

Q.16. What is the electronic configuration of Group 16 elements?

Ans. ns²np⁴

Q.17. Which form does the phosphorous exist?

Ans. P₄

Q.18. Which has higher electronegativity between nitrogen and oxygen?

Ans. Oxygen

Q.19. What is the maximum oxidation state of Gr16 elements?

Ans. +6

Q.20. Nitrogen exists as diatomic molecule N_2 , where as phosphorous exists as tetraatomic molecule, P_4 . Justify.

Ans. Being small in size nitrogen forms multiple bonds with another nitrogen atom but phosphorous being large in size forms single bonds with other P-atoms.

Q.21. What is the basicity of H_3PO_4 ?

Ans. 3

Q.22. Complete the reaction $Ca_3P_2 + H_2O \rightarrow$

Ans. $Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + Ca(OH)_2$

Q.23. Zero group elements are chemically inert. Why ?

Ans. The zero group or Group 18 elements have completely filled valence shell orbitals. As a result they are unreactive hence they are called noble gases.

Q.24. Why inert gases are monoatomic?

Ans. The atoms of inert gas elements held together by weak Vander Waal forces with completely filled valence shell and therefore monatomic.

Q.25. The electronegativity of halogens decreases from F to I. Why?

Ans. As the size of atoms increases down the group electronegativity decreases down the group. So F has highest electronegativity and I has lowest electronegativity.

Q.26. Why can be Chlorine converted into chloride ion easily as compared to fluoride ion from fluorine?

Ans. Chlorine has high electron affinity than fluorine and due to small size and more electronegativity, fluorine forms intermolecular H-bonding and forms ionic compounds. F does not undergo disproportionate reaction to form fluoride.

Q.27. Electron affinity of halogens is high explain?

Ans. Halogens have the smallest size in their respective periods and have high effective nuclear charge. As a result, they accept one electron to acquire the stable electronic configuration. Therefore electron affinity is maximum.

Q.28. The electron affinity of chlorine is higher than fluorine although their electronegativity values are in the reverse order. Justify ?

Ans. Electronegativity decreases down the group but electron affinity of F is higher due to small and high effective nuclear charge. The electron gain enthalpy of fluorine is less negative than the chlorine.

Q.29. Electron affinity of noble gases is zero and those of N and P are very low. Explain.

Ans. The noble gases have very low electron affinities and considered to be zero but N and P present in 15th group, the electronegativity is more and electron affinity is more than noble gases but very low.

UNIT - VIII

d- AND f - BLOCK ELEMENTS

- I. Select the correct answer from the choices given under each bit :
- d-Block elements form coloured ions because**
 - they absorb some energy for d-s transition
 - they absorb some energy for p-d transition
 - they absorb some energy for d-d transition
 - they do not absorb any energy
 - The characteristics of transition metals to form the complex ion is**
 - having d-subshell unpaired electrons
 - having paired d-subshell electrons
 - providing empty d-orbitals
 - having small charge / size ratio
 - Which of the following properties shows that iron is a transition element ?**
 - it forms double salts
 - it forms stable complexes
 - it decomposes steam at high temp
 - it rusts on moist air
 - Which of the following elements involves gradual filling of 5-f level ?**
 - transition metals
 - lanthanoids
 - coinage metals
 - actinides
 - 18 carat gold contains**
 - 18% gold
 - 24% gold
 - 60% gold
 - 75% gold
 - The general electronic configuration of transition elements is**
 - ns^2nd^{1-10}
 - $(n-1)d^{1-10} ns^{0-2}$
 - $(n-1)d^{1-10} ns^2$
 - $ns^{0-2}(n-1)d^{10}$
 - Permanent magnets are generally made of alloys of**
 - Fe
 - Co
 - Ni
 - Any one of them
 - Which of the ions will give colourless aqueous solution ?**
 - Cu^{2+}
 - Cu^+
 - Ni^{2+}
 - Fe^{2+}
 - Which of the following belongs to the actinide series of elements ?**
 - Y
 - U
 - Yb
 - Ta
 - Which of the following compounds will not give positive chromyl chloride test ?**
 - $HgCl_2$
 - $ZnCl_2$
 - $CuCl_2$
 - $C_6HN^+H_3Cl^-$

11. Which metal in the 1st transition series exhibit +1 oxidation state most frequently ?
 (a) Zn (b) Sc
 (c) Cu (d) Cd
12. Which of the following oxides of Mn is amphoteric in nature MnO, MnO₂, Mn₂O₃, Mn₂O₇ ?
 (a) MnO (b) MnO₂
 (c) Mn₂O₃ (d) Mn₂O₇
13. Which of the following form an alloy?
 (a) Zn + Pb (b) Fe + Hg
 (c) Fe + C (d) Pt + Hg
14. Which of the following are transition elements Zn, Ag, Cd, Au?
 (a) Zn, Ag (b) Zn, Cd
 (c) Ag, Cd (d) Ag, Au
15. The formula of chromyl chloride is
 (a) Cr₂O₅Cl₂ (b) Cr₂O₂Cl₂
 (c) CrO₂Cl₂ (d) Cr₂OCl₂
16. Chromic acid mixture used for cleaning glassware is
 (a) K₂Cr₂O₇ + Conc H₂SO₄
 (b) K₂Cr₂O₇ + Conc HCl
 (c) Cr₂O₃ + Conc H₂SO₄
 (d) Cr₂O₃ + Conc HNO₃
17. The compound whose transition metal has +7 oxidation states :
 (a) K₂Cr₂O₇ (b) KMnO₄
 (c) K₂MnO₄ (d) Cr₂O₃
18. Cadmium salts are
 (a) green (b) blue
 (c) white (d) red
19. Which element/s of actinide series has maximum oxidation state
 (a) Am and Cf (b) U and Pu
 (c) U and Am (d) Np and Pu
20. Which of the following has maximum number of unpaired electrons ?
 (a) Fe²⁺ (b) Mg²⁺
 (c) V³⁺ (d) Ti³⁺
21. The inner transition series element has electronic configuration is :
 (a) (n-1)f¹⁻¹⁴(n-2)d⁰⁻¹ns²
 (b) (n-2)f¹⁻¹⁴(n-1)d⁰⁻⁹ns²
 (c) (n-2)f¹⁻¹⁴nd⁰⁻⁹(n+1)s²
 (d) (n-2)f¹⁻¹⁴(n-1)d⁰⁻¹ns²
22. The lanthanide contraction is responsible for the fact that
 (a) Regular decrease in atomic and ionic radii with increasing number in lanthanoid series.
 (b) Regular increase in atomic and ionic radii with increasing number in lanthanoid series.
 (c) Both the d-block and f-block elements have decrease in atomic size.
 (d) f-block elements having same oxidation state with increasing atomic number.
23. Which of the following elements belongs to lanthanide series ?
 (a) Nobelium (b) Cerium
 (c) Thorium (d) Tellurium

- 24. Lanthanide contraction is due to increase in**
- shielding by 4f electrons
 - atomic number
 - effective nuclear charge
 - size of 4-f orbital
- 25. The highest magnetic moment is in the transition metal having**
- $3d^2$
 - $3d^7$
 - $3d^5$
 - $3d^9$
- 26. Lanthanides are**
- 14 elements in the sixth period of atomic No. 90 to 103 that are filling 4f sub shell.
 - 14 elements in the seventh period of atomic No. 90 to 103 that are filling 5f sub shell.
 - 14 elements in the sixth period of atomic No. 58 to 71 that are filling 4f sub shell.
 - 14 elements in the seventh period of atomic No. 58 to 71 that are filling 4f sub shell.
- 27. Lanthanides and actinides resemble in :**
- electronic configuration
 - oxidation state
 - ionization energy
 - formation of complexes
- 28. Which of the following factor may be regarded as the main cause of lanthanide contraction ?**
- Poor shielding of one of the 4-f electrons by another in the sub shell.
 - Effective shielding of one of the 4-f electrons by another in the sub shell.
 - Poorer shielding of 5-d electrons by 4-f electrons.
 - Greater shielding of 5-d electrons by 4-f electrons.
- 29. The main reason for large number of oxidation states exhibited by the actinoids than the corresponding lanthanoids is :**
- lesser energy difference between 5f and 6d orbitals than between 4f and 5d orbitals.
 - more energy difference between 5f and 6d orbitals than between 4f and 5d orbitals.
 - greater reactive nature of the actinoids than the lanthanoids.
 - larger atomic size of the actinoids than the lanthanoids.
- 30. Which of the following is not an actinoid ?**
- Curium
 - Californium
 - Thorium
 - Terbium
- 31. The transition metal exists in its highest oxidation state. It is expected to behave as :**
- a chelating agent
 - a reducing agent
 - an oxidising agent
 - a central metal in a coordination compound

32. $K_2Cr_2O_7$ reacts with NH_4Cl in presence of $ConcH_2SO_4$, gives
- Chromyl chlorate with green vapour
 - Chromous chloride with white vapour
 - Chromous chloride with blue vapour
 - Chromyl chloride with red vapour
33. $Cr_2O_7^{2-} \xrightarrow{H^+} Cr^{3+}$ equivalent weight of $Cr_2O_7^{2-}$ is
- Mol. wt/6
 - Mol. wt/3
 - Mol. wt/4
 - Mol. wt/1
34. Least paramagnetic property is shown by
- Fe
 - Ni
 - Cu
 - Mn
35. One mole of acidified $K_2Cr_2O_7$ on reaction with excess of KI will liberate moles of I_2
- 6
 - 7
 - 2
 - 3
36. $KMnO_4$ is a strong oxidising agent in acid medium. To provide acid medium H_2SO_4 is used instead of HCl because
- H_2SO_4 is a stronger acid than HCl
 - HCl is oxidized by $KMnO_4$ to Cl_2
 - H_2SO_4 is a dibasic acid
 - Rate is faster in presence of H_2SO_4
37. $K_2Cr_2O_7$ can be converted into potassium chromate (K_2CrO_4) using
- H_2SO_4
 - KOH
 - KCl
 - KNO_2
38. The purple colour of $KMnO_4$ is due to the
- charge transfer from O to Mn
 - charge transfer from Mn to O
 - transition of d - d
 - transition of p - d
39. +3 oxidation state is most common in
- Fe (26)
 - Ni (28)
 - Zn (30)
 - Cu (29)
40. Which of the following belong to 3d series ?
- copper
 - gold
 - silver
 - platinum
41. Transition elements have greater tendency to form complexes because
- they have large size
 - they have vacant d orbitals
 - they have two electrons in their outermost shells
 - none of the above
42. The colour of transition metal ions is due to
- d - d transition
 - change in geometry
 - small in size
 - none of these
43. $K_4[Fe(CN)_6]$ is used for the detection of
- Cu^{2+}
 - Cu^+
 - Fe^{3+}
 - Ni^{2+}

44. When H_2O_2 is added to acidified $\text{K}_2\text{Cr}_2\text{O}_7$, a blue colour is produced due to formation of
- (a) CrO_3 (b) CrO_5
 (c) Cr_2O_3 (d) CrO_4^{2-}
45. Which of the following is coloured Cu^+ , VO^{2+} , Sc^{3+} , Ni^{2+} ?
- (a) Cu^+ (b) VO^{2+}
 (c) Sc^{3+} (d) Ni^{2+}
46. Which of the following lanthanoids have one electron in 5d subshell ?
- (a) Cerium & Europium
 (b) Neodymium & Samarium
 (c) Gadolinium & Lutetium
 (d) Lanthanum & Ytterbium
47. Which of the following exhibit oxidation states upto +7 ?
- (a) uranium (b) plutonium
 (c) californium (d) curium
48. Which of the following compound has oxidation state +6 ?
- (a) KMnO_4 (b) K_2MnO_4
 (c) $\text{K}_2\text{Cr}_2\text{O}_7$ (d) Cr_2O_3
49. The most common oxidation state of lanthanoids is
- (a) +4 (b) +6
 (c) +2 (d) +3
50. Which of the following metals is used in incandescent lamps ?
- (a) Chromium
 (b) Tungsten
 (c) Zirconium
 (d) Molybdenum
51. The disproportionation reaction combination of the following is
- (i) $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
- (ii) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \rightarrow 5\text{MnO}_2 + 4\text{H}^+$
- (iii) $2\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}$
- (iv) $2\text{KMnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
- (a) (i) and (ii) (b) (ii) and (iii)
 (c) (i) and (iii) (d) (iii) and (iv)
52. Which ion gives coloured solution?
- (a) Cu^+ (b) Zn^{2+}
 (c) Ag^+ (d) Fe^{2+}
53. The maximum oxidation state of actinide is
- (a) +7 (b) +6
 (c) +5 (d) +3
54. Ni^{2+} gives coloured salts due to
- (a) complete filled d-orbitals
 (b) incompletely filled d-orbitals
 (c) presence of p-orbitals
 (d) presence of f-orbitals

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (a) | 15. (c) | 29. (a) | 43. (c) |
| 2. (c) | 16. (a) | 30. (d) | 44. (b) |
| 3. (b) | 17. (b) | 31. (c) | 45. (d) |
| 4. (d) | 18. (c) | 32. (d) | 46. (c) |
| 5. (d) | 19. (d) | 33. (a) | 47. (b) |
| 6. (b) | 20. (a) | 34. (c) | 48. (c) |
| 7. (d) | 21. (d) | 35. (d) | 49. (d) |
| 8. (b) | 22. (a) | 36. (b) | 50. (b) |
| 9. (b) | 23. (b) | 37. (b) | 51. (c) |
| 10. (a) | 24. (c) | 38. (a) | 52. (d) |
| 11. (c) | 25. (c) | 39. (a) | 53. (a) |
| 12. (b) | 26. (c) | 40. (a) | 54. (b) |
| 13. (c) | 27. (b) | 41. (b) | |
| 14. (d) | 28. (a) | 42. (a) | |

II. Short Questions

1. **Cu, Ag, Au have completely filled d-orbitals, why are they considered as transition metals ?**

Ans. The cations have only partially filled d-orbitals, show the transition properties.

2. **Which of 3d transition series has maximum oxidation state & why ?**

Ans. Manganese (Atomic number 25) shows maximum number of oxidation states. It has maximum number of electrons to lose. All 3d subshells are unpaired and s-subshell is doubly occupied. So Mn shows oxidation state from + 2 to + 7 (+ 2, + 3, + 4, + 5, + 6 and + 7).

3. **To what extent do the electronic configuration decide the stability of oxidation states in the 1st transition series elements ?**

Ans. For the 1st transition series the electronic configuration of $3d^{1-10}4s^2$, but Mn has maximum oxidation state from +2 to +7 and Mn^{2+} is most stable having half filled $3d^5$ configuration. Similarly Sc^{3+} and Zn^{2+} are more stable having $3d^0$ and $3d^{10}$ configurations respectively.

4. **What are transition elements ? Give example.**

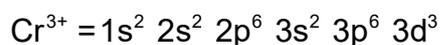
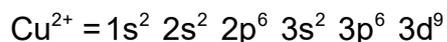
Ans. The 'd' block elements present between 's' block and 'p' block elements are called transition elements.

1st transition series from ^{21}Sc to ^{30}Zn .

2nd transition series from ^{39}Y to ^{48}Cd etc.

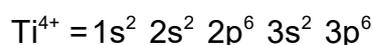
5. **Write electronic configuration of Cu^{2+} and Cr^{3+} ions.**

Ans. The electronic configuration of



6. **Name the d-block elements which do not have partially filled d-orbitals in their atoms or in their simple ions.**

Ans. $Sc^{3+} = 1s^2 2s^2 2p^6 3s^2 3p^6$



both having no partially filled 'd' orbitals.

7. Why does a transition metal form alloys with other transition metals easily ?

Ans. The 'd' block transition metals have almost similar atomic sizes. Therefore, these elements can mutually substitute their position in their crystal lattices. In this way many alloys are possible between transition metals.

8. Why is $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ coloured ?

Ans. In presence of H_2O molecule, the 'd' orbital of Cu^{2+} split into two sets having slightly different energies. Hence, d-d transitions become possible in hydrated CuSO_4 and acquires blue colour due to absorption of visible light.

9. Why is CuCl is colourless but CuCl_2 is blue ?

Ans. In CuCl , Cu^+ has fully filled subshell, hence it can not give d-d transition. Therefore, it is colourless. But CuCl_2 , the Cu^{2+} ion has d^9 (half filled) orbitals. It can give d-d transition, hence it is coloured.

10. Why is E^0 values of $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple much more positive than $\text{Cr}^{3+}/\text{Cr}^{2+}$?

Ans. The high reduction potential of $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is due to the reason that Mn^{3+} ($3d^4$) by accepting an electron acquires very stable $3d^5$ electron configuration. But $\text{Cr}^{3+}/\text{Cr}^{2+}$ the reduction potential is small.

11. Why 2nd and 3rd transition series elements show similar size ?

Ans. In 3rd transition series after lanthanum, there is lanthanids contraction. Due to this contraction the size of any atom of the third transition series is almost the same as that of the element lying just above in the second transition series. This leads to similarity in their properties.

12. Why is the separation of lanthanide elements difficult ?

Ans. Due to lanthanide contraction, the change in atomic or ionic radii of these elements is very small. Hence their chemical properties are similar. Thus, their separation is difficult.

13. Why are lanthanids paramagnetic in nature ?

Ans. All lanthanides except La^{3+} and Lu^{3+} contain unpaired electrons and therefore paramagnetic in nature.

14. On what ground Sc (At. No. = 21) is a transition element, but Zn (At. No. 30) is not?

Ans. Sc (At. No. 21) has incomplete 3d orbital ($3d^1$), but Zn (At. No. 30) has complete 3d orbital ($3d^{10}$), Hence Zn is not considered as transition element.

15. Why mercury (I) ion exist as Hg_2^{2+} ion while copper (I) exist as Cu^+ ?

Ans. The electronic configuration of Hg^+ is $[\text{Xe}] 4f^{14} 5d^{10}, 6s^1$, thus has one electron in 6s orbital, which shows paramagnetic. But it shows diamagnetic, so the single filled Hg^+ should overlap with another Hg^+ single filled s-orbital forming Hg-Hg covalent bond. Thus shows dimeric species. Where as in Cu^+ it is filled 3d¹⁰ orbital and no unpaired electrons to form dimeric species, so it exists as Cu^+ ion.

16. Explain copper (I) is diamagnetic where as Copper (II) is paramagnetic.

Ans. Cu^+ has complete 3d¹⁰ electrons (no unpaired shells), so diamagnetic but Cu^{++} has 3d⁹ (having unpaired d-orbital) shows paramagnetic.

17. What is lanthanoid contraction ?

Ans. The regular decrease (contraction) in the atomic and ionic radii with increasing atomic number is known as lanthanide contraction.

18. Why transition metals show coloured compounds ?

Ans. Due to presence of unpaired 'd' orbitals.

19. What happens when

(a) $\text{K}_2\text{Cr}_2\text{O}_7$ is heated

(b) KMnO_4 is heated

(c) KI solution is treated with alkaline KMnO_4 solution

(d) SO_2 is passed through acidified solution of $\text{K}_2\text{Cr}_2\text{O}_7$

Ans. (a) $\text{K}_2\text{Cr}_2\text{O}_7 \xrightarrow{\Delta} 4\text{K}_2\text{CrO}_4 + 2\text{Cr}_2\text{O}_3 + 3\text{O}_2$

(b) $2\text{KMnO}_4 \xrightarrow{\Delta} \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$

(c) $2\text{KMnO}_4 + \text{H}_2\text{O} + \text{KI} \longrightarrow 2\text{MnO}_2 + 2\text{KOH} + \text{KIO}_3$

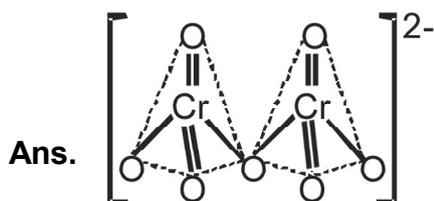
(d) $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 + 3\text{SO}_2 \longrightarrow \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$

20. Describe the structure of

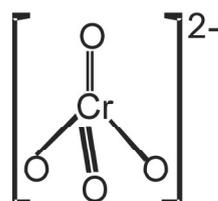
(a) dichromate ion

(b) chromate ion

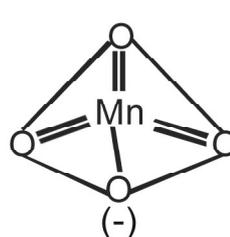
(c) manganate ion



dichromate



Chromate



Permanganate

21. In the titration of FeSO₄ with KMnO₄ in the acidic medium, why is dil H₂SO₄ used instead of dil HCl ?

Ans. In titration of FeSO₄ with KMnO₄ if HCl (acid) is added, the oxygen produced from KMnO₄ + HCl is partly used up to oxidise HCl to chlorine.

22. Why Zn²⁺ salts are white Cu²⁺ salts are blue ?

Ans. Zn²⁺ salts having 3d¹⁰ filled orbital shows white, but Cu²⁺ having 3d⁹ (unpaired) electrons shows colour.

23. Explain the following observations.

(a) **transition metals form coloured compounds.**

(b) **transition metals exhibit variable oxidation state.**

Ans. (a) Transition metals form coloured compounds due to unpaired 'd' orbitals.

(b) The energies of (n-1)d and ns orbitals have very close hence both can participate to show variable valence.

24. What is the basic difference between electronic configuration of the transition and inner transition elements ?

Ans. Electronic configuration of transition series is (n-1)d¹⁻¹⁰ ns⁰⁻² electronic configuration of inner transition series is (n - 2) f¹⁻¹⁴ (n - 1)d⁰⁻¹ ns².

25. Why Zn, Cd and Hg are soft and have low m.p.

Ans. As there are no unpaired electrons in Zn, Cd, Hg, they are soft and low m.p.

26. What are the differences between lanthanide contraction and actinide contraction?

Ans. Lanthanide contraction refers to the gradual decrease in size of the lanthanoids and their trivalent ions where as actinoids refers to the gradual decrease in the size of the actinoids or their ions. They differ in actinoid series, the contraction is greater from element to element due to poor shielding by 5f electrons than by 4f electrons.

27. What is disproportionation of an oxidation state ? Give an example.

Ans. Disproportion of an oxidation state means the oxidation state of an element either increase or decrease in the products e.g.



28. Silver has completely filled orbitals ($4d^{10}$) in its ground state. How can it be placed in transition elements ?

Ans. Silver has Ag^+ and Ag^{2+} states. In +2 oxidation state Ag has $3d^9$ i.e. incomplete 'd' orbitals. Hence, placed in transition elements.

29. What are characteristics of the transition elements and why are they called transition elements ?

Ans. Characteristics of transition elements :

- (i) the atomic radii of the elements are in between s and p block elements
- (ii) they have high ionization energy, more electro positive and show variable oxidation state
- (iii) most elements form coloured compounds and are paramagnetic
- (iv) they have tendency to form complexes

The elements which lie between s & p block elements are called transition elements.

30. Why is +2 oxidation state of manganese quite stable while the same is not true for iron ? ($Mn = 25$, $Fe = 26$)

Ans. The electronic configuration of Mn^{2+} is $3d^5$ which has stable half filled 'd' shell. So it is difficult to form Mn^{3+} . Whereas Fe^{2+} has $3d^6$ configuration, hence one more electron can be taken out to form Fe^{3+} having stable $3d^5$ configuration. Hence Fe^{3+} is more stable than Fe^{2+} .

31. Why is separation of lanthanide elements difficult ?

Ans. Due to lanthanide contraction, the change in atomic and ionic radii is very small and the chemical properties are similar. So separation is difficult.

32. Why the properties of IIIrd transition series are very similar to second transition series ?

Ans. See question no. 11.

UNIT - IX

COORDINATION COMPOUNDS

I. Select the correct answer from the choices given under each bit :

- Among the following which is not a complex compound.
 - $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
 - $K_4[Fe(CN)_6]$
 - $[Co(NH_3)_6]Cl_3$
 - $[Ni(CO)_4]$
- Secondary valency of Pt in $[Pt(NH_3)_6]Cl_4$ is
 - 4
 - 6
 - 0
 - 2
- Among the following which has highest paramagnetism property ?
 - $[Cr(H_2O)_6]^{3+}$
 - $[Fe(H_2O)_6]^{2+}$
 - $[Cu(H_2O)_6]^{2+}$
 - $[Zn(H_2O)_6]^{2+}$
- 2 moles of AgCl is precipitated per mole of the compound $NiCl_2 \cdot 6H_2O$. Total number of ions produced are :
 - 2
 - 3
 - 4
 - 0
- EDTA⁴⁻ is a :
 - unidentate ligand
 - didentate ligand
 - hexadentate ligand
 - tridentate ligand
- The oxidation number of Fe in $K_3[Fe(C_2O_4)_3]$ is
 - 0
 - +3
 - +4
 - +2
- $[Cr(NH_3)_6][Co(CN)_6]$ show
 - Co-ordination isomerism
 - Ionization isomerism
 - Linkage isomerism
 - Hydrate isomerism
- In $[Ni(CO)_4]$ nickel has
 - sp³ hybridization
 - dsp² hybridization
 - sp² hybridization
 - sp³d hybridization
- Among the following which is an outer orbital complex ?
 - $[CoF_6]^{3-}$
 - $[Co(NH_3)_6]^{3+}$
 - $[Fe(CN)_6]^{4-}$
 - $[Fe(CN)_6]^{3-}$

10. $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ give 2 moles of AgCl precipitated per mole of the compound with excess AgNO_3 . The secondary valency of nickel is
- (a) 2 (b) 4
(c) 6 (d) 8
11. Tetraammineaquachlorido cobalt (III) chloride is
- (a) $[\text{Co}(\text{NH}_3)_4 \text{H}_2\text{O} \cdot \text{Cl}] \text{Cl}_2$
(b) $[\text{Co}(\text{NH}_3)_4 \text{Cl}_2] \text{Cl}$
(c) $[\text{Co}(\text{NH}_3)_3 \text{Cl}_3]$
(d) $[\text{Co}(\text{NH}_3)_4 (\text{H}_2\text{O})_2] \text{Cl}_3$
12. The number of ions produced from the complex $[\text{Co}(\text{NH}_3)_6] \text{Cl}_2$ in solution is :
- (a) 2 (b) 3
(c) 4 (d) 6
13. The oxidation number of cobalt in $[\text{Co}(\text{NH}_3)_6] \text{Cl}_3$ is
- (a) +1 (b) +2
(c) +3 (d) 0
14. Among the following, the most stable complex is
- (a) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
(b) $[\text{Fe}(\text{CN})_6]^{3-}$
(c) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
(d) $[\text{FeCl}_6]^{3-}$
15. Which one of the following species, the transition metal ion has d^3 electronic configuration ?
- (a) $[\text{Cr}(\text{NH}_3)_6]^{3+}$
(b) $[\text{CoF}_6]^{3-}$
(c) $[\text{Fe}(\text{CN})_6]^{3-}$
(d) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
16. Which one of the following species has a square planer structure ?
- (a) $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$
(b) $[\text{BeF}_4]^{2-}$
(c) $[\text{Hg}(\text{NH}_3)_2] \text{Cl}_2$
(d) SF_6
17. The maximum co-ordination number of EDTA is
- (a) 2 (b) 4
(c) 6 (d) 3
18. The I U P A C name of sodium nitroprusside is
- (a) Sodium nitrotricyanide
(b) Sodium nitroferrocyanide
(c) Sodium pentacyanonitrosyl ferrate (III)
(d) None of these
19. The oxidation state of brown ring complex $[\text{Fe}(\text{H}_2\text{O})_5 \text{NO}] \text{SO}_4$ is
- (a) +1 (b) +2
(c) +3 (d) +4

20. Which compound will yield Fe^{3+} ion in solution ?
- $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
 - $\text{Fe}_2(\text{SO}_4)_3$
 - $[\text{Fe}(\text{CN})_6]^{4-}$
 - $[\text{Fe}(\text{CN})_6]^{3-}$
21. The chemical formula of nitro pentaminecobalt (III) chloride.
- $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
 - $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{Cl}_2$
 - $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}$
 - $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_3$
22. In which of the following complex the nickel is in highest oxidation state ?
- $\text{Ni}(\text{CO}_4)$
 - $\text{K}_2[\text{NiF}_6]$
 - $[\text{Ni}(\text{NH}_3)_6](\text{BF}_4)_2$
 - $\text{K}_4[\text{Ni}(\text{CN})_6]$
23. In which of the following compound, the metal is in the lowest oxidation state ?
- $[\text{Co}(\text{NH}_3)_5\text{Br}_2]\text{SO}_4$
 - $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$
 - $[\text{Mn}_2(\text{CO})_{10}]$
 - $\text{K}[\text{PtCl}_3(\text{C}_2\text{H}_4)]$
24. Which of the following observation / statement is correct ?
- Anhydrous CuSO_4 becomes blue in aqueous medium due to the complex formation.
 - $\text{Ni}(\text{CN})_2$ dissolves in KCN giving an orange-red solution.
 - $\text{Fe}(\text{OH})_3$ can be precipitated by adding NH_4OH to $\text{K}_3[\text{Fe}(\text{CN})_6]$.
 - None of the above.
25. The correct structure of $\text{Fe}(\text{CO})_5$ is
- Octahedral
 - Tetrahedral
 - Square pyramidal
 - Trigonal bipyramidal
26. The IUPAC name of $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$ is
- Sodium cobaltinitrite
 - Sodium hexanitritocobaltate (III)
 - Sodium hexanitrocobalt (III)
 - Sodium hexanitritocobaltate (II)
27. Which of the following species represents the example of dsp^2 hybridization ?
- $[\text{Fe}(\text{CN})_6]^{3-}$
 - $[\text{Ni}(\text{CN})_4]^{2-}$
 - $[\text{Ag}(\text{CN})_2]^-$
 - $[\text{Co}(\text{CN})_6]^{3-}$

- 28. Copper Sulphate dissolves in excess of KCN to give**
- (a) $[\text{Cu}(\text{CN})_4]^{2-}$ (b) $\text{Cu}(\text{CN})_2$
 (c) CuCN (d) $[\text{Cu}(\text{CN})_4]^{3-}$
- 29. When excess ammonia is added to CuSO_4 solution, the deep blue complex obtained is :**
- (a) Tetrahedral and paramagnetic
 (b) Tetrahedral and di-magnetic
 (c) Square planar and di-magnetic
 (d) Square planar and paramagnetic
- 30. The dark blue colour solution formed when excess of ammonia is added to a solution of copper (II) sulphate is due to the presence of the ion**
- (a) $[\text{Cu}(\text{OH})_4(\text{H}_2\text{O})_2]^{2-}$
 (b) $[\text{Cu}(\text{NH}_3)_2(\text{H}_2\text{O})_4]^{4+}$
 (c) $[\text{Cu}(\text{NH}_3)_2(\text{H}_2\text{O})_4]^{2+}$
 (d) $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_4]^{2+}$
- 31. The ligand : NO is named as**
- (a) Nitrosonium (b) Nitronium
 (c) Nitrosyl (d) Nitro
- 32. Prussian blue is obtained by mixing together aqueous solution of Fe^{3+} salt with**
- (a) Ferricyanide
 (b) Ferrocyanide
 (c) Hydrogen cyanide
 (d) Sodium cyanide
- 33. According to crystal field theory, five 'd' orbitals in an octahedral field split to give**
- (a) two orbitals with lower energy and three orbitals with higher energy
 (b) three orbitals with lower energy and two orbitals with higher energy
 (c) one orbitals with lower energy and four orbitals with higher energy
 (d) four orbitals with lower energy and one orbitals with higher energy
- 34. The central metal in a complex behaves as**
- (a) Lewis acid
 (b) Lewis base
 (c) Neutral compound
 (d) None
- 35. A group of atoms can act as ligand when**
- (a) it is a small molecule
 (b) it is a negativity charged ion
 (c) it has lone pair of electrons
 (d) it is positively charged ion
- 36. The group present outside the co-ordination sphere in a complex is**
- (a) ionic (b) covalent
 (c) co-ordinate (d) None

37. An ambidentate ligand is one which

- (a) is linked to the metal through two donor atom
- (b) has two donor atoms but only one of them has capacity to form a co-ordinate bond
- (c) has two donor atoms but either of two can form a co-ordinate bond
- (d) form chelate rings

38. The formula of tetra ammine nickel (II) hexa cyanoferrate (III) is

- (a) $[\text{Ni}(\text{NH}_3)_4][\text{Fe}(\text{CN})_6]$
- (b) $[\text{Ni}(\text{NH}_3)_4]_3[\text{Fe}(\text{CN})_6]_4$
- (c) $[\text{Ni}(\text{NH}_3)_4]_4[\text{Fe}(\text{CN})_6]_2$
- (d) $[\text{Ni}(\text{NH}_3)_4]_3[\text{Fe}(\text{CN})_6]_2$

39. Chlorophyll is a co-ordination compound having metal atom of

- (a) Ca
- (b) Mg
- (c) Na
- (d) K

40. Which is not the co-ordination compound among the following

- (a) Potassium Ferricyanide
- (b) Potassium Ferrocyanide
- (c) Ferrous ammonium sulphate
- (d) Tetraammine copper sulphate

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (a) | 11. (a) | 21. (a) | 31. (c) |
| 2. (b) | 12. (b) | 22. (b) | 32. (b) |
| 3. (b) | 13. (c) | 23. (b) | 33. (b) |
| 4. (b) | 14. (c) | 24. (a) | 34. (a) |
| 5. (c) | 15. (a) | 25. (d) | 35. (c) |
| 6. (b) | 16. (a) | 26. (b) | 36. (a) |
| 7. (a) | 17. (c) | 27. (b) | 37. (c) |
| 8. (a) | 18. (c) | 28. (d) | 38. (d) |
| 9. (a) | 19. (a) | 29. (d) | 39. (b) |
| 10. (c) | 20. (b) | 30. (d) | 40. (c) |

II. Short Questions

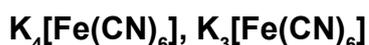
Q1. On the basis of valence bond theory explain $[\text{Ni}(\text{CN})_4]^{2-}$ ion with square planar structure having diamagnetic and $[\text{NiCl}_4]^{2-}$ ion is tetrahedral and paramagnetic.

Ans. $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{NiCl}_4]^{2-}$ entities seems to be similar but $[\text{Ni}(\text{CN})_4]^{2-}$ shows dsp^2 hybridization giving square planar structure having no unpaired electrons hence diamagnetic. But $[\text{NiCl}_4]^{2-}$ shows sp^3 hybridization having two unpaired electrons in 'd' orbital, hence it is paramagnetic.

Q2. A co-ordination compound has the formula $\text{CoCl}_3 \cdot 4\text{NH}_3$. It does not liberate ammonia but precipitates chloride ions as silver chloride. Give the IUPAC name of the complex and write its formula.

Ans. $[\text{Co}(\text{NH}_3)_4\text{Cl}_2] \text{Cl}$. As Cobalt has C. N. 6, then the compound is $[\text{Co}(\text{NH}_3)_4\text{Cl}_2] \text{Cl}$. tetraamminedichlorido cobalt (III) chloride.

Q3. Which of the two compounds is more stable and why ?



Ans. $\text{K}_4[\text{Fe}(\text{CN})_6]$ is more stable than $\text{K}_3[\text{Fe}(\text{CN})_6]$. The effective atomic number of metal complex is the number of electrons present in the metal ion plus the number of electrons donated to it by the ligand. The calculation $\text{EAN} = \text{At No} - \text{Oxd}^n \text{ state} + 2 \times \text{C.N.}$

$$\text{For } \text{K}_4[\text{Fe}(\text{CN})_6]^{4-}, \text{EAN} = 26 - 2 + 2 \times 6 = 36 \text{ i.e. Kr}$$

$$\text{For } \text{K}_3[\text{Fe}(\text{CN})_6], \text{EAN} = 26 - 3 + 2 \times 6 = 35$$

So $\text{K}_4[\text{Fe}(\text{CN})_6]^{4-}$ is more stable.

Q4. What is crystal field splitting ?

Ans. In free transition metal ion, all the 5d-orbitals are degenerate but when it is involved in a complex formation, the degeneracy is split. This is called crystal field splitting.

Q5. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is strongly paramagnetic where as $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic. Explain.

Ans. In both the complexes, Fe is in +3 oxidation state with $3d^5$ configuration. In the presence of 3d electrons pair up leaving only one unpaired electron. There is d^2sp^3 hybridization forming inner orbital complex with CN^- strong ligand.

H_2O is a weak ligand. In the presence of H_2O ligand, the 3d electrons do not pair up. The hybridization is sp^3d^2 forming an outer orbital complex containing five unpaired electrons. Hence it is strongly paramagnetic.

Q6. Why metal carbonyls are called organometallics ?

Ans. Metal carbonyls are called organometallics because the 'C' atom of the CO is linked to the metal atom. So that the metal - carbon bonds have both σ and π character.

Q7. A co-ordination compound with the molecular formula $\text{CrCl}_3 \cdot 4\text{H}_2\text{O}$ precipitates AgCl with AgNO_3 solution. Its molar conductivity is found to be equivalent to two ions. What is the structural formula of the compound ?

Ans. Cr has co-ordination number 6. But there are 4 neutral H_2O ligands, hence two more ligands are taken as Cl^- and the other Cl^- will be present outside entity. So the structure is $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2] \text{Cl}$ - tetraaquadichloridochromium (III) chloride.

Q8. Using IUPAC norms write the names of the following.

(a) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (b) $[\text{NiCl}_4]^{2-}$ (c) $[\text{Co}(\text{en})_3]^{3+}$

Ans. $\text{K}_4[\text{Fe}(\text{CN})_6]$ - Potassium hexacyanoferrate (II)

$[\text{NiCl}_4]^{2-}$ - Tetrachloridonickelate (II) ion

$[\text{Co}(\text{en})_3]^{3+}$ - Tris (ethane 1,2 diammine) Cobalt (III) ion

Q9. How many isomers are possible for the neutral complex $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$?

Ans. $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ has two isomers, cis and trans.

Q10. What is meant by unidentate and ambidentate ligands ?

Ans. A molecule or an ion has only one donor atom to form one co-ordinate bond with the central metal atom is called unidentate ligand e.g. Cl^- , NH_3 . A molecule or an ion has two donor atoms but only one of them can form a co-ordinate bond at a time with the central metal atom is called ambidentate ligand e.g. CN^- or NC^- and NO_2^- or ONO^- .

Q11. Calculate the oxidation numbers of the metals in the following co-ordination species.

(a) $[\text{PtCl}_4]^{2-}$ (b) $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$ (c) $\text{K}_4[\text{Fe}(\text{CN})_6]$

Ans. (a) $[\text{PtCl}_4]^{2-}$, the oxidation no: $x + 4(-1) = -2$ or $x = +2$

(b) $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$, the oxidation No. : $x + 0 + 3(-1) = 0$ or $x = +3$

(c) $\text{K}_4[\text{Fe}(\text{CN})_6]$, the oxidation No. : $x + 6(-1) = -4$ or $x = +2$

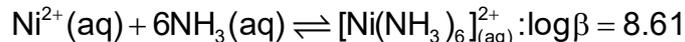
Q12. Write the formula of the following co-ordination compounds

- (a) Dichloridoplatinum (IV) tetrachloroplatinate (II)
- (b) Sodium pentacyanonitrosylsulphido ferrate (III)
- (c) Potassium amminetrichloridoplatinate (II)

- Ans.** (a) Dichloridoplatinum (IV) tetrachloridoplatinate (II) : $[\text{Pt Cl}_2] [\text{Pt Cl}_4]$
(b) Sodium pentacyanonitrosylsulphido ferrate (III) : $\text{Na}_4 [\text{Fe}(\text{CN})_5 \cdot \text{NOS}]$
(c) Potassium ammine trichloridoplatinate (II) : $\text{K} [\text{Pt} (\text{NH}_3) \text{Cl}_3]$

Q13. What is meant by chelate effect ? Give examples.

Ans. The complexes which are formed by chelating ligands like ethylene diamine (en), EDTA etc are more stable than those formed by monodentate ligands such as H_2O or NH_3 . This enhanced stability of complexes containing chelating ligands is called chelate effect. Such as the complex of Ni with chelating ligand (en) is more stable than corresponding complex with ammonia ligand.



Q14. Explain the difference between weak field ligand and strong field ligand.

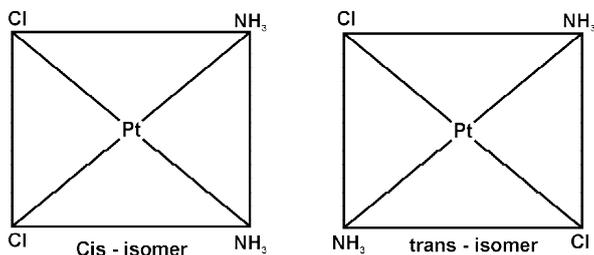
Ans. Ligands have different field strength and as a result the crystal field splitting Δ_0 or Δ_t , depends upon the field produced by the ligand and charge on metal ions. Some ligands are able to produce strong fields in which the splitting will be large whereas others produce weak fields and consequently result in small splitting of d-orbitals. The arrangement of ligands in order of increasing field strength is known as spectro chemical series.



Q15. Define stereo isomerism. Give the geometrical isomers of $[\text{Pt} (\text{NH}_3)_2 \text{Cl}_2]$.

15. In co-ordination compounds, the ligands are arranged in space in specific orientation around a given metal atom or ion which is known as stereo isomerism. This is two types
(i) Geometrical (ii) Optical.

The geometrical isomers of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$: diamminedichloridoplatinum (II) shows Cis and trans isomers.



Q16. A solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green but a solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless. Explain.

Ans. In $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ the metal ion Ni is in +2 state with $3d^8$ configuration that is two unpaired electrons do not pair up in the presence of the weak H_2O ligand. Hence it is coloured and shows green. But in $[\text{Ni}(\text{CN})_4]^{2-}$, though Ni is in +2 state but due to presence of strong field ligand (CN), the two unpaired electrons in 3d orbitals pair up. Thus, it shows no unpaired electrons and is colourless.

Q17. What is the oxidation state of Ni in $[\text{Ni}(\text{CO})_4]$?

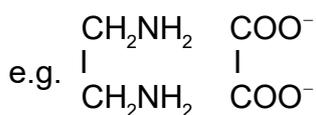
Ans. $[\text{Ni}(\text{CO})_4]$ the oxidation state of Ni : $x + 4 \times 0 = 0$ or $x = 0$

Q18. Give the geometry and magnetic character of $[\text{NiCl}_4]^{2-}$.

Ans. $[\text{NiCl}_4]^{2-}$ gives sp^3 hybridization of tetrahedral structure. The electrons present in $3d^8$ orbitals do not pair up as Cl^- is weak ligand. So it shows paramagnetic.

Q19. What is bidentate ligand ? Give one example.

Ans. The molecule or ion which contain two donor atoms and hence forms two co-ordinate bonds with the central metal atom is called bidentate ligand



Q20. What are t_{2g} and e_g orbitals ?

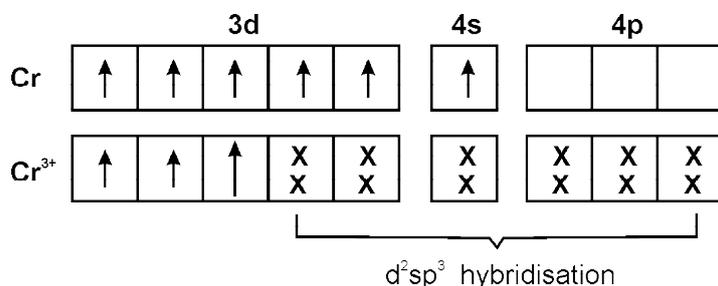
Ans. In a free transition metal ion, the five 'd' orbitals are degenerate. When complex is formed, the degeneracy is split. In octahedral field, the three 'd' orbitals having lower energy called t_{2g} and the remaining two 'd' orbitals of higher energy called e_g orbitals.

Q21. What are the basic postulates of Werner's theory of co-ordination ?

Ans. Werner's postulate : The co-ordination complex the metal possesses primary and secondary valencies. Primary valence satisfies the oxidation state and secondary valence satisfies the coordination number. Different co-ordination numbers have characteristic spatial arrangement of the ions or groups bound by secondary linkage.

Q22. Using valence bond theory of complexes, explain the geometry and paramagnetic nature of the ion $[\text{Cr}(\text{NH}_3)_6]^{3+}$, given the atomic number of Cr = 24.

Ans. In $[\text{Cr}(\text{NH}_3)_6]^{3+}$ ion the Cr is in +3 oxidation state. The electronic configuration $3d^5 4s^1$.



6 pairs of electrons from 6 NH_3 molecules

So $[\text{Cr}(\text{NH}_3)_6]^{3+}$ has d^2sp^3 hybridization of octahedral structure. But due to presence of unpaired electrons, it is paramagnetic.

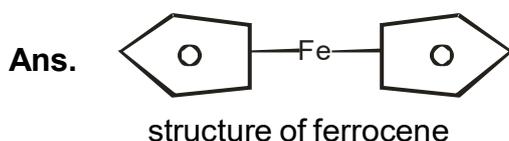
Q23. How does the crystal field theory explain high spin and low spin states of complexes ?

Ans. When ligand is approached the transition metal ion, the 'd' orbitals split into two sets. One set is to lower energy of triple generated and the other set is to higher energy of doubly generated. The energy difference between these two splitting is Δ_0 (for octahedral field).

If $\Delta_0 < P$ (pairing energy) the 4th electron enters one of the e_g orbital giving $t_{2g}^3 e_g^1$ thus forming high spin complexes. Such ligands for which $\Delta_0 < P$ are called weak field ligands.

If $\Delta_0 > P$, the 4th electron enters to t_{2g} orbitals to pair up giving $t_{2g}^4 e_g^0$, there by forming low spin complexes. Such ligands for which $\Delta_0 > P$ are called strong field ligands.

Q24. Draw the structure of ferrocene.



Q25. What is the difference between inner and outer orbital complex ?

Ans. When the complex formed involves the inner (n-1) d orbital for hybridisation (e.g. d^2sp^3), the complex is called inner orbital complex. In this case, the electrons of the metal are made to pair up, so the complex will be either diamagnetic or will have lesser No. of unpaired electrons give low spin complex $[\text{Co}(\text{NH}_3)_6]^{3+}$.

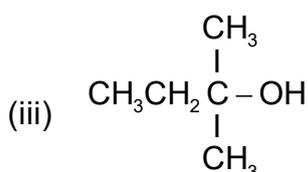
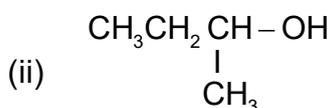
When the complex formed involves the use of nd orbitals for hybridization (sp^3d^2) called outer orbital complex. The complex will have large number of unpaired electrons and remains unchanged. So it is called high spin complex e.g. $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$.

UNIT - X

HALO ALKANES AND HALOARENES

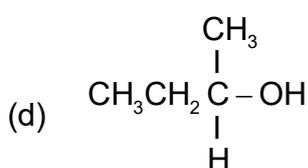
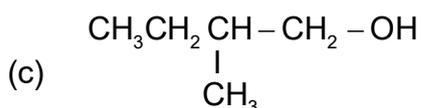
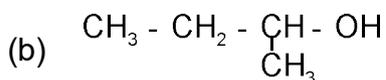
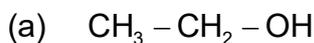
I. Select the correct answer from the choices given under each bit :

1. The order of reactivity of following alcohols with halo acids is

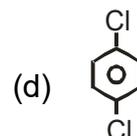
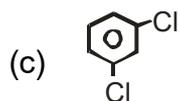
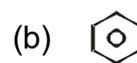
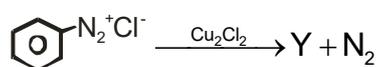
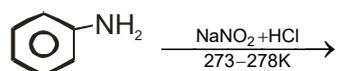


- (a) $i > ii > iii$ (b) $iii > ii > i$
 (c) $ii > i > iii$ (d) $i > iii > ii$

2. Which of the following alcohols will yield the corresponding alkyl chloride on reaction with concentrated HCL at room temperature ?



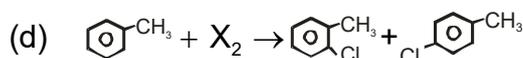
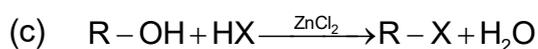
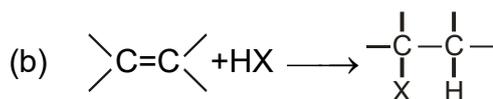
3. Identify the compound Y in the following reaction.



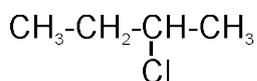
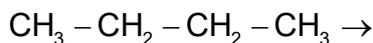
4. Toluene reacts with a halogen in presence of iron (III) chloride giving ortho and para halo compound. The reaction is

- (a) Electrophilic elimination reaction
 (b) Electrophilic substitution reaction
 (c) Free radical addition reaction
 (d) Nucleophilic substitution reaction

5. Which of the following is halogen exchange reaction ?

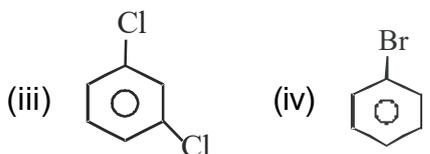
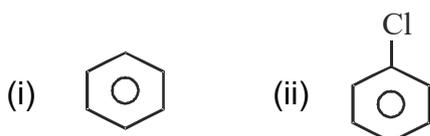


6. Which reagent will you use for the following reaction ?



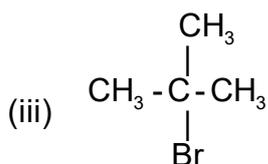
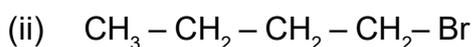
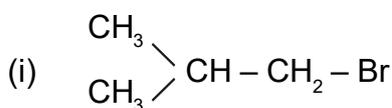
- (a) Cl_2 / uv light
 (b) $\text{NaCl} + \text{H}_2\text{SO}_4$
 (c) Cl_2 gas in dark
 (d) Cl_2 gas in the presence of iron in dark

7. Arrange the following compounds in the increasing order of their densities.



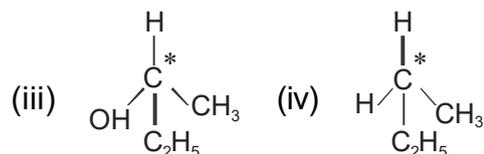
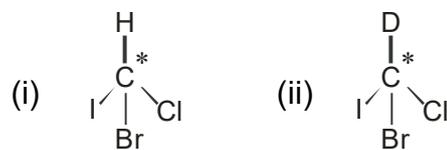
- (a) $i < ii < iii < iv$ (b) $i < iii < iv < ii$
 (c) $iv < iii < ii < i$ (d) $ii < iv < iii < i$

8. Arrange the following compounds in increasing order of their boiling points.



- (a) $ii < i < iii$ (b) $i < ii < iii$
 (c) $iii < i < ii$ (d) $iii < ii < i$

9. In which of the following molecules carbon atom marked with asterisk (*) is assymatric ?



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

10. Which of the following is an example of Vic-dihalide

- (a) dichloro methane
 (b) 1,2 dichloro ethane
 (c) ethylidene chloride
 (d) alkyl chloride

11. The position of -Br in the compound in $\text{CH}_3 - \text{CH} = \text{CHC}(\text{Br})(\text{CH}_3)_2$ can

_____.

- (a) Alkyl (b) Aryl
 (c) Vinyl (d) Secondary

12. Chlorobenzene is formed by reaction of chlorine with benzene in the presence of AlCl_3 , which of the following species attacks the benzene ring in this reaction.

- (a) Cl^- (b) Cl^+
 (c) AlCl_3 (d) $[\text{AlCl}_4]^-$

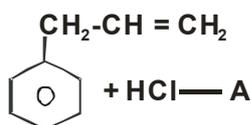
13. Ethylidene chloride is a/an _____

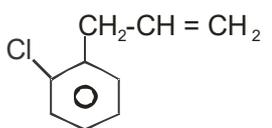
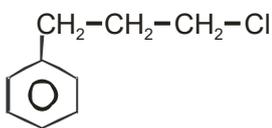
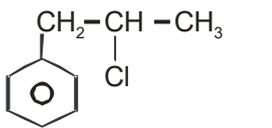
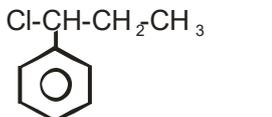
- (a) vic-dihalide (b) gem-dihalide
 (c) allylic halide (d) vinylic halide

14. Which of the following alkyl halide will undergo S_N1 reaction most readily ?

- (a) $(CH_3)_3C-F$ (b) $(CH_3)_3C-Cl$
 (c) $(CH_3)_3C-Br$ (d) $(CH_3)_3C-I$

15. What is 'A' in the following reaction?

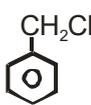
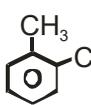
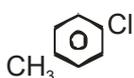


- (a) 
- (b) 
- (c) 
- (d) 

16. A primary alkyl halide would prefer to undergo _____

- (a) S_N1 reaction
 (b) S_N2 reaction
 (c) α - Elimination
 (d) Racemisation

17. The reaction of toluene with chlorine in the presence of iron and in the absence of light yields _____.

- (a)  (b) 
- (c)  (d) Mixture of b & c

18. Chloromethane on treatment with excess ammonia yields mainly :-

- (a) N-N dimethyl methanamine
 $(CH_3-N\langle\begin{smallmatrix} CH_3 \\ CH_3 \end{smallmatrix}\rangle)$
 (b) N-methyl methanamine
 $(CH_3-NH-CH_3)$
 (c) Methanamine (CH_3NH_2)
 (d) Mixture containing all these in equal proportion

19. Which of the following are secondary bromides ?

- (a) $(CH_3)_2CHBr$
 (b) $(CH_3)_3CCH_2Br$
 (c) $CH_3CH(Br)CH_2CH_3$
 (d) $(CH_3)_2C(Br)CH_2CH_3$

20. Which of the following compounds can be classified as aryl halide ?

- (a) p - $ClC_6H_4CH_2CH(CH_3)_2$
 (b) p - $CH_3-CHCl(C_6H_4)CH_2CH_3$
 (c) o - $BrCH_2-C_6H_4CH(CH_3)CH_2CH_3$
 (d) C_6H_5Cl

21. Ethylene dichloride and ethylidene chloride are isomers. Identify the correct statement.

- (a) Both the compounds form same product with alcoholic KOH.
 (b) Both the compounds form same product on treatment with aq. NaOH.
 (c) Both the compounds form same products on reduction
 (d) Both the compounds are optically active

22. In the addition of HBr to propene in the absence of peroxides, the first step involves the addition of
- (a) H^+ (b) Br^-
(c) $\dot{\text{H}}$ (d) $\dot{\text{Br}}$
23. $\text{S}_{\text{N}}2$ reaction proceeds through the intervention of
- (a) Carbonium ion
(b) Transition state
(c) Free radical
(d) Carbanion
24. Which of the following reactions is most suitable for the preparation of n-propylbenzene.
- (a) Friedel - Craft reaction
(b) Wurtz reaction
(c) Wurtz - Fittig reaction
(d) Grignard reagent
25. The addition of HBr is easiest with
- (a) $\text{CH}_2 = \text{CHCl}$
(b) $\text{ClCH} = \text{CHCl}$
(c) $\text{CH}_3 - \text{CH} = \text{CH}_2$
(d) $(\text{CH}_3)_2\text{C} = \text{CH}_2$
26. The most reactive nucleophile among the following is
- (a) CH_3O^-
(b) $\text{C}_6\text{H}_5\text{O}^-$
(c) $(\text{CH}_3)_2\text{CHO}^-$
(d) $(\text{CH}_3)\text{CO}^-$
27. Which of the following can not be used in Friedel-Crafts reaction ?
- (a) FeCl_3 (b) FeBr_3
(c) AlCl_3 (d) NaCl
28. Tertiary alkyl halides are practically inert to substitution by $\text{S}_{\text{N}}2$ mechanism, because
- (a) insolubility
(b) instability
(c) inductive effect
(d) steric hinderance
29. Among the following the strongest nucleophile is
- (a) $\text{C}_2\text{H}_5\text{SH}$ (b) CH_3COO^-
(c) CH_3NH_2 (d) NCCH_2^-
30. The catalyst used in the preparation of alkyl chlorides by the action of dry HCL on an alcohol is
- (a) anhydrous AlCl_3
(b) FeCl_3
(c) anhydrous ZnCl_2
(d) Cu
31. The halogen compound which most readily undergoes nucleophilic substitution is
- (a) $\text{CH}_2 = \text{CHCl}$
(b) $\text{CH}_3\text{CH}=\text{CHCl}$
(c) $\text{CH}_2 = \text{CHC}(\text{Cl}) = \text{CH}_2$
(d) $\text{CH}_2 = \text{CHCH}_2\text{Cl}$

32. **S_N1 reaction of optically active alkyl halides leads to**
- retention of configuration
 - racemisation
 - inversion of configuration
 - none of these
33. **Aryl halides are less reactive towards nucleophilic substitution reactions as compared to alkyl halides due to**
- the formation of less stable carbonium ion
 - resonance stabilization
 - longer carbon-chlorine bond
 - the inductive effect
34. **An S_N2 reaction at an asymmetric carbon of a compound always gives**
- an enantiomer of the substrate
 - a product with opposite optical rotation
 - a mixture of diastereomers
 - a single stereoisomer
35. **Hydrolysis of benzyl chloride to form benzyl alcohol is an example of**
- electrophilic addition
 - elimination reaction
 - substitution reaction
 - hydrolysis reaction

ANSWER KEYS

I. **Select the correct answer from the choices given under each bit :**

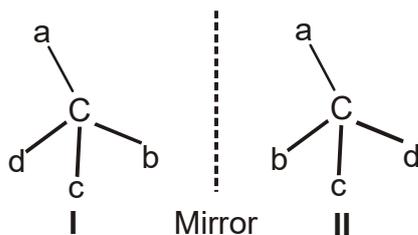
- | | | | |
|--------|---------|---------------|---------|
| 1. (b) | 10. (b) | 19. (a) & (c) | 28. (d) |
| 2. (d) | 11. (a) | 20. (b) & (d) | 29. (a) |
| 3. (a) | 12. (b) | 21. (a) & (c) | 30. (c) |
| 4. (b) | 13. (b) | 22. (a) | 31. (d) |
| 5. (a) | 14. (d) | 23. (b) | 32. (b) |
| 6. (a) | 15. (c) | 24. (c) | 33. (b) |
| 7. (a) | 16. (b) | 25. (d) | 34. (d) |
| 8. (c) | 17. (d) | 26. (a) | 35. (c) |
| 9. (b) | 18. (a) | 27. (d) | |

II. Short Questions

Q1. What are enantiomers ?

Ans. Molecules which are non-superimposable mirror image of each other are called enantiomers.

Fig. I is not super imposable with Fig. II.

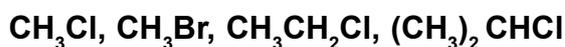


Q2. Differentiate between chiral and achiral molecules.

Ans. A chiral molecule has one asymmetric carbon atom. It gives none super imposable mirror image.

Achiral molecule gives superimposable mirror image.

Q3. Arrange the following halides in order of increasing S_N2 reactivity



Ans. $(\text{CH}_3)_2\text{CHCl} < \text{CH}_3\text{CH}_2\text{Cl} < \text{CH}_3\text{Cl} < \text{CH}_3\text{Br}$

4. Arrange the following in decreasing order of S_N1 reactivity.



Ans. $\text{CH}_2 = \text{CHCHClCH}_3 > \text{CH}_3\text{CH}_2\text{CHClCH}_3 > \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$.

5. Explain vinyl chloride is hydrolysed more slowly than ethyl chloride.

Ans. Vinyl chloride is represented as two resonance structures

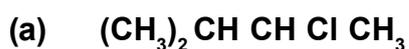


Thus the C - Cl bond acquires some double bond character but in ethyl chloride ($\text{CH}_3 - \text{CH}_2 - \text{Cl}$), the C - Cl bond is purely single bond. So vinyl chloride hydrolyses more slowly than ethyl chloride.

6. Justify haloalkanes undergo nucleophilic substitution reactions whereas haloarenes undergo electrophilic substitutions.

Ans. Haloalkanes having C - X bond form carbocation having more +ve charge than haloarenes due to presence of benzene ring, as a result haloalkanes undergo nucleophilic substitution more readily and haloarenes undergo electrophilic substitution due to presence of benzene ring.

7. Write the IUPAC names of the following.



Ans. (a) $(\text{CH}_3)_2\text{CHCHClCH}_3$: 2-chloro-3-methylbutane

(b) $\text{CHF}_2\text{CBrClF}$: 1-bromo-1-chloro-1,1,2-trifluoroethane

(c) $\text{Br} \text{---} \text{C}_6\text{H}_4 \text{---} \text{Cl}$: p-bromochlorobenzene

8. What are ambident nucleophiles? Explain with example.

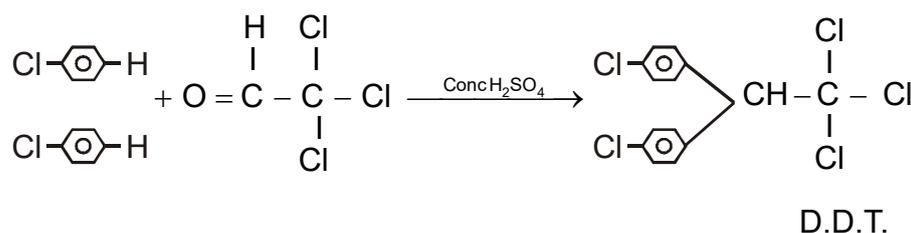
Ans. The nucleophiles which can attack through two different sites are called ambident nucleophiles e.g.



So it can act as cyanides when attack was done on C atom and can act as isocyanides when attack was done on N atom.

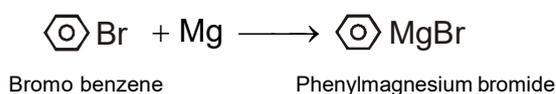
9. How DDT is prepared?

Ans. When chlorobenzene reacts with trichloroacetaldehyde (Chloral) in presence of Conc H_2SO_4 form DDT (pp'-dichlorodiphenyl trichloroethane)



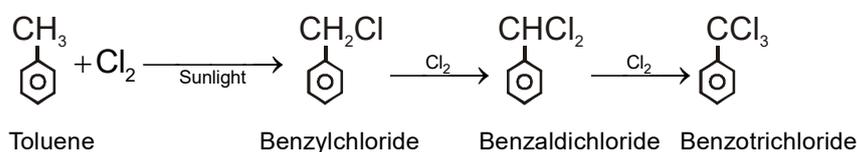
10. What happens when bromobenzene is treated with Mg in the presence of dry ether ?

Ans. When bromobenzene is treated with Mg in the presence of dry ether forms Grignard reagent (phenyl magnesium bromide).



11. What happens when chlorine is passed through boiling toluene in the presence of sunlight ?

Ans. When chlorine is passed through boiling toluene in presence of sunlight benzyl chloride is formed, further form benzal dichloride, then benzotrichloride

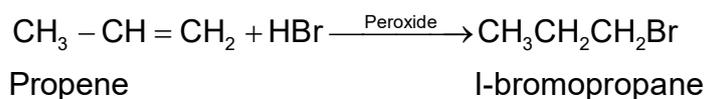


12. Give one test to distinguish $\text{C}_2\text{H}_5\text{Br}$ and $\text{C}_6\text{H}_5\text{Br}$.

Ans. On hydrolysis $\text{C}_2\text{H}_5\text{Br}$ with aqueous KOH followed by acidification with dil HNO_3 and then on treatment with AgNO_3 gives light yellow precipitate of AgBr whereas $\text{C}_6\text{H}_5\text{Br}$ does not give this test.

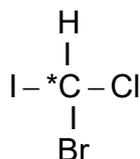
13. How will you obtain 1-bromopropane from propene ?

Ans. Propene reacts with HBr in presence of peroxide (anti Markovnikov's rule) forms 1-bromopropane



14. What is an asymmetric carbon ?

Ans. A carbon which is attached to four different atoms or groups is called asymmetric carbon.



15. What is the condition to be satisfied for a compound to be chiral ?

Ans. The mirror image of the compound is not super imposable is said to be chiral.

16. What is a racemic modification ?

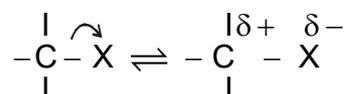
Ans. When equal proportions of two enantiomers of any optically active compound present together is called racemic mixture and the product is optically inactive.

17. What happens when iodoform is heated with silver powder ? Write the chemical equation.

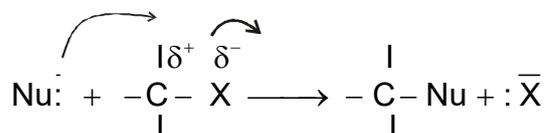
Ans. $2\text{CH}_3\text{I} + 6\text{Ag} \xrightarrow{\text{heat}} \text{CH} \equiv \text{CH} + 6\text{AgI}$

18. Why do alkyl halides show nucleophilic substitution reactions ?

Ans. The halogen atom in haloalkanes is more electronegative than the carbon atom attached to it. As a result, carbon atom acquires a partial positive charge and the halogen atom a partial negative charge



The presence of +ve charge on carbon atom makes it easy to attack by nucleophilic reagents. When the nucleophile stronger than the halide ion approaches to carbocation, the halogen atom is displaced and a new bond is formed by the nucleophile with the carbon.



Such reactions in which a strong nucleophile displaces a weaker nucleophile.

19. Explain why alkyl halides undergo hydrolysis more easily than aryl halides.

Ans. The aryl halides are stabilized by resonance but alkyl halides are not. The displacement of halogen from aryl halide is much less than alkyl halides towards nucleophilic substitution reaction. Hence alkyl halides undergo hydrolysis more easily than aryl halides..

20. Write the following name reactions.

(a) **Friedel-Craft reaction**

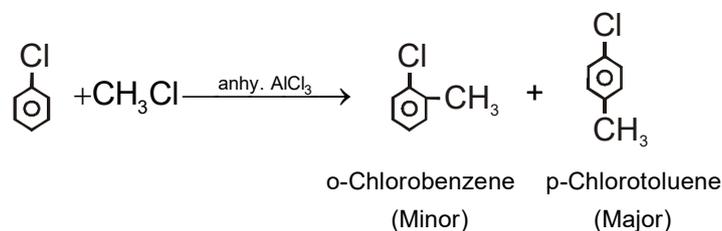
(b) **Wurtz-Fittig reaction**

(c) **Markovnikov's rule**

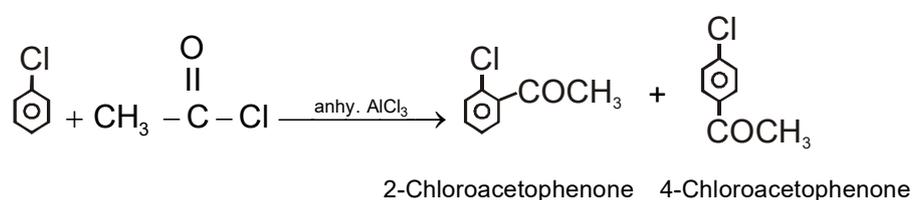
(d) **Sandmeyer reaction**

Ans. (a) Friedel Craft Reaction

Haloarenes undergo electrophilic substitution reaction such as alkylation and acylation. The alkylation is possible when chlorobenzene reacts with methyl chloride in presence of anhydrous AlCl_3 forms o and p chloro toluene.

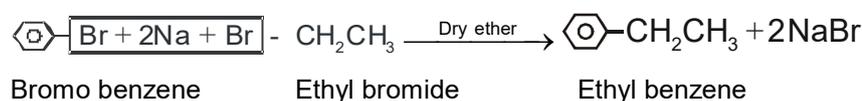


Friedel Craft Acylation : When chlorobenzene reacts with acetyl chloride in presence of anhy AlCl_3 forms. 2- chloroacetophenone and 4-chloroacetophenone.



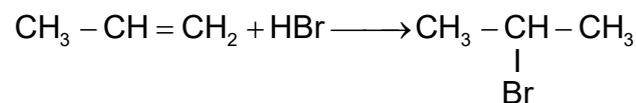
(b) Wurtz Fittig Reaction :

Halo arenes when treated with an ethereal solution of an alkyl halide in presence of sodium form alkyl derivatives of benzene.

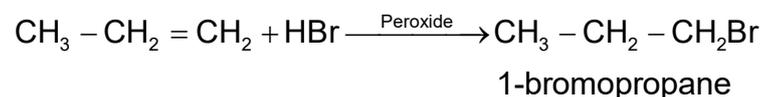


(c) Markovnikov's Rule :

Alkenes react with halogen acids form haloalkanes.

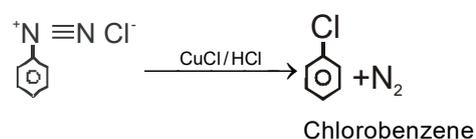


2 - bromopropane



(d) Sandmeyer's Reaction :

Haloarenes (chloro and bromo arenes) are prepared from diazonium salt on treatment with CuCl and HCl .



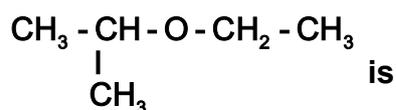
UNIT - XI

ALCOHOLS, PHENOLS AND ETHERS

I. Select the correct answer from the choices given under each bit :

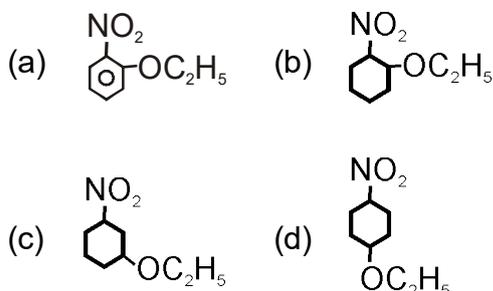
- In allylic alcohol, the -OH group is attached to**
 - sp³ hybridised carbon
 - sp² hybridised carbon
 - sp hybridised carbon
 - None of these
- In vinylic alcohol the -OH group is attached to**
 - sp³ hybridised carbon
 - sp² hybridised carbon
 - sp hybridised carbon
 - sp³d hybridised carbon
- In phenol the -OH group is attached to**
 - sp³ hybridized carbon
 - sp² hybridized carbon
 - sp hybridized carbon
 - sp³d hybridized carbon
- $\text{CH}_3 - \underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_2\text{OH}$ is a**
 - Primary alcohol
 - Secondary alcohol
 - Tertiary alcohol
 - None of these
- Identity which is allylic alcohol among the following**
 - CH₂ = CHOH
 - CH₂ = CH - CH₂OH
 - $\text{HO} - \underset{\text{C}_6\text{H}_5}{\text{CH}} - \text{CH}_3$
 - CH₃CH₂OH
- IUPAC name of isobutyl alcohol is**
 - 2-methyl propan-1-ol
 - butan-2-ol
 - Butan-1-ol
 - 2-methyl propan-2-ol
- 2-methyl propan-1-ol is a ____ alcohol.**
 - Primary
 - Secondary
 - Tertiary
 - None of these
- 2-methyl phenol is a**
 - o-cresol
 - p-cresol
 - Resorcinol
 - Quinol
- Catechol is**
 - Benzene - 1, 2 - diol
 - Benzene - 1, 3 - diol
 - Benzene - 1, 4 - diol
 - None of these
- Hydroquinone is**
 - Benzene - 1, 4 - diol
 - 1-ethoxy propane
 - Propoxy ethane
 - 2-ethoxy butane

11. IUPAC name of



- (a) 2-ethoxy propane
 (b) 1-ethoxy propane
 (c) propoxy ethane
 (d) 2-ethoxy butane

12. The structure of 1-ethoxy-2-nitro cyclohexane is



13. $\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{H}^+}$
 product. The product is

- (a) Propan-2-ol
 (b) Propan-1-ol
 (c) Butan-1-ol
 (d) Butan-2-ol

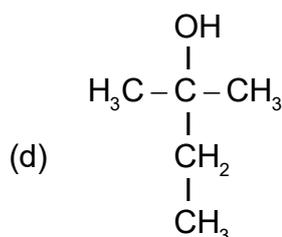
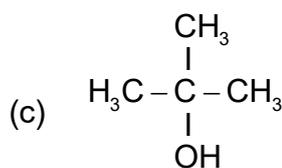
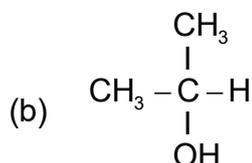
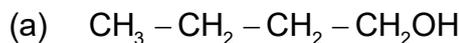
14. $\text{CH}_3 - \text{CH}_2 - \text{COOH} \xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) LiAlH}_4}$
 product. The product is

- (a) Butan-1-ol
 (b) Propan-1-ol
 (c) Propan-2-ol
 (d) Butan-2-ol

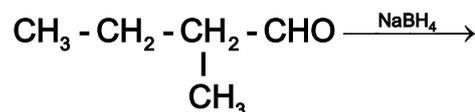
15. Catalytic reduction of butanal gives

- (a) Butan-2-ol (b) Butan-1-ol
 (c) Propan-2-ol (d) Propan-1-ol

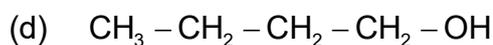
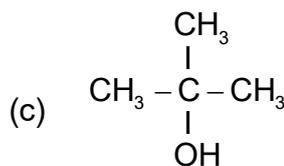
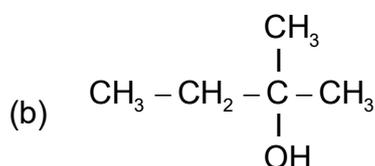
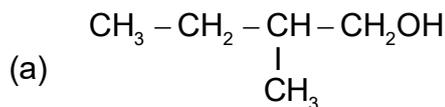
16. The structure of the compound formed by the reaction of propanone with methyl magnesium bromide followed by hydrolysis is

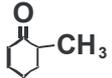


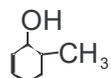
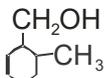
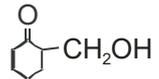
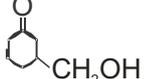
17. The structure of the product of the reaction



product is



18.  $\xrightarrow{\text{NaBH}_4}$ product. The product is

- (a)  (b) 
- (c)  (d) 

19. the increasing order of the boiling points of

- (i) Butan-1-ol (ii) Butan-2-ol
 (iii) ethanal (iv) propan-1-ol
 (a) iii < ii < i < iv (b) iii < iv < ii < i
 (c) i < ii < iii < iv (d) iv < iii < ii < i

20. Which of the following alcohols, the least soluble alcohol in water is

- (a) n-butyl alcohol
 (b) Isobutyl alcohol
 (c) Tertiary butyl alcohol
 (d) Secondary butyl alcohol

21. The increasing order of boiling points

- (i) pentan-1-ol (ii) n-butane
 (iii) pentanal (iv) ethoxy ethane
 (a) ii < iv < iii < i (b) i < ii < iii < iv
 (c) iv < iii < ii < i (d) iv < ii < iii < i

22. The compound which is most acidic :-

- (a) phenol
 (b) p-nitro phenol
 (c) o-nitro phenol
 (d) m-nitro phenol

23.  $\xrightarrow{\text{NaOH}}$ A $\xrightarrow[\text{H}^+]{\text{CO}_2}$ B. The end product B is

- (a) Aspirin
 (b) Phenyl Acetate
 (c) Salicylic Acid
 (d) Salicylaldehyde

24. The acid strength of alcohol decreases in the order

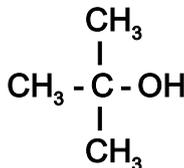
- (a) T > S > P (b) P > S > T
 (c) P > T > S (d) T > P > S

25. Ethyl Alcohol on heating with Conc H_2SO_4 at 443K gives

- (a) Methyl Alcohol
 (b) Methane
 (c) Ethane
 (d) Ethene

26. The relative ease of dehydration of alcohols follows the following order

- (a) T > S > P (b) P > S > T
 (c) T > P > S (d) S > P > T

27.  $\xrightarrow[573\text{K}]{\text{Cu}}$ product. The product is

- (a) 2-methyl propene
 (b) propene
 (c) but-2-ene
 (d) but-1-ene

28. When phenol is treated with $\text{Br}_2/\text{H}_2\text{O}$, we get

- (a) 2,4,6 - tribromo phenol
- (b) 2,4 - dibromo phenol
- (c) 2 - bromo phenol
- (d) 3 - bromo phenol

29. On treatment with chloroform in presence of sodium hydroxide a -CHO group is introduced in ortho position of benzene ring of phenol. The reaction is known as

- (a) Reimer - Tiemann reaction
- (b) Kolbe's reaction
- (c) Wurtz reaction
- (d) Rosenmonds reaction

30. When phenol is treated with Zinc dust, we get

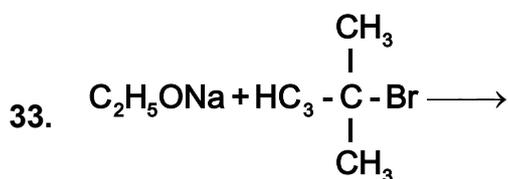
- (a) n-hexane
- (b) cyclo hexane
- (c) Benzene
- (d) Toluene

31. Oxidation of phenol with chromic acid gives

- (a) Benzene
- (b) Toluene
- (c) Benzoquinone
- (d) Benzoic acid

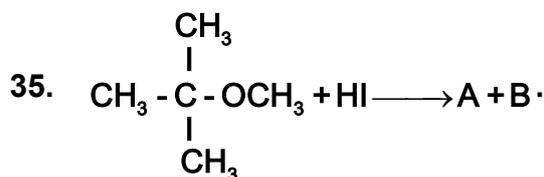
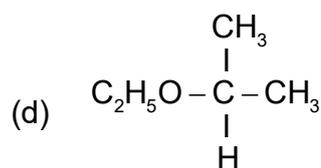
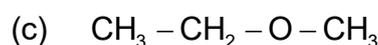
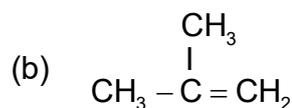
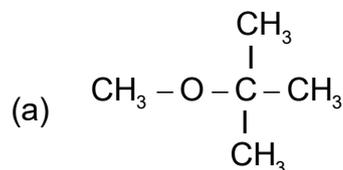
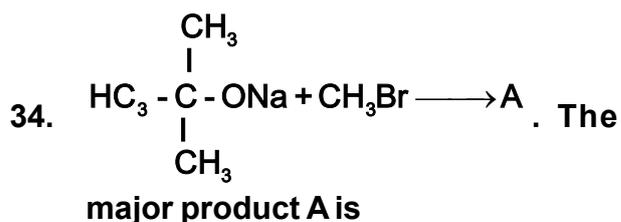
32. Williamson's synthesis method is used for the preparation of

- (a) alcohol
- (b) ether
- (c) ketone
- (d) aldehyde

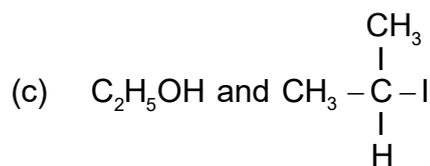
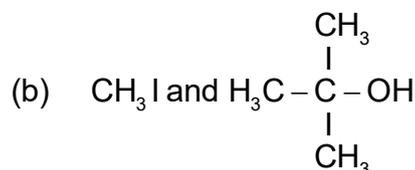
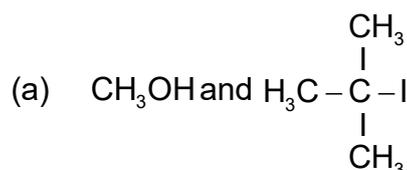


major product is

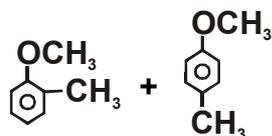
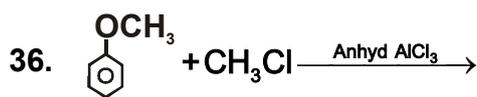
- (a) 2- methyl prop-1-ene
- (b) T- butyl ethyl ether
- (c) ethyl - propyl ether
- (d) methyl butyl ether



The product A and B are



- (d) None of these



reaction is known as

- (a) Friedel Craft's alkylation
 (b) Friedel Craft's acylation
 (c) Electrophilic substitution reaction
 (d) Diels Alder addition reaction
37. Phenol can be distinguished from ethyl alcohol by all reagents except
- (a) NaOH (b) FeCl₃
 (c) Br₂/H₂O (d) Na

38. Aspirin is an acetylation product of

- (a) p- Dihydroxy benzene
 (b) o- Hydroxy benzoic acid
 (c) o- Dihydroxy benzene
 (d) m- Hydroxy benzoic acid

39. The compound A when treated with methyl alcohol and few drops of H₂SO₄ gave smell of winter green. The compound A is

- (a) succinic acid (b) salicylic acid
 (c) tartaric acid (d) oxalic acid

40. Wood spirit is known as

- (a) methanol (b) ethanol
 (c) acetone (d) benzene

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (a) | 11. (a) | 21. (a) | 31. (c) |
| 2. (b) | 12. (b) | 22. (b) | 32. (b) |
| 3. (b) | 13. (a) | 23. (c) | 33. (a) |
| 4. (a) | 14. (b) | 24. (b) | 34. (a) |
| 5. (b) | 15. (b) | 25. (d) | 35. (a) |
| 6. (a) | 16. (c) | 26. (a) | 36. (a) |
| 7. (a) | 17. (a) | 27. (a) | 37. (d) |
| 8. (a) | 18. (a) | 28. (a) | 38. (b) |
| 9. (a) | 19. (b) | 29. (a) | 39. (b) |
| 10. (a) | 20. (a) | 30. (c) | 40. (a) |

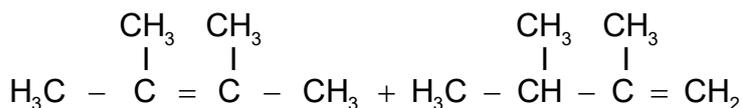
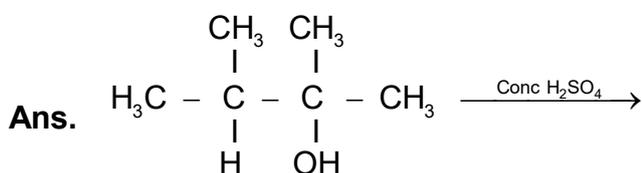
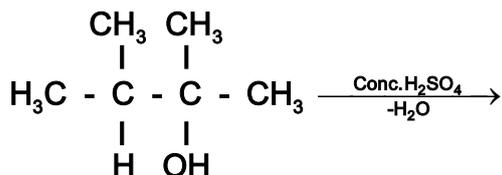
II. Short Questions

1. Arrange the following with their increasing order of basicity :



Ans. $\text{H}_2\text{O}, \text{CH}_3\text{OH}, \text{OH}^-, \text{CH}_3\text{O}^-$

2. Identify the organic product obtained in the following reaction



2, 3-dimethyl but-2-ene (major) 2,3 dimethyl but-1-ene (minor)

3. How will you know whether a given-OH group is alcoholic or phenolic in nature?

Ans. Phenolic OH gives blue / violet colour with neutral FeCl_3 where as alcoholic OH does not.

4. Why boiling points of phenols are higher than those of corresponding aromatic hydrocarbons and alkyl halides ?

Ans. Because of H- bonding.

5. Alcohols react with halogen acids to form haloalkanes but phenols do not from halobenzenes. Explain.

Ans. The C-O bond of phenols has some double bond character due to resonance hence can not easily cleaved by X^- ion in presence of halogen acids but C-O bond in alcohols is a pure single bond and is cleaved easily with X^- ions in presence of halogen acids to form haloalkanes.

6. Explain why anisole is less reactive than phenol towards electrophilic substitution reactions ?

Ans. -OH and -OCH₃ are both +R effect. The electrophilic substitution reaction mainly occur at o and p positions, but the aromatic ethers are less reactive than phenols.

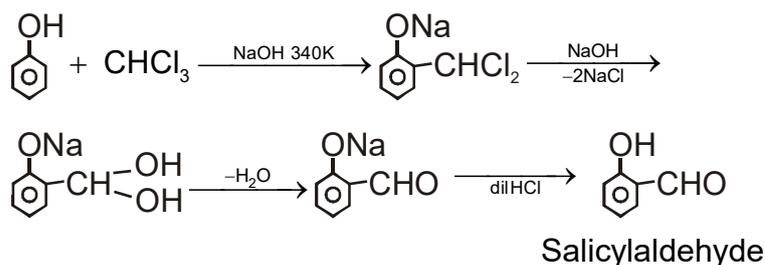
7. **Why is phenol more acidic than ethanol ?**

Ans. After the loss of proton, phenoxide ion is stabilized by resonance while ethoxide ion is not.

8. **Write the equation involved in Reimer - Tiemann reaction.**

Ans. Reimer - Tiemann Reaction:

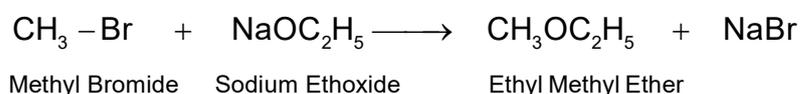
When phenol is treated with chloroform in presence of aqueous NaOH (or KOH) at 340K followed by hydrolysis forms salicylaldehyde.

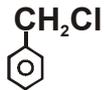


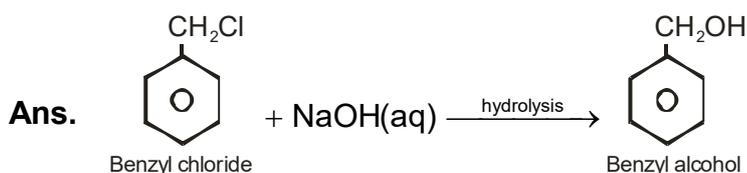
9. **Write the reaction of Williamson synthesis.**

Ans. Williamson's Synthesis :

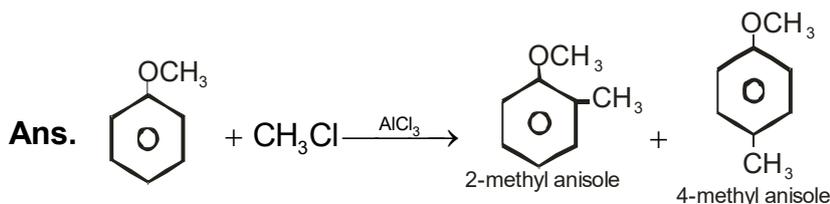
When alkyl halide is treated with sodium or potassium salt of alcohol or phenol forms ether.



10. **Complete the reaction**  + NaOH(aq) $\xrightarrow{\text{hydrolysis}}$



11. **Write the equation of Friedel - Crafts reaction of alkylation in anisole.**



12. **Why phenols do not undergo substitution of - OH group like alcohols ?**

Ans. See question No. 5.

13. Ortho-nitrophenol is more acidic than ortho-methoxy phenol. Give reason.

Ans. Due to strong -R and -I effect of the $-\text{NO}_2$ group, electron density in the O-H bond decreases and hence the loss of proton becomes easy. After loss of proton, the orthonitro phenoxide ion is stabilized by resonance.

But in case of ortho methoxy phenol, the electron density in O - H bond increases, thereby making the loss of proton difficult. Further, the ortho - methoxy phenoxide ion is destabilized by resonance, thereby making o- methoxy phenol a weaker acid.

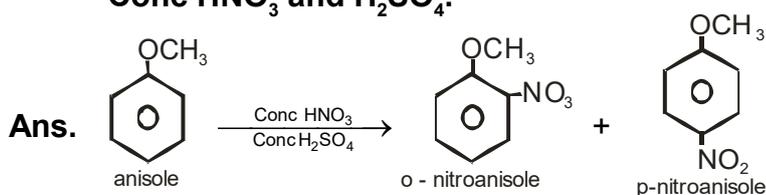
14. Why are higher ethers insoluble in water ?

Ans. Higher ethers are of bigger size and the oxygen atom fails to form inter molecular H-bonds with water. Hence higher ethers are insoluble in water.

15. Explain - diethyl ether does not react with sodium.

Ans. Diethyl ether has no active hydrogen attached to oxygen like alcohol and phenols, so it does not react with sodium.

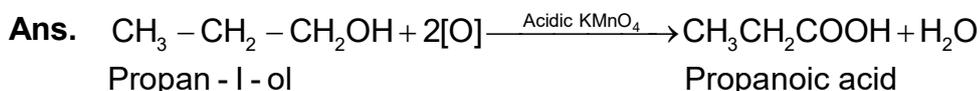
16. Write the reaction products obtained when anisole is treated with a mixture of Conc HNO_3 and H_2SO_4 .



17. Explain how does the -OH group attached to a carbon of benzene ring activates towards electrophilic substitution.

Ans. Phenol has +R effect of OH group. The electron density of benzene ring increases and facilitate the attack of a electrophile. So presence of -OH group activates the benzene ring towards electrophilic substitution mainly at o and p positions.

18. Write the chemical reaction when 1-propanal reacts with acidified KMnO_4 solution.



19. Nitration of phenol gives ortho and para products only. Give reasons.

Ans. See question No. - 6

20. Describe the test to distinguish between primary, secondary and tertiary alcohols.

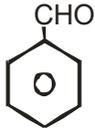
Ans. When alcohols are treated with equimolar mixture of conc HCl and anhy ZnCl_2 at room temp., if turbidity appears immediately, the alcohol is tertiary. If no trubidy, it is primary alcohol. If turbidity appears after sometime, it is secondary alcohol.

UNIT - XII

ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

I. Select the correct answer from the choices given under each bit :

- Which of the following compounds respond the typical properties of a carbonyl group ?
 - CH_3CHO
 - CH_3COOH
 - CH_3COCl
 - $\text{CH}_3\text{COOC}_2\text{H}_5$
- Which one of the following compounds can not be prepared from alkynes by using acidified HgSO_4 ?
 - CH_3CHO
 - CH_3COCH_3
 - HCHO
 - $\text{CH}_3\text{CH}_2\text{COCH}_3$
- In order to prepare an aldehyde or ketone from alcohols the reagent used is
 - acidified KMnO_4
 - acidified $\text{K}_2\text{Cr}_2\text{O}_7$
 - SeO_2
 - heating in between 300-330K
- Dry distillation of calcium formate gives
 - CH_3CHO
 - HCHO
 - CH_3COCH_3
 - $\text{CH}_3\text{CH}_2\text{COCH}_3$
- Dry distillation of calcium propanoate gives
 - HCHO
 - CH_3CHO
 - CH_3COCH_3
 - $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
- When 1 : 1 mixture of calcium formate and calcium butanoate is dry distilled gives
 - Ethanal
 - Propanal
 - Butanal
 - Butanone
- Starting material of Rosenmund reduction is
 - Acid
 - Acid Chloride
 - Acid Amide
 - Acid Anhydride
- During Rosenmund reduction, the catalyst used is
 - Zn/Hg and Conc. HCl
 - Pd & BaSO_4
 - LiAlH_4
 - NaBH_4
- During Rosenmund's reduction sulphur/quinoline is used in order to
 - Avoid the conversion of an aldehyde to alcohol
 - Avoid the conversion of an aldehyde to acid
 - Avoid the aldol condensation
 - Avoid the cannizzaro's reaction

10. The starting material for Stephen's method for the formation of an aldehyde is
- Acid chloride
 - Acid amide
 - Alkyl halide
 - Alkyl cyanide
11. When acetonitril is subjected to stephun's reaction, the final product formed is
- $\text{CH}_3\text{CH}_2\text{OH}$
 - CH_3CHO
 - HCHO
 - CH_3COCH_3
12. Which one of the compounds contain no α - Hydrogen atom ?
- Acetaldehyde
 - Acetone
 - Acetic Acid
 - Formal dehyde
13. Which one of the compound does not contain α - carbon atom ?
- $\text{CH}_3\text{CH}_2\text{CHO}$
 - HCHO
 - CH_3COCH_3
 - $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
14. Which one of the compounds contain α - C atom but no α - H atom?
- 
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
 - $\text{CH}_3\text{COCH}_2\text{CH}_3$
 - HCHO
15. An example of the compound which has no α - H atom but contain α - carbon atom.
- $\text{CH}_3\text{CH}_2\text{CHO}$
 - $$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CHO} \\ | \\ \text{CH}_3 \end{array}$$
 - HCHO
 - $\text{CH}_3\text{CH}_2\text{COCH}_3$
16. Why aldehydes and ketones undergo nucleophilic addition reaction ?
- Due to greater electronegativity of oxygen, the carbon atom of carbonyl group developes positive charge and act a nucleophile
 - Due to greater electronegativity of oxygen, the oxygen atom developes slight positive charge for nucleophilic reaction.
 - There is a cleavage of $\text{C} = \text{O}$ gr. to form a carbanion ion for the nucleophilic reaction.
 - None of the above
17. Which of the compound reduces Fehling's solution ?
- CH_3COCH_3
 - $\text{CH}_3\text{COCH}_2\text{CH}_3$
 - CH_3CHO
 - $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
18. Which one of the followings is not the composition of Fehling-B solution?
- $\text{NaOH} + \text{Na}$, K- tartarate
 - $\text{KOH} + \text{Na}$, K- tartarate
 - $\text{NH}_4\text{OH} + \text{Na}$, K- tartarate
 - $\text{Ca}(\text{OH})_2 + \text{Na}$, K- tartarate

19. When ethanol and propanal mixture is subjected to Aldol condensation, the number of products formed are
- (a) One (b) Two
(c) Three (d) Four
20. When formaldehyde is subjected to Cannizzaro's reaction using Conc NaOH, the products formed
- (a) Methanol and formic acid
(b) Methanol and sodium formate
(c) Ethanol and formic acid
(d) Ethanol and sodium formate
21. When the mixture of HCHO and C_6H_5CHO is subjected to Cannizzaro's reaction, the products formed are
- (a) Methanol and benzyl alcohol
(b) Sodium formate and benzyl alcohol
(c) Methanol and sodium benzoate
(d) Sodium methoxide and sodium benzoate
22. When benzaldehyde is treated with NH_3 , the product formed is
- (a) Urotropine
(b) Hydrobenzamide
(c) Hydrazone derivative of benzaldehyde
(d) Semicarbazone derivative of benzaldehyde
23. When formaldehyde is treated with NH_3 , the product formed is
- (a) Urotropine
(b) Hydrobenzamide
(c) Formamide
(d) Acetamide
24. Which of the following will respond iodoform test ?
- (a) Butanone
(b) Formaldehyde
(c) Pentan-3-one
(d) Hexan-3-one
25. When benzaldehyde is treated with acetic anhydride and sodium acetate, the product formed is
- (a) Benzoic acid
(b) Sodium benzoate
(c) Cinnamic acid
(d) Propanoic acid
26. When benzaldehyde is refluxed with KCN, the product is
- (a) Benzoic acid
(b) Benzoin
(c) Phthalic acid
(d) Potassium benzoate
27. The starting material and final product of Etard's reaction are
- (a) Benzene and benzaldehyde
(b) Benzene and benzoic acid
(c) Toluene and benzaldehyde
(d) Toluene and benzoic acid
28. The starting material and final product of Gattermann - Koch reaction are
- (a) Toluene and benzaldehyde
(b) Toluene and benzoic acid
(c) Benzene and benzoic acid
(d) Benzene and benzaldehyde

29. The correct order of acid strength is

- (a) $\text{ClCH}_2\text{COOH} > \text{Cl}_2\text{CHCOOH} > \text{Cl}_3\text{CCOOH} > \text{CH}_3\text{COOH}$
- (b) $\text{Cl}_3\text{CCOOH} > \text{Cl}_2\text{CHCOOH} > \text{ClCH}_2\text{COOH} > \text{CH}_3\text{COOH}$
- (c) $\text{CH}_3\text{COOH} > \text{ClCH}_2\text{COOH} > \text{Cl}_2\text{CHCOOH} > \text{Cl}_3\text{CCOOH}$
- (d) $\text{Cl}_2\text{CHCOOH} > \text{ClCH}_2\text{COOH} > \text{Cl}_3\text{CCOOH} > \text{CH}_3\text{COOH}$

30. The correct order of acid strength is

- (a) $\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{ICH}_2\text{COOH}$
- (b) $\text{ClCH}_2\text{COOH} > \text{FCH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{ICH}_2\text{COOH}$
- (c) $\text{ICH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH}$
- (d) $\text{FCH}_2\text{COOH} < \text{ClCH}_2\text{COOH} < \text{BrCH}_2\text{COOH} < \text{ICH}_2\text{COOH}$

31. The correct order of acid strength is

- (a) $\text{HCOOH} > \text{CH}_3\text{COOH} > \text{ClCH}_2\text{COOH}$
- (b) $\text{CH}_3\text{COOH} > \text{HCOOH} > \text{ClCH}_2\text{COOH}$
- (c) $\text{ClCH}_2\text{COOH} > \text{HCOOH} > \text{CH}_3\text{COOH}$
- (d) $\text{ClCH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{HCOOH}$

32. When ethyl benzene is oxidised by SeO_2 , the product formed

- (a) Benzoic acid
- (b) Salicylic acid
- (c) Phthalic acid
- (d) Benzaldehyde

33. When ortho xylene is oxidised by SeO_2 , the product formed is

- (a) Benzoic acid
- (b) Phthalic acid
- (c) Terephthalic acid
- (d) Isophthalic acid

34. During esterification, the reagent used is

- (a) Dil NaOH (b) Dil KOH
- (c) Conc H_2SO_4 (d) Conc Alkali

35. Which of the following acid reduces Fehling's solution or Tollen's reagent ?

- (a) CH_3COOH
- (b) $\text{CH}_3\text{CH}_2\text{COOH}$
- (c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
- (d) HCOOH

36. During Clemmenson's reduction process

- (a) $>\text{C}=\text{O}$ group is converted to CH_2OH
- (b) $>\text{C}=\text{O}$ group is converted to $>\text{CH}_2$ group
- (c) $>\text{C}=\text{O}$ group is converted to $>\text{CHOH}$
- (d) $>\text{C}=\text{O}$ group is converted to $-\text{COOH}$

37. Component 'A' of formula $\text{C}_5\text{H}_{10}\text{O}$ form oxime and give negative silver mirror test and iodoform test. Component 'A' is

- (a) Pentan-2-one
- (b) Pentanal
- (c) Pentan-3-one
- (d) 2-methyl butanal

38. Cyclohexanone is reduced by NaBH_4 . The product formed is
- Cyclohexane
 - Cyclohexanal
 - Cyclohexadiene
 - Cyclohexanol
39. From the following acids, the one which is optically active ?
- Benzoic acid
 - $$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{COOH} \\ | \\ \text{NH}_2 \end{array}$$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
40. Which one the following is not a derivative of carboxylic acid ?
- RCOOR'
 - RCONH_2
 - RCOCl
 - R-NH_2
41. Wolf-Kishner Reduction of acetaldehyde gives
- Propanone
 - Acetone
 - Alkane
 - Butanone
42. Hell-Volhard-Zelinsky (HVZ) reaction of acetic acid gives
- Acetaldehyde
 - Propanone
 - Trichloro acetic acid
 - Butanone
43. Which of the following reactions is responded by HCHO ?
- Cannizzaro's reaction
 - Clemmenson's reaction
 - Haloform reaction
 - Aldol condensation
44. In aldehyde and ketone, the carbonyl carbon atom is
- sp^3 hybridized
 - sp^2 hybridised
 - sp -hybridized
 - unhybridised
45. Schiff's reagent is
- Magenta solution decolorised by SO_2
 - Magenta solution decolorised by Cl_2
 - Ammoniacal cobalt chloride solution
 - Ammoniacal manganese sulphate solution
46. Which of the following organic compounds are second oxidation product of alkanes ?
- 1° and 2° alcohols
 - carboxylic acids and esters
 - 2° and 3° alcohols
 - aldehydes and ketones
47. Phenones are
- Aldehydes in which carbonyl group is attached to the benzene ring
 - Ketones in which carbonyl group is attached to the benzene ring
 - Aldehydes in which carbonyl group is attached to the alkyl group
 - Acids in which carbonyl group is attached to the benzene ring

48. During the Claisen's condensation, ethyl ethanoate gives

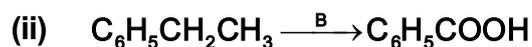
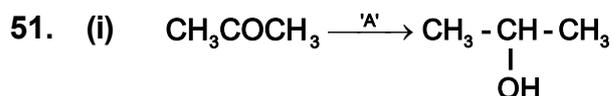
- (a) Ethanoic acid
- (b) Propanoic acid
- (c) Butanoic acid
- (d) Ethyl-3-Keto butanoate

49. Kolbe's electrolysis of potassium propanoate gives

- (a) Ethane
- (b) Propane
- (c) Butane
- (d) Pentane

50. The reagent used during claisen condensation is

- (a) Sodium ethoxide
- (b) NaOH
- (c) KOH
- (d) Br₂ and alkali



In the above reactions A and B are

- (a) LiAlH₄ and NaBH₄
- (b) LiAlH₄ and SeO₂
- (c) Acidified KMnO₄ and SeO₂
- (d) Acidified K₂Cr₂O₇ and LiAlH₄

ANSWER KEYS

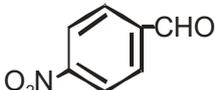
I. Select the correct answer from the choices given under each bit :

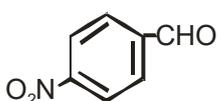
- | | | | |
|---------|---------|---------|---------|
| 1. (a) | 14. (a) | 27. (c) | 40. (d) |
| 2. (c) | 15. (b) | 28. (d) | 41. (c) |
| 3. (d) | 16. (a) | 29. (b) | 42. (c) |
| 4. (b) | 17. (c) | 30. (a) | 43. (a) |
| 5. (d) | 18. (c) | 31. (c) | 44. (b) |
| 6. (c) | 19. (d) | 32. (a) | 45. (a) |
| 7. (b) | 20. (b) | 33. (b) | 46. (d) |
| 8. (b) | 21. (b) | 34. (c) | 47. (b) |
| 9. (a) | 22. (b) | 35. (d) | 48. (d) |
| 10. (d) | 23. (a) | 36. (b) | 49. (c) |
| 11. (b) | 24. (a) | 37. (c) | 50. (a) |
| 12. (d) | 25. (c) | 38. (d) | 51. (b) |
| 13. (b) | 26. (b) | 39. (b) | |

II. Short Questions

Q1. What is Carbonyl group ?

Ans: It is carbon-oxygen double bond, represented as $>C=O$

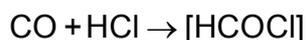
Q2. Write IUPAC names of , $CH_3-C(=O)-CH_2CH_3$ and $CH_3-C(Br)(H)-COOH$.

Ans. , $CH_3-C(=O)-CH_2CH_3$ and $CH_3-C(Br)(H)-COOH$

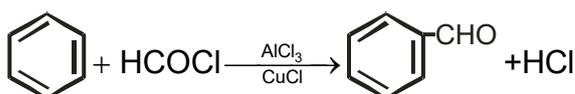
4-Nitrobenzene-carbaldehyde, butan-2-one 2-bromopropanoic acid

Q3. What is Gattermann-Koch reaction ?

Ans: When a mixture of CO and HCl is passed through a solution of benzene or toluene in nitrobenzene at 323 K in presence of $AlCl_3$ and $CuCl$, benzaldehyde or p-tolualdehyde is formed.



formylchloride



Q4. Why are aldehydes more reactive than Ketones ?

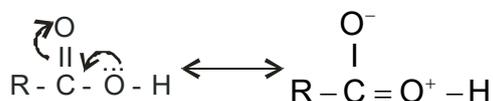
Ans: The +ve charge on carbon atom of aldehyde is more due to smaller +I effect of one alkyl group than ketones of two alkyl groups. As a result nucleophilic addition reactions occur more readily. And due to presence of H atom on carbonyl group of aldehyde is readily oxidized, as a result aldehydes act as reducing agent and reduce Tollen's reagent Fehling's solution etc.

Q5. What is Fehling's solution ?

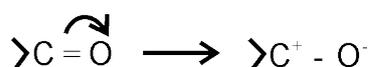
Ans: Alkaline solution $CuSO_4$ and sodium potassium tartarate mixture solution.

Q6. Why carboxylic acids do not give the characteristic reactions of carbonyl group?

Ans: Due to lone pair of electrons on oxygen atom of OH group, exhibit resonance hybrid structures.



Similarly carbonyl group of aldehydes and ketones may be regarded as resonance hybrid structure



Thus Carbonyl group acts as electrophile. So carboxylic group is less electrophilic than aldehydes and ketone. So nucleophilic addition reaction takes place.

7. Write Rosenmund's reaction.

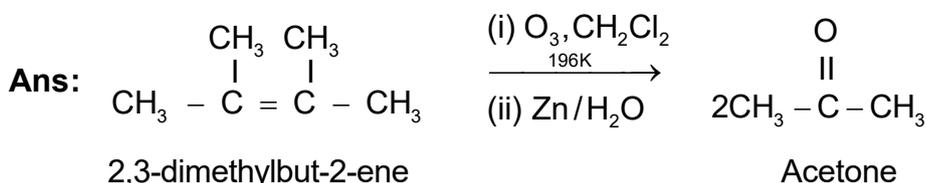
Ans: Acid chlorides are reduced to corresponding aldehydes by passing H_2 gas in presence of Pd and BaSO_4 .



8. Which type of aldehydes undergo cannizzaro's reaction ?

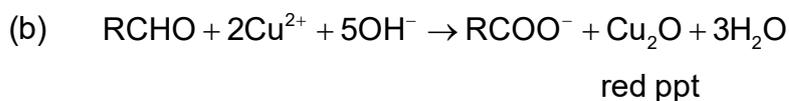
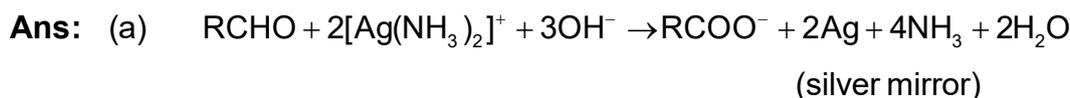
Ans: The aromatic or aliphatic aldehydes which do not contain α -hydrogens undergo cannizzaro's reaction.

9. Which alkenes on reductive ozonolysis gives acetone as the only product ?

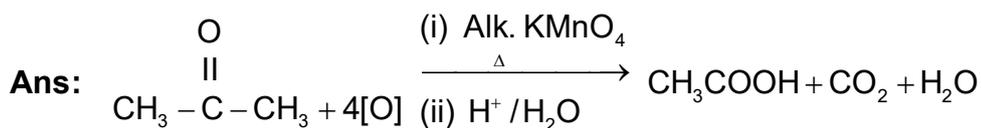


10. How do you test aldehydes and ketones with

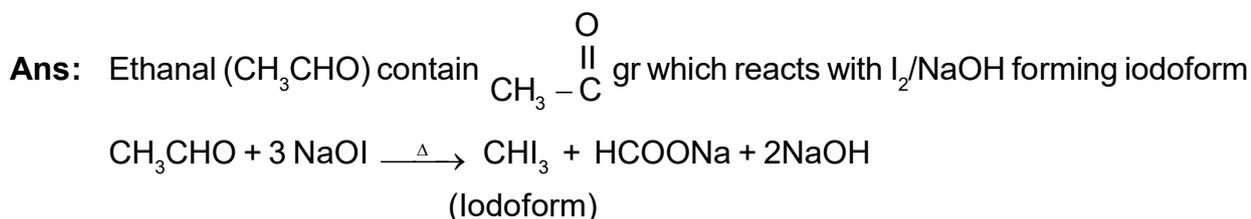
- (a) Tollen's reagent
- (b) Fehling's solution



11. How will you convert acetone into ethanoic acid ?



12. How will you distinguish between ethanal and propanal ?



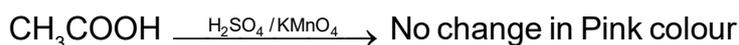
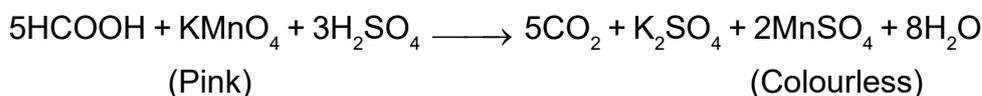
Where as propanal ($\text{CH}_3 - \text{CH}_2 - \text{CHO}$) does not contain CH_3CO group and does not give iodoform test.

13. Why does benzoic acid not undergo Friedel - Craft reaction ?

Ans: Due to presence of deactivated electron withdrawing - COOH group and AlCl_3 gets bonded with - COOH group.

14. How methanoic acid differs from ethanoic acid ? Write the chemical reactions.

Ans: Methanoic acid acts as a reducing agent and decolorises acidified KMnO_4 soln, where as acetic acid does not.



15. Why HCOOH does not give HVZ reaction but CH_3COOH does ?

Ans: CH_3COOH contains α -Hydrogen atom hence gives HVZ reaction but HCOOH does not contain any α -Hydrogen atom hence does not give HVZ reaction.

UNIT - XIII

AMINIES

I. Select the correct answer from the choices given under each bit :

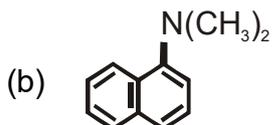
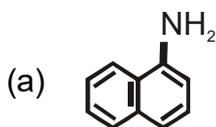
1. The IUPAC name of Isopropyl amine is :

- (a) Propan-1-amine
- (b) Propan-2-amine
- (c) Ethanamine
- (d) N-methyl ethanamine

2. The common name of 2-methyl aniline is

- (a) Toluene
- (b) o-toluidine
- (c) m-toluidine
- (d) p-toluidine

3. Among the following which is tertiary amine ?



- (c) $C_2H_5NH_2$
- (d) $(C_2H_5)_2NH$

4. $\xrightarrow{Sn/HCl}$ product. The

product is

- (a) Aniline
- (b) Toluene
- (c) Benzene dichloride
- (d) phenol

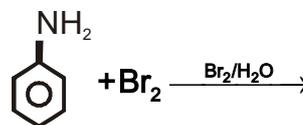
5. $CH_3CONH_2 \xrightarrow[H_2O]{LiAlH_4}$ product

- (a) CH_3CN
- (b) $CH_3COCH_2NH_2$
- (c) $CH_3CH_2NH_2$
- (d) CH_3NH_2

6. The correct decreasing order of basis character among the following NH_3 , CH_3NH_2 , $(CH_3)_2NH$, $(CH_3)_3N$ is

- (a) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$
- (b) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$
- (c) $CH_3NH_2 > (CH_3)_2NH > NH_3 > (CH_3)_3N$
- (d) $NH_3 > (CH_3)_3N > CH_3NH_2 > (CH_3)_2NH$

7. What is the product of the reaction?



- (a) 2-bromo aniline
- (b) 3-bromo aniline
- (c) 4-bromoaniline
- (d) 2,4,6- tribromo aniline

8. Which of the following will give N_2 gas on treatment with HNO_2 ($NaNO_2 + HCl$) ?
- $C_2H_5NH_2$
 - CH_3NH_2
 - $(CH_3)_2CH-NH_2$
 - all of these
9. Which will not undergo diazotisation?
- $C_6H_5NH_2$
 - $C_2H_5NH_2$
 - $$\begin{array}{c} H_2N \\ \diagdown \\ C_6H_4 \\ \diagup \\ CH_3 \end{array}$$
 - $$\begin{array}{c} NH_2 \\ \diagdown \\ C_6H_4 \\ \diagup \\ C_2H_5 \end{array}$$
10. A positive carbylamines test is given by
- N, N-dimethyl aniline
 - 2,4- dimethyl aniline
 - N-methyl benzylamine
 - N-ethyl aniline
11. The correct decreasing order of base strength in gas phase :
- $(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > NH_3$
 - $NH_3 > C_2H_5NH_2 > (C_2H_5)_2NH > (C_2H_5)_3N$
 - $C_2H_5NH_2 > NH_3 > (C_2H_5)_2NH > (C_2H_5)_3N$
 - $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2 > NH_3$
12. A- mixture of 1^0 , 2^0 and 3^0 amines can be separated by Hinsberg's reagent which is
- Benzoyl Chloride
 - Acetyl Chloride
 - Benzosulphonyl Chloride
 - Benzyl Chloride
13. Reduction of benzene diazonium chloride with Zn/HCl gives
- Aniline
 - Phenyl hydrazine
 - Benzyl Alcohol
 - Anisole
14. Gabriel Phthalimide reaction is used for the preparation of
- Primary aromatic amines
 - Secondary amines
 - Aliphatic primary amines
 - Tertiary amines
15. Which of the following compounds gives dye test ?
- Aniline
 - Methyl amine
 - Diphenyl amine
 - Ethylamine
16. The amine that does not react with acetyl chloride is
- CH_3NH_2
 - $(CH_3)_2NH$
 - $(CH_3)_3N$
 - None of these
17. Benzene diazonium chloride is reduced to benzene by
- Phosphorous Acid
 - Hypo phosphorous Acid
 - Hypo phosphoric Acid
 - Phosphine
18. Which of the following is most basic ?
- aniline
 - p-nitro aniline
 - p-methyl aniline
 - benzyl amine

19. Which of the following on reduction with LiAlH_4 yields a secondary amine ?
- Methyl cyanide
 - Nitro ethane
 - Methyl isocyanide
 - Acetamide
20. Which of the following compound will dissolve in an alkali solution after it undergoes reaction with Hinsberg's reagent ?
- CH_3NH_2
 - $(\text{CH}_3)_3\text{N}$
 - $(\text{C}_2\text{H}_5)_2\text{NH}$
 - $\text{C}_6\text{H}_5\text{NH C}_6\text{H}_5$
21. Which of the following gives yellow oily liquid with nitrous acid ?
- Methylamine
 - Aniline
 - Dimethyl amine
 - Trimethyl amine
22. The amine which will not liberate nitrogen on reaction with nitrous acid is
- trimethyl amine
 - ethyl amine
 - t-butyl amine
 - isopropyl amine

ANSWER KEYS

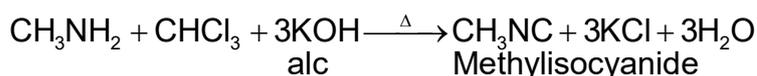
I. Select the correct answer from the choices given under each bit :

- | | | | |
|--------|---------|---------|---------|
| 1. (b) | 7. (d) | 13. (d) | 19. (c) |
| 2. (b) | 8. (d) | 14. (c) | 20. (a) |
| 3. (b) | 9. (b) | 15. (a) | 21. (c) |
| 4. (a) | 10. (b) | 16. (c) | 22. (a) |
| 5. (c) | 11. (d) | 17. (b) | |
| 6. (a) | 12. (c) | 18. (d) | |

II. Short Questions

Q1. Give the distinction between methyl amine and dimethyl amine.

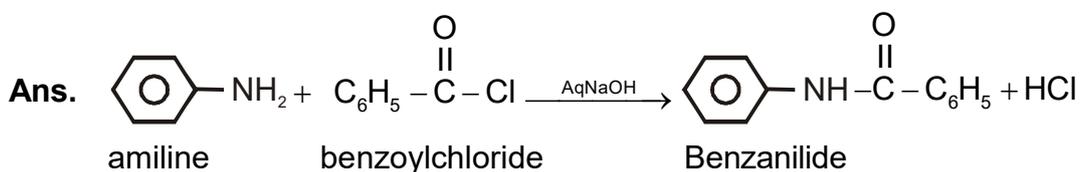
Ans. Methyl amine is a primary amine, gives carbylamine test i.e when methyl amine is heated with alcoholic solution of KOH and CHCl_3 gives methyl isocyanide whereas dimethyl amine, a secondary amine does not give this test.



Q2. Why pK_b aniline is more than that of methyl amine ?

Ans. Aniline is an aromatic amine and the lone pair of electrons on Nitrogen are delocalized. So the electron density on nitrogen decreases. But in CH_3NH_2 , +I effect of CH_3 increases the electron density on N-atom, so a stronger base than aniline. Therefore, pK_b value of methyl amine is lower than aniline.

Q3. Write the chemical reaction of aniline with benzoyl chloride and write the name of the product.

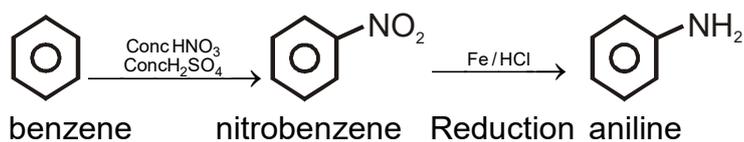


Q4. How will you convert

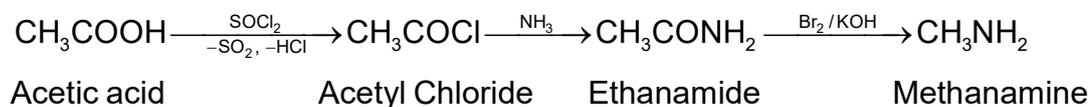
(a) Benzene to aniline

(b) Acetic acid to methanamine

Ans. (a) Benzene to aniline

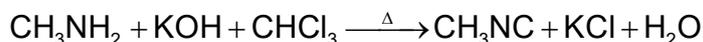


(b) Acetic acid to methanamine



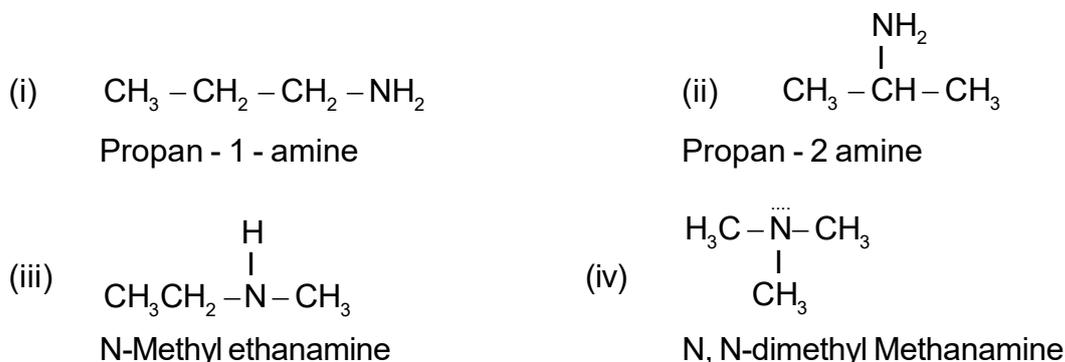
Q5. Write notes on carbylamines reactions giving examples.

Ans. Primary amine when heated with alcoholic solution of KOH and CHCl_3 (Chloroform) gives methyl isocyanide is known as carbylamines reaction.

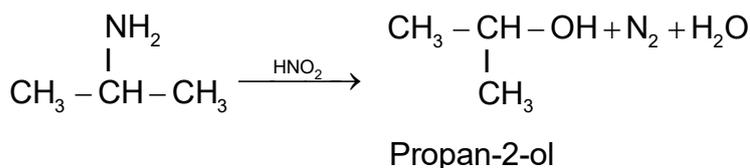
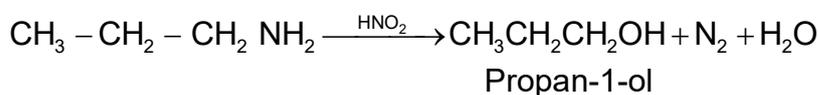


Q6. Write the structures of different isomers corresponds to molecular formula $\text{C}_3\text{H}_9\text{N}$. Write IUPAC names of the isomers which will liberate N_2 gas on treatment with HNO_2 .

Ans. The various isomers of $\text{C}_3\text{H}_9\text{N}$ are



As primary amine can give N_2 gas on treatment with HNO_2 .



Q7. What is benzoylation ? Give one example.

Ans. See question no. - 3

Q8. How will you distinguish between primary amine, secondary amine and tertiary amine ?

Ans. When amine is shaken with benzene sulphonyl chloride in presence of aqueous KOH, a primary amine gives clear solution which on acidification gives an insoluble N-alkyl benzene sulphonamide which is soluble in alkali.

Secondary amine gives N.N dialkylbenzene sulphonamide which is insoluble in alkali.

Tertiary amines do not react with Hinsberg reagent at all.

Q9. Explain why do primary amines have higher boiling points than tertiary amines.

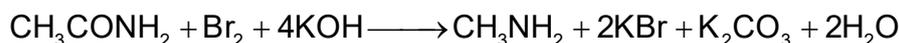
Primary > Secondary > Tertiary

Ans. Among amines, the primary amines have higher b.p. than corresponding secondary amines. This is due to extensive H-bonding in primary amines because of two N-H bonds in the molecule. Tertiary amines do not have N-H bond, consequently have lowest b.p. So the order is

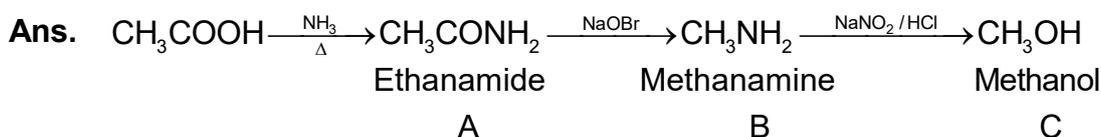
Primary > Secondary > Tertiary

Q10. Write short notes on Hofmann's bromamide reaction.

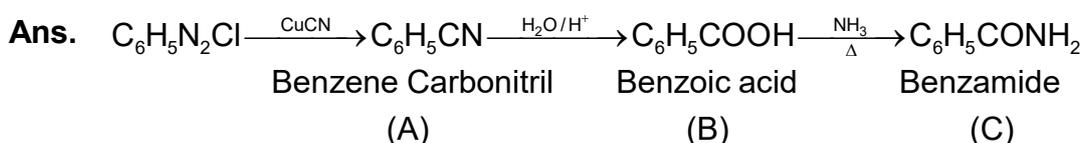
Ans. Hoffmann's Bromamide Reaction : The primary acid amides on reaction with Br₂ in the presence of alkalies at about 343 K give primary amines. The amine formed in this method has one carbon atom less than the parent amide.



Q11. Give the structures of A, B and C in the following reaction.



12. Give the structures of A, B and C in the following reaction.



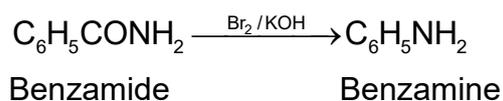
13. Why aromatic primary amines can not be prepared by Gabriel phthalimide synthesis.

Ans. Gabriel Phthalimide Synthesis shows that Phthalimide is first converted into potassium phthalimide by reaction with KOH which on further treatment with alkyl halide gives N-alkyl phthalimide which on subsequent alkaline hydrolysis with NaOH gives primary amine.

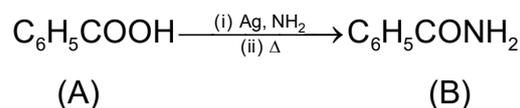
But aromatic primary amines cannot be prepared because aryl halides do not undergo nucleophilic substitution reactions under ordinary conditions.

14. An aromatic compound 'A' on treatment with aqueous NH_3 and heating forms compound 'B' which on heating with Br_2 and KOH forms compound 'C' of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structures and IUPAC names of compounds A, B, C.

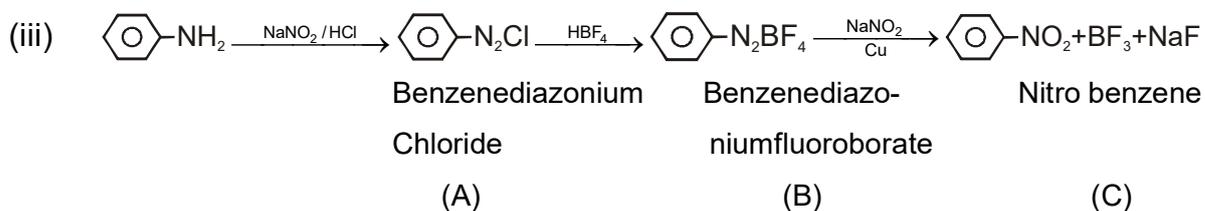
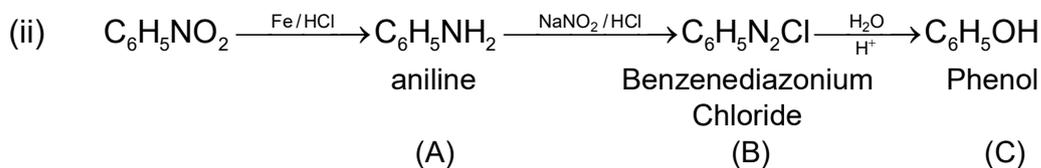
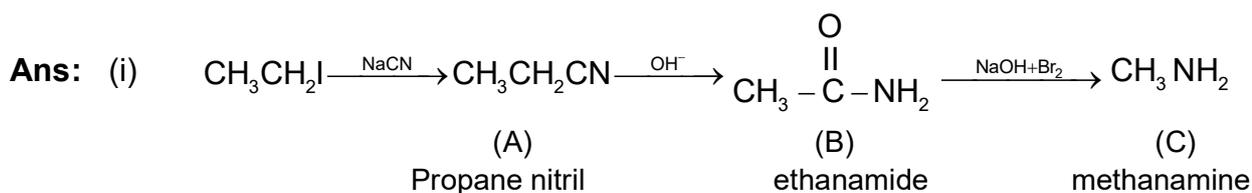
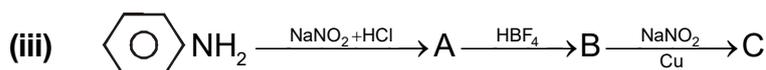
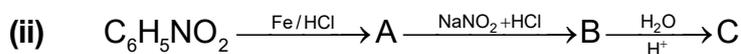
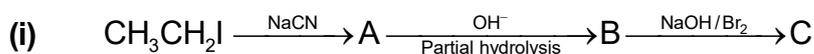
Ans: Since compound C is of M.F. $\text{C}_6\text{H}_7\text{N}$, is formed from 'B' on treatment with Br_2/KOH i.e Hoffmann's bromamide reaction, therefore, the compound 'B' is an amide and 'C' must be an amine. The only amine of M.F. $\text{C}_6\text{H}_5\text{NH}_2$ (aniline). Since 'C' is an amine, the amide formed must be benzamide ($\text{C}_6\text{H}_5\text{CONH}_2$) i.e. B.



Further 'B' is formed from compound 'A' with aq NH_3 and heating must be benzoic acid $\text{C}_6\text{H}_5\text{COOH}$.



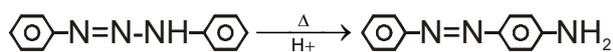
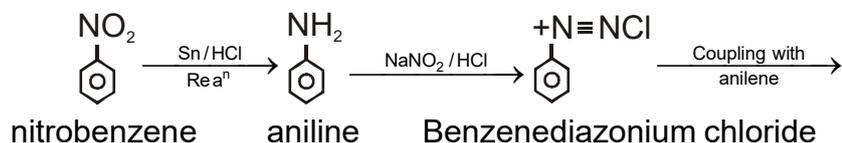
15. Give the structures of A, B and C in the following reaction.



16. How can you convert

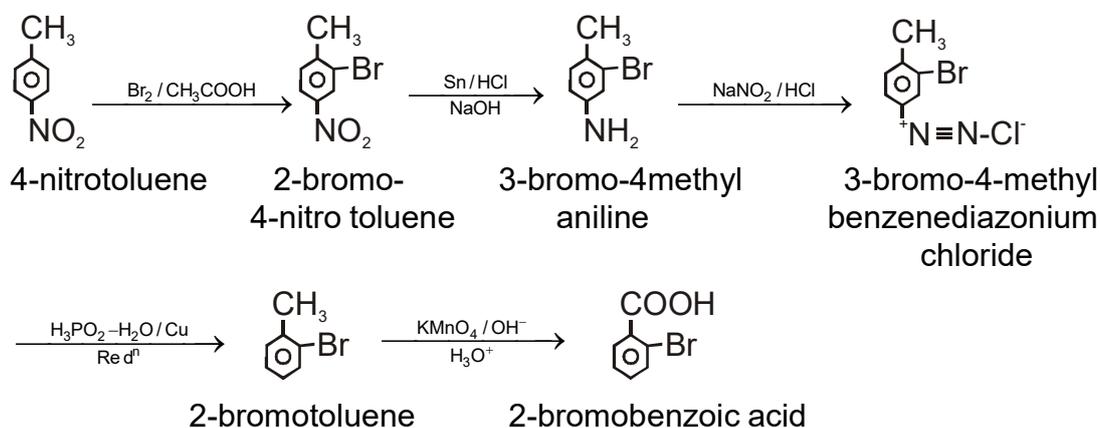
- (a) Nitro-benzene to p-aminoazobenzene
 (b) 4-nitrotoluene to 2-bromo benzoic acid

Ans.: (a) Nitrobenzene to P-aminoazobenzene



Diazoaminobenzene p-aminoazobenzene

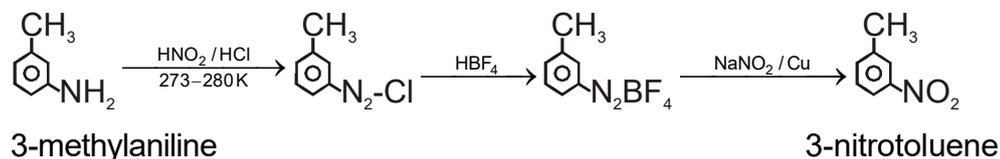
(b) 4-nitrotoluene to 2-bromobenzoic acid



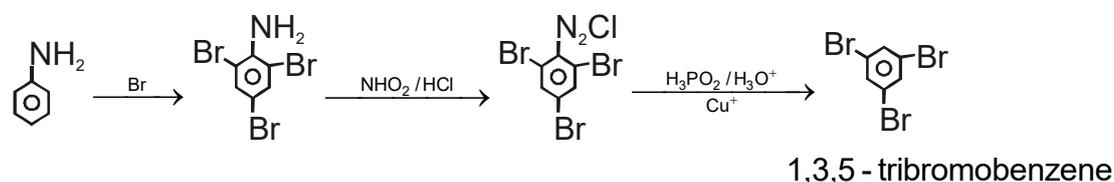
17. How can you convert

- (a) 3-methyl aniline to 3-nitro toluene
 (b) Aniline to 1,3,5-tribromo benzene
 (c) Methanamine to ethanamine

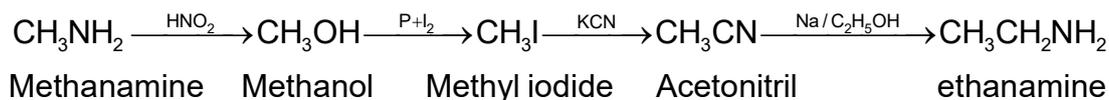
Ans.: (a) 3-methylaniline to 3-nitrotoluene :-



(b) Aniline to 1, 3, 5 tribromobenzene :



(c) Methanamine to Ethanamine



18. Arrange the following in increasing order of basic character ?

(a) $\text{C}_6\text{H}_5\text{NH}_2$, NH_3 , $\text{C}_6\text{H}_5\text{CH}_2^-$, NH_2 , $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$

(b) $\text{C}_6\text{H}_5\text{NH}_2$, $\text{C}_2\text{H}_5\text{NH}_2$, $(\text{C}_2\text{H}_5)_3\text{N}$, $(\text{C}_2\text{H}_5)_2\text{NH}$

(c) $\text{C}_6\text{H}_5\text{NH}_2$, $(\text{CH}_3)_3\text{N}$, $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$, CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$

Ans.: (a) $\text{C}_6\text{H}_5\text{NH}_2 < \text{NH}_3 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$

(b) $\text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_3\text{N} < (\text{C}_2\text{H}_5)_2\text{NH}$

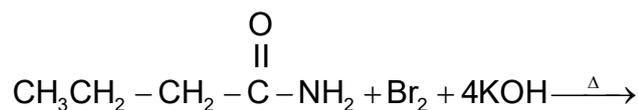
(c) $\text{C}_6\text{H}_5\text{NH}_2 < \text{C}_6\text{H}_5\text{CH}_2\text{NH}_2 < (\text{CH}_3)_3\text{N} < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH}$

19. Write the structure and IUPAC names of

(i) The amide which give propanamine by Hoffmann's bromamide reaction.

(ii) The amide produced by Hoffmann degradation of benzamide

Ans.: (i) Propanamine contains three carbon atoms which is formed after Hoffmann's bromamide reaction. So the amide should have 4 carbon atoms i.e.

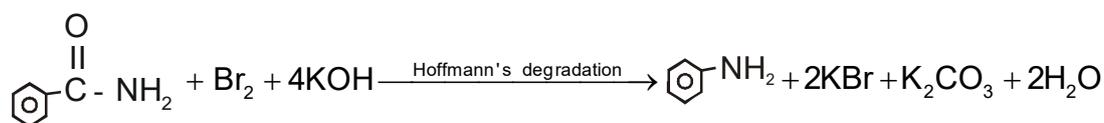


Butanamide



Propanamine

(ii) Benzamide has 7 carbon atoms. The amine formed from benzamide is aromatic primary amine containing six carbon atoms i.e. aniline

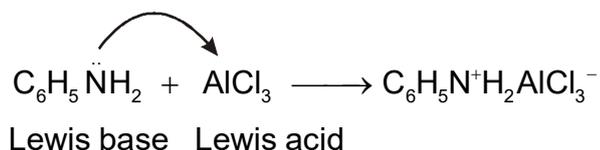


Benzamide

Aniline or Benzamine

20. (a) Why aniline does not undergo Friedel-Craft reaction ? explain.
 (b) Why do primary amines have higher b.p than tertiary amine ?
 (c) Why aliphatic amines are stronger base than aromatic amines ?

Ans.: (a) Aniline is a Lewis base reacts with Lewis acid AlCl_3 to form a salt



As a result aniline acquires a positive charge and acts as deactivating group for electrophilic substitution. Hence aniline does not undergo Friedel - Craft reaction.

- (b) Due to presence of two H-atoms on N-atom of primary amines, they undergo H-bonding where as tert amines do not have H-atom on N-atom, do not possess H-bonding. So primary amines have highest b.p. than tert amines.
- (c) Aromatic amines have resonance effect due to presence of benzene ring. As a result the lone pair of electrons on N-atom gets delocalized and less easily available for protonation. Hence aromatic amines are weaker base than aliphatic amines.

UNIT - XIV

BIOMOLECULES

I. Select the correct answer from the choices given under each bit :

- A nano peptide contains how many peptide linkage ?**
(a) 10 (b) 8
(c) 9 (d) 18
- Which of the following exists in Zwitter ionic form ?**
(a) alkaline (b) glucose
(c) fructose (d) ethanamide
- Which of the following biomolecule will give blue colouration with Cu^{2+} and purple colour with nin-hydrin solution ?**
(a) aldehyde (b) α -amino acid
(c) carbohydrate (d) DNA
- Which among the following is the monomer of starch ?**
(a) glucose (b) sucrose
(c) protein (d) lactose
- Which of the following is/are reducing sugars ?**
(a) sucrose (b) fructose
(c) starch (d) cellulose
- The Carbon Atom involves in osazone formation are**
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 5 and 6
- The bonds in protein structure that are not broken on denaturation**
(a) hydrogen bond
(b) peptide bond
(c) ionic bond
(d) disulphide bond
- The phenomenon of mutarotation is not exhibited by**
(a) glucose (b) fructose
(c) sucrose (d) maltose
- Which of these is not found in nucleotides ?**
(a) guanine (b) cytosine
(c) adenine (d) tyrosine
- Which of the following does not undergo hydrolysis ?**
(a) glucose (b) cellulose
(c) cane sugar (d) maltose
- Which of the following is a monosaccharide ?**
(a) sucrose (b) galactose
(c) maltose (d) lactose
- Which of the following carbohydrates is most abundant in nature ?**
(a) glucose (b) fructose
(c) cellulose (d) starch

- 13. Which gives red colour with Fehling's Solution ?**
- (a) glucose
(b) cellulose
(c) benzaquinone
(d) cane sugar
- 14. On hydrolysis, proteins give**
- (a) nucleotides (b) nucleosides
(c) amides (d) amino acids
- 15. The change in optical rotation with time of freshly prepared solutions of sugar is known as**
- (a) specific rotation
(b) inversion
(c) rotatory motion
(d) mutarotation
- 16. Which of the following carbohydrates is used in silvering of mirror ?**
- (a) Sucrose (b) Cellulose
(c) Fructose (d) Glucose
- 17. Helical structure of proteins is stabilized by**
- (a) ionic bond
(b) covalent bond
(c) vanderwaal's forces
(d) hydrogen bond
- 18. Glucose and fructose are**
- (a) optical isomers
(b) functional isomers
(c) chain isomers
(d) position isomes
- 19. The number of chiral carbon atoms in β -D(+)
glucose molecule is**
- (a) 3 (b) 5
(c) 4 (d) 6
- 20. Glucose with excess of phenyl hydrazine forms**
- (a) fructosazone
(b) glucose phenyl hydrazone
(c) glucosazone
(d) phenyl hydrazone of glucosazone
- 21. Protein is an important constituent of our diet. It functions mainly as**
- (a) source of energy
(b) a construction material
(c) shock absorber
(d) reserve food
- 22. The coagulation of protein is called**
- (a) dehydration (b) decay
(c) deamination (d) denaturation
- 23. Which one of the following is a disaccharide ?**
- (a) starch (b) lactose
(c) cellulose (d) fructose
- 24. A protein is best described as a**
- (a) poly amide (b) polyester
(c) poly peptide (d) poly urethane
- 25. α -D(+)
- glucose and β -D(+)
- glucose are called**
- (a) geometrical isomers
(b) anomers
(c) enantiomers
(d) epimers

- 26. The number of amino acids which form proteins in nature are about**
- (a) 6 (b) 10
(c) 15 (d) 20
- 27. The pH value of a solution in which a polar amino acid does not migrate under influence of electrical field is called**
- (a) iso electric point
(b) iso electronic point
(c) neutralization
(d) none of the above
- 28. The protein which transports oxygen in the blood stream is**
- (a) hemoglobin (b) insulin
(c) collagen (d) albumin
- 29. Which of the following base is found only in RNA and not in DNA ?**
- (a) thiamine (b) guanine
(c) uracil (d) adenine
- 30. At the iso electric point, amino acids are present as**
- (a) $H_2N \cdot CHR \cdot COOH$
(b) $H_3N^+CHR\text{COO}^-$
(c) $H_3N^+CHR\text{COOH}$
(d) $H_2N\text{CHR}\text{COO}^-$
- 31. The most important energy carrier in the living cell is**
- (a) AMP (b) ADP
(c) UDP (d) ATP
- 32. Glucose and Fructose can also be distinguished by**
- (a) molisch test
(b) acetylation
(c) conc solution of NaOH
(d) phenyl hydrazine
- 33. Which of the following is a protein?**
- (a) Nylon (b) Natural silk
(c) Rayon (d) Teryline
- 34. Proteins give purple colour with**
- (a) Benedict's Solution
(b) Iodine Solution
(c) Ninhydrin Reagent
(d) Biuret
- 35. Bases common to RNA and DNA are**
- (a) adenine, guanine, cytosine
(b) adenine, uracil, cytosine
(c) adenine, guanine, thymine
(d) guanine, uracil, thymine
- 36. In nucleic acids, the sequence is**
- (a) base, phosphate, sugar
(b) base, sugar, phosphate
(c) sugar, base, phosphate
(d) phosphate, base, sugar
- 37. Which of the following contain a transition metal ?**
- (a) Chlorophyll (b) Hemoglobin
(c) Vitamin (d) DNA

- 38. The letter 'D' and 'L' in carbohydrates represent**
- its optional rotation
 - its mutarotation
 - its direct synthesis
 - its configuration
- 39. Carbohydrates are used by body mainly**
- for obtaining vitamins
 - as a source of energy
 - for building muscles
 - for all its developmental needs
- 40. The number of asymmetric carbon atoms in fructose are**
- 2
 - 3
 - 4
 - 5
- 41. Which one of the following is the reagent used to identify glucose ?**
- Neutral FeCl_3
 - CHCl_3 and alc. KOH
 - Ammoniacal AgNO_3
 - CH_5ONa
- 42. Charring of sugar is due to**
- oxidation
 - reduction
 - dehydration
 - reduction & hydration
- 43. On hydrolysis of starch, we finally get**
- glucose
 - fructose
 - both glucose & fructose
 - sucrose
- 44. The aqueous solution of carbohydrate gave a dark blue colour with iodine solution, the carbohydrate is**
- glucose
 - fructose
 - sucrose
 - starch
- 45. The glucose is an example of**
- disaccharide
 - aldohexose
 - ketohexose
 - none of these
- 46. Which carbohydrate is an essential constituent of plant cells ?**
- Starch
 - Cellulose
 - Sucrose
 - Vitamins
- 47. The reason for double helical structure of DNA is operation of**
- hydrogen bonding
 - electrostatic attraction
 - Vander Waal's force
 - dipole-dipole interaction
- 48. The conversion of maltose to glucose is possible by the enzyme**
- Zymase
 - Lactase
 - Maltase
 - Diastase
- 49. Which of the following amino acid is optically active**
- phenyl alanine
 - glycine
 - glutamic acid
 - asparagine

50. A compound gives negative test with ninhydrin and positive test with Benedict's solution. The compound is
- a lipid
 - a protein
 - an amino acid
 - a mono saccharids
51. The essential amino acids are
- glycine
 - alanine
 - valine
 - cysteine
52. Glucose does not react with
- NH_2OH
 - HCN
 - NaHSO_3
 - NH_2OH
53. Glucose is stored in our body as
- carbohydrates
 - fats
 - glycogen
 - lipid
54. DNA multiplication is called
- translation
 - transduction
 - transcription
 - replication
55. How can you say that glucose is a cyclic compound ?
- Glucose undergoes reaction with Tollen's reagent
 - Glucose reacts with phenyl hydrazine
 - Glucose fails to react with sodium bisulphate
 - Glucose reacts with nitric acid
56. The sweetest carbohydrate is
- Sucrose
 - Glucose
 - Fructose
 - Lactose
57. Which of the following is the first member of monosaccharides ?
- $\text{CH}_2\text{OH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2\text{OH}$
 - $\text{HOCH}_2-\text{CHOH}-\text{CHO}$
 - $\text{OHCH}_2-\text{CHOH}-\text{CHOH}-\text{CHO}$
 - $\text{CH}_2\text{OH}-\text{CHOH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2\text{OH}$
58. A carbohydrate is treated with α -naphthol and conc. H_2SO_4 . What colour will be formed at the junction of two liquids ?
- Blood red
 - Violet
 - Brown
 - Orange
59. Milk changes into ___ after digestion.
- Cellulose
 - Fructose
 - Glucose
 - Lactose
60. In alkaline medium, glycine predominately exists as a/an
- cation
 - anion
 - zwitter ion
 - covalent form
61. Denaturation of protein leads to loss of its biological activity by
- formation of amino acids
 - loss of primary structure
 - loss of both primary and secondary structures
 - loss of both secondary and tertiary structures

- 62. At pH = 4, glycine exists as**
- (a) $\text{H}_3\text{N}^+ - \text{CH}_2 - \text{COO}^-$
 (b) $\text{H}_3\text{N}^+ - \text{CH}_2 - \text{COOH}$
 (c) $\text{H}_2\text{N} - \text{CH}_2 - \text{COOH}$
 (d) $\text{H}_2\text{N} - \text{CH}_2 - \text{COO}^-$
- 63. The purine base present in RNA is**
- (a) guanine (b) cytosine
 (c) uracil (d) thymine
- 64. Which one of the following statements about amino acids is not true ?**
- (a) They are constituents of all proteins
 (b) They are all high melting solids
 (c) Most naturally occurring amino acids have D-configuration
 (d) They are characterized by iso electric point
- 65. The secondary structure of protein refers to**
- (a) α -helical backbone
 (b) Hydrophobic interactions
 (c) Sequence of α -amino acids
 (d) Fixed configuration of the poly peptide backbone
- 66. Monomer of nucleic acid is**
- (a) Nucleotide (b) Nucleosides
 (c) Amino Acids (d) Carboxylic Acid
- 67. Which one is not a constituent of nucleic acid ?**
- (a) Uracil
 (b) Guanidine
 (c) Phosphoric Acid
 (d) Ribose Sugar
- 68. The function of DNA in an organism is**
- (a) to assist in the synthesis of RNA molecule
 (b) to store information of heredity characteristics
 (c) to assist in the synthesis of proteins and polypeptides
 (d) All of the above
- 69. A sequence of how many nucleotides in messenger RNA make a codon for an amino acid ?**
- (a) Three (b) Four
 (c) One (d) Two
- 70. The presence and absence of hydroxy group on which carbon atom of sugar differentiates RNA and DNA ?**
- (a) First (b) Second
 (c) Third (d) Fourth
- 71. Which one is correct representation of peptide bond ?**
- (a) $\begin{array}{c} \text{O} \\ || \\ \text{H}-\text{C}-\text{N}- \\ | \quad | \end{array}$ (b) $\begin{array}{c} \text{O} \\ || \\ -\text{C}-\text{N}- \\ | \\ \text{H} \end{array}$
- (c) $\begin{array}{c} \text{OH} \\ | \\ \text{H}-\text{C}-\text{N}- \\ | \end{array}$ (d) None of these

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 19. (c) | 37. (b) | 55. (c) |
| 2. (d) | 20. (c) | 38. (d) | 56. (c) |
| 3. (b) | 21. (b) | 39. (b) | 57. (b) |
| 4. (a) | 22. (d) | 40. (b) | 58. (b) |
| 5. (b) | 23. (b) | 41. (c) | 59. (c) |
| 6. (a) | 24. (c) | 42. (c) | 60. (b) |
| 7. (b) | 25. (b) | 43. (a) | 61. (d) |
| 8. (c) | 26. (d) | 44. (d) | 62. (b) |
| 9. (d) | 27. (a) | 45. (b) | 63. (a) |
| 10. (a) | 28. (a) | 46. (b) | 64. (c) |
| 11. (b) | 29. (c) | 47. (a) | 65. (a) |
| 12. (c) | 30. (b) | 48. (c) | 66. (a) |
| 13. (a) | 31. (d) | 49. (b) | 67. (b) |
| 14. (d) | 32. (c) | 50. (d) | 68. (d) |
| 15. (d) | 33. (b) | 51. (c) | 69. (a) |
| 16. (d) | 34. (c) | 52. (c) | 70. (b) |
| 17. (d) | 35. (a) | 53. (c) | 71. (b) |
| 18. (b) | 36. (b) | 54. (d) | |

II. Short Questions

Q.1. What is structural feature characterizing reducing sugar ?

Ans. The reducing sugars contain aldehyde group (-CHO) e.g Glucose, Mannose, Galactose etc. or α -Keto group (-CO-CH₂OH) like fructose.

Q.2. Define mono saccharides. What is the main difference between the anomers of glucose ?

Ans. Monosaccharides are simple carbohydrates which cannot be hydrolysed to smaller molecules. The general formula is (CH₂O)_n where n = 3 to 7 carbon atoms.

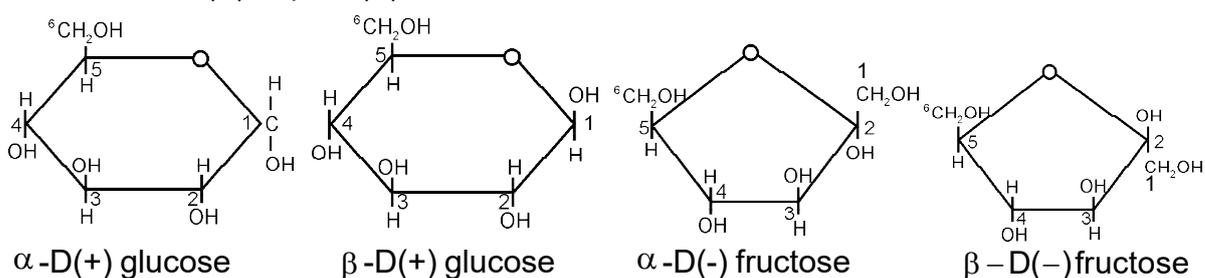
Glucose shows open chain structure as well as 5 or 6 numbered cyclic structures containing an oxygen atom. D-glucose exists as α and β forms which differ in configuration only around C₁ called anomers and C₁ carbon is called anomeric carbon.

Q.3. Explain mutarotation taking place in D-glucose.

Ans. The α -D(+) glucose has specific rotation +111° and β -D(+) glucose has specific rotation 19.2°. Both the forms are stable in aqueous sodium, but each form slowly changes into an equilibrium mixture of both. It is seen that the specific rotation of α -D(+) glucose falls gradually from +111° to +52.5° with time and β -D(+) glucose increases from 19.2° to 52.5°. This spontaneous change in specific rotation of optically active compound with time to an equilibrium value is called 'mutarotation'.

Q.4. How does glucose differ from fructose ?

Ans. Glucose has two isomers having α -D(+) and β -D(+). Similarly fructose has two isomers α -D(-) & β -D(-).



Glucose is pyranose structure whereas fructose is furanose structure.

Q.5. Why glucose does not give 2,4 dinitrophenyl hydrazine test ?

Ans. Glucose does not give 2,4 dinitrophenyl hydrazine test, which shows that the -CHO group is not free but combines with C₅-OH to form a hemiacetal. This cyclic structure of hemiacetal form cannot disturb the equilibrium to generate more open chain form from the cyclic form. Hence it does not react with 2,4 DNP.

Q.6. What is the significance of 'D' and '+' for glucose ?

Ans. The letter 'D' in D(+) glucose indicates that C₅ - OH group is oriented towards right while the sign (+) indicates that glucose is dextrorotatory.

Q.7. How is it explained the amphoteric nature of amino acid ?

Ans. Amino acids contain an acidic (-COOH gr) and a basic (-NH₂) gr. in the same molecule. In aqueous solution, they neutralise each other. -COOH gr. loses H⁺ ion and -NH₂ accepts it, as a result they are dipolar or Zwitter ion. The ⁺NH₃ gr acts as acid and -COO⁻ gr acts as base. Therefore, amino acids are amphoteric.

Q.8. What are enzymes ?

Ans. Enzymes are biological catalysts. Different biological system needs different enzyme. They are very specific and efficient in their action. They acts at optimum temperature and atmospheric pressure.

Q.9. How are vitamins classified ?

Ans. Vitamins are classified as two groups (i) Water soluble vitamins and (ii) Fat soluble vitamins. Water vitamins include Vitamin B Complex, Vitamin C.. Fat soluble vitamins include Vitamin A, D, E and K. They are stored in liver and adipose tissues.

Q.10. What is nucleoside ?

Ans. A nucleoside consists of two components a nitrogenous base (purine and pyrimidine) and a five carbon sugar (ribose or deoxyribose). It is obtained when the nitrogenous base is attached to C₁ of sugar by a β-linkage. A nucleoside is represented as base-sugar. They are adenosine, cytidine etc.

Q.11. What are the constituents of starch ?

Ans. Amylose and amylopectin are constituents of starch.

Q.12. What happens when protein is denatured ?

Ans. When protein is denatured, it loses its biological activity due to changes in the secondary and tertiary structures.

Q.13. What are reducing sugars ?

Ans. Sugar which reduces Tollen's reagent and Fehling's solution are known as reducing Sugars. Glucose, Fructose, Galactose, Mannose, Maltose, Lactose are reducing sugars.

Q.14. What is inversion of sugar ?

Ans. Sucrose (cane sugar) on hydrolysis gives D(+) glucose and D(-) fructose. Sucrose is dextrorotatory, D(+) glucose is dextrorotatory but D(-) fructose is laevorotatory. The change in specific rotation from dextrorotatory (from sucrose) to laevorotatory (glucose and fructose) is called inversion of sugar.

Q.15. What are bio molecule ?

Ans. The complex organic molecules such as carbohydrates, proteins, lipids, nucleic acids etc. which form the basis of life i.e. which build up living organisms and are also required for their growth and maintenance are called 'biomolecules'.

Q.16. Discuss primary and secondary structures of nucleic acids.

Ans. Nucleic acids are polynucleotides and are formed by thousand molecules of nucleotides with the elimination of water molecules. During this polymerization the $5' \text{CH}_2 - \text{OH}$ hydroxy group of the sugar residue of one nucleotide combines with one of the $-\text{OH}$ groups of the phosphoric acid at C_3' of the other nucleotide to form a long poly nucleotide chain. The back bone consists of alternating sugar phosphate residue, each sugar on this backbone is further connected to one of the four nitrogenous bases. This chain is called the Primary Structure.

In secondary structure of nucleic acid, the base composition is DNA. It consists two right handed poly nucleotide strands, run in opposite directions giving a double helix structure.

The two strands are complementary and not identical. The base pairs of two strands are linked together through H-bonds. H-bonding is taking place between specific bases. A purin base of one strand is paired with a pyrimidine base of the other strand. The possible pairings of DNA are guanine (G) and cytosine (C) through three H-bonds and between adenine (A) and thiamine (T) through two H-bonds. On heating two strands of DNA separate from each other. On cooling they hybridise. Like DNA, RNA has single strand.

Q.17. What are vitamins ? Which vitamin difficiencies cause night blindness ?

Ans. Vitamins are group of bio molecules (other than fats, carbohydrates and proteins) which are required in small amounts for normal metabolic processes and for the life, growth and health of human beings and animal organisms.

The deficiency of Vitamin A causes night blindness.

Q.18. What are the functions of DNA ?

Ans. There are two important functions of DNA, these are (i) Replication and (ii) Protein synthesis.

The process by which a single DNA molecule produces two identical copies of itself is called Cell Division (mitosis) or replication.

Proteins are synthesized by RNA molecules in the cell, but the message for synthesis of a particular protein is coded in DNA. The three types of RNA molecules are (i) messenger RNA (m-RNA), ribosomal RNA (r-RNA) and transfer RNA (t-RNA).

Q.19. What are complementary nature of two DNA strands ?

Ans. See question no. - 16

Q.20. How are proteins related to amino acids ?

Ans. Proteins are polymers of α -amino acids. Like peptides the amino acid units in proteins are held up by peptide (-CONH-) linkage. The polymeric products of α -amino acids with molecular mass up to 10,000 are called poly peptides while those having molecular mass more than 10,000 are considered as proteins.

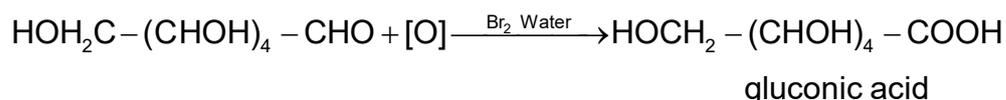
Q.21. What are essential and non-essential amino acids ?

Ans. Amino acids which the body can not synthesize are called essential amino acid e.g phenylalanines, valine, leucine, isoleucine, methionine, tryptophan, threonine, lysine, arginine and histidine (10 amino acids) are essential amino acids.

The ten amino acids which the body can synthesize are called non-essential or dispensable amino acids. They are glycine, alanine, serine, cysteine, asparagine, glutamine, threonine, tyrosine, aspartic acid, glutamic acid.

Q.22. Write the reaction of glucose converted to gluconic acid.

Ans. Glucose on oxidation with Br_2 water gives gluconic acid.



This confirms the presence of -CHO gr. in glucose.

Q.23. What are the main differences between α and β forms of glucose ?

Ans. See question no. 4.

UNIT - XV

POLYMERS

I. Select the correct answer from the choices given under each bit :

- Which is a natural polymer of the following?
(a) Polyester (b) Glyptal
(c) Starch (d) Nylon-C
- Which compound is used to form Bakelite with phenol ?
(a) Acetaldehyde
(b) Acetal
(c) Formaldehyde
(d) Chlorobenzene
- Which of the following is an example of co-polymer.
(a) Polythene
(b) Polyvinyl chloride
(c) Polytetrafluoro ethene
(d) Nylon - 6,6
- The monomer of PVC is
(a) Ethylene
(b) Vinyl chloride
(c) Tetrafluoro ethylene
(d) Stynene
- Polyacrylonitrile (PAN) is an example of
(a) Addition Polymer
(b) Condensation Polymer
(c) Natural Polymer
(d) Biodegradable Polymer
- Which of the following is an addition polymer ?
(a) Nylon 6
(b) Nylon 66
(c) High density polymer
(d) Dacron
- Natural rubber is a polymer of
(a) Butadiene (b) Ethyne
(c) Styrene (d) Isoprene
- Which of the following polymers contain 1,3 butadiene as one of the monomer ?
(a) Butyl rubber (b) Nitril rubber
(c) ABS plastic (d) All of them
- Which is not a macro molecule ?
(a) DNA (b) Starch
(c) Palmitate (d) Insulin
- Which of the following is a biodegradable polymer ?
(a) Cellulose
(b) Polythene
(c) Polyvinyl chloride
(d) Nylon-6
- Which of the following is a biodegradable polymer of polyamide class ?
(a) Dextran (b) Nylon-2-nylon-6
(c) nylon-66 (d) PHBV

12. Teryline is a condensation polymer of ethylene glycol and
- Benzoic acid
 - Phthalic acid
 - Salicylic acid
 - Terephthalic acid
13. $\text{CF}_2 = \text{CF}_2$ is a monomer of
- Teflon
 - Nylon-6
 - Buna-S
 - Glyptal
14. Natural Silk is a
- Poly peptide
 - Poly acrylate
 - Polyester
 - Poly saccharide
15. Which is an example of thermosetting polymer ?
- Polythene
 - Neoprene
 - PVC
 - Bakelite
16. Which of the following is not semi synthetic polymer ?
- Cis-poly isoprene
 - Cellulose nitrate
 - Cellulose acetate
 - Vulcanised rubber
17. Which of the following statements is not true about low density polythene ?
- It is obtained through free radical addition
 - It is hard and less flexible
 - It is poor conductor of electricity
 - It has a highly branched structure
18. Soft drinks and baby feeding bottles are generally made up of
- Polyester
 - Polyamide
 - Polystyrene
 - Polyurathane
19. Which of the following used in paints ?
- Terylene
 - Nylon
 - Glyptal
 - Chloroprene
20. Orlon has a unit of
- Vinyl cyanide
 - Acrolein
 - Glycol
 - Isoprene
21. Which is not a polymer ?
- Glucose
 - Starch
 - Enzyme
 - Teflon

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

- | | | | |
|--------|---------|---------|---------|
| 1. (c) | 6. (c) | 11. (b) | 16. (a) |
| 2. (c) | 7. (d) | 12. (d) | 17. (d) |
| 3. (d) | 8. (d) | 13. (a) | 18. (c) |
| 4. (b) | 9. (c) | 14. (a) | 19. (c) |
| 5. (a) | 10. (a) | 15. (d) | 20. (a) |
| | | | 21. (a) |

II. Short Questions

Q1. What are natural and synthetic polymers ? Give example of each type.

Ans. Natural polymers are found in nature i.e. animals and plants e.g. proteins, starch, cellulose, nucleic acids, resins and rubber. Man made polymers are called synthetic polymers e.g. plastics, PVC, polythene, polyester, nylon-6 & neoprene, Buna-S etc.

Q2. Define the term polymerization.

Ans. Polymerization is a process of formation of a high molecular mass from one or more monomers by linking together with repeating structural units of covalent bonds.

Q3. Define thermo plastics and thermosetting polymers with examples.

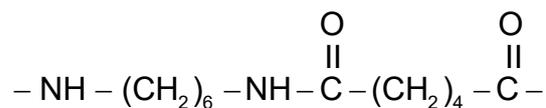
Ans. The thermo plastic polymers are the linear polymers which can make soft on heating and hard on cooling. There is no cross linking between the polymer chains. Examples- polythene, poly styrene, polyvinyl chloride, poly propylene etc.

The thermosetting polymers become hard infusible on heating. They are normally made from semi fluid substances with molecular masses. On heating in a mould, they get hardened and cannot be soften again. This polymerisation is a cross linking of different polymer chains to give three dimensional network solid. Example; Bakelite, melamine, formaldehyde polymers.

Q4. What are monomeric repeating units of Nylon-6 and Nylon-66 ?

Ans. The monomeric unit of Nylon 6 is Caprolactum $\left(-\text{NH} - (\text{CH}_2)_5 - \overset{\text{O}}{\parallel} \text{C} - \right)$ which is obtained from Cyclohexane.

The monomeric unit of Nylon 66 is derived from two monomers, adipic acid (1,6 hexadioic acid) and hexamethylene diamine (1,6 diaminohexane)



Q5. Discuss the purpose of vulcanization of rubber.

Ans. Natural and synthetic rubber are very soft and sticky. It is more soft on high temperature and brittle at low temperature. As a result articles made from natural rubber do not last for long period. These are hardened by a process known as vulcanisation. To increase tensile strength, high resistance, resistant to solvents natural rubber is vulcanized by heating 5% sulphur at 373-415 K. The polymer has double bond, the chains have bends and formed a tightly packed crystalline polymer. Cross linking prevents the polymer from being torn when it is stretched. When the stress is removed it comes back to its original shape.

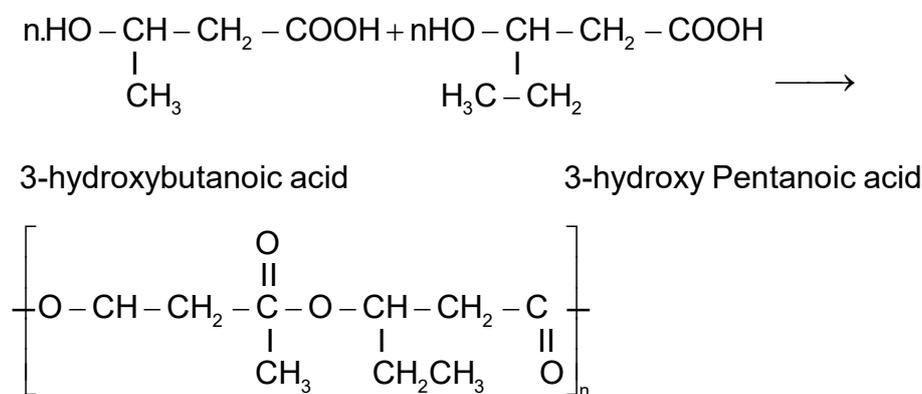
- (ii) **Branched Chain Polymer** : In this polymer, the monomeric units are linked to constitute long chains. Branched chain polymers are irregularly packed, has low density, low m.p., low tensile strength example : Amylopectin, glycogen etc.
- (iii) **Cross- Linked or network polymers**. In this polymer, the monomeric units are linked together to constitute three dimensional network. Only two cross links chains are required to form a long chain polymer. These polymers are hard, rigid and brittle. Example : Bakelite, melamine formaldehyde, urea formaldehyde polymer etc.

Q10. What is a biodegradable polymer ? Give the name of its monomer.

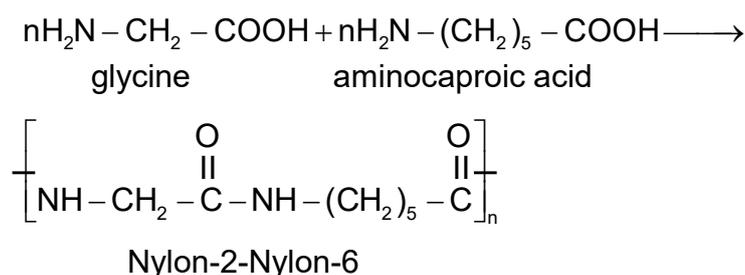
Ans. The biodegradable polymers which are broken into small segments by enzyme catalyzed reactions. These enzymes are produced by microorganisms. The C-C bonds of polymers can not be broken by enzymes, so to make it feasible, certain bonds are inserted and can be broken by the enzymes. When such polymers are buried as waste, microorganisms present in the ground can degrade the polymer.

Example

- (i) **Poly- β hydroxyl-co- β -hydroxy valerate** :- It is copolymer of 3-hydroxy butanoic acid and 3-hydroxy pentanoic acid in which two monomers are connected by ester linkage.



- (ii) **Nylon 2- nylon6** : Glycine and aminocaproic acid forms Nylon2- Nylon6



UNIT - XVI

CHEMISTRY IN EVERYDAY LIFE

I. Select the correct answer from the choices given under each bit :

1. Which of the following drug reduces fever ?

- (a) Analgesic (b) Antipyretic
(c) Antibiotic (d) Tranquillisac

2. Tincture iodine is :

- (a) aqueous solution of I_2
(b) solution of I_2 in aqueous KI
(c) alcoholic solution of I_2
(d) aqueous solution of KI

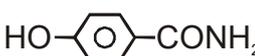
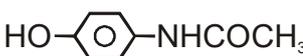
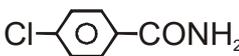
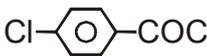
3. 2-acetoxy benzoic acid is called :

- (a) Antiseptic (b) Aspirin
(c) Antibiotic (d) Mordant dye

4. Barbituric acid is used as :

- (a) An antibiotic
(b) An antiseptic
(c) An analgesic
(d) A tranquillizer

5. The structure of paracetamol is

- (a) 
(b) 
(c) 
(d) 

6. Choose the correct statement

- (a) Saccharin is 650 times sweeter than sugar
(b) Alitame is 2000 times sweeter than sugar
(c) Sucralose is 160 times sweeter than sugar
(d) Aspartame is 550 times sweeter than sugar

7. An ester used as medicine

- (a) ethyl acetate
(b) methyl acetate
(c) methyl salicylate
(d) ethyl benzoate

8. Which of the following cannot be used as artificial sweetener ?

- (a) Aspartame (b) Sucralose
(c) Alitame (d) Galactose

9. Which of the following is an antihistamine drug ?

- (a) Chloro pheniramine maleate
(b) Ciprofloxacin
(c) Chloram phenicol
(d) Chloroquine

10. Which of the following not used as antacid ?

- (a) Omeprazol
- (b) Zantac
- (c) Lanso pyrazol
- (d) Sulphanilamide

11. Sodium benzoate is used as

- (a) cleaning clothes
- (b) food preservative
- (c) anit-malaria drug
- (d) food sweetener

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

1. (b)

5. (b)

9. (a)

2. (c)

6. (b)

10. (d)

3. (b)

7. (c)

11. (b)

4. (d)

8. (d)

II. Short Questions

Q1. Discuss the advantage of synthetic detergents over soaps.

Ans. Synthetic detergents have the following advantages over soaps.

- (a) Synthetic detergents can be used even in hard water where as some of the soaps gets wasted in hard water.
- (b) Synthetic detergents can be used in acidic medium and not decomposed in acidic medium while soaps get precipitated.
- (c) Synthetic detergents have stronger cleaning action than soaps.
- (d) Synthetic detergents are more soluble in water than soaps, hence produce lather more easily.
- (e) Synthetic detergents are prepared from the hydrocarbons obtained from petroleum, this saves vegetable oils which are otherwise used in preparation of soaps.

Q2. What is the disadvantage of detergents.

Ans. Synthetic detergents are non biodegradable and cause soil and water pollution. This is because detergents are highly branched hydrocarbon and stop the bacteria to break the chains. If straight chain hydrocarbon can be used then this problem may be solved.

Some phosphate additives present in detergents act as nutrients for algae which form thick green scum over the river water and upset the animal life in the river.

Q3. Accounts the helps of aspirin in the prevention of heart attack.

Ans. Most of heart attacks are due to blood clotting in the coronary arteries. Aspirin helps to make the blood thinner and check the formation of blood clotting in the coronary arteries, thus prevents heart attack.

Q4. What are antihistamines ? Explains how do they act in human body ?

Ans. Allergy caused in the body due to dust, fur, fibers and certain drugs intake etc. This is due to release of a substance called histamine in the body. Antihistamines are the drugs which reduce the action of histamine in the body thereby preventing allergy. Example, terphenadine and brompheniramine.

Histamines interact with the binding sites of receptor in the body to produce allergy. Antihistamines interfere with the natural action of histamine by competing with histamine for binding sites of receptor where histamine acts. The antihistamines are widely used for fever, conjunctivitis, sneezing, itching of eyes etc. Some drugs are Benadryl , Cetrizine, Chlorpheniramine etc.

Q5. What are artificial sweetening agents ?

Ans. The artificial sweeteners are the chemical substances which are sweet in taste but do not give any calories to our body. These are excreted through urine. These are saccharine, aspartame, alitame etc.

Q6. What do you understand by chemotherapy ?

Ans. The treatment of diseases by chemical compound is known as chemotherapy. The chemicals so used for the cure are called Chemotherapeutic agents. Each chemical is used should be specific in its toxicity towards a particular microorganism.

Q7. Describe the action of Tranquillizers ?

Ans. Tranquillizers are the substances which are used for the treatment of stress and mental diseases. These affect the central nervous system and induce sleep to the patients. Such compounds are also called sleeping pills or psychotherapeutic drugs.

Different tranquilizer function by different mechanisms. Certain tranquilizers function by deactivating the action of some enzymes e.g the anti depression drug iproniazid and phenelzine act through such mechanism. Noradrenaline used for mood change. It is also known as antidepressant drug. Barbituric acid and its derivatives are most commonly tranquillizers used for sleep. Chloridiazepoxide and meprobamate are mild tranquillizers used for relieving tension.

Q8. How do antiseptics differ from disinfectants ?

Ans. Antiseptics are chemical substances which prevent the growth of micro organisms or kill them but are not harmful to the living human tissues. These are applied to wounds, ulcers and diseased skin surfaces in form of antiseptic creams like furacine, soframycin. The anticeptics are used in face powders, deodorants, breath purifiers etc. to reduce the odours as a result of bacterial decomposition of organic matter on the body and mouth.

Disinfectants : Chemical substances which kill micro organisms or stop their growth but are harmful to human tissue are called disinfectants. As these substances are harmful to human tissue, they can not be applied directly to wounds. They are used to disinfect floors, toilets etc. For example, phenol (1%), SO₂ etc., chlorine 0.2 ~ 0.4 ppm used for disinfectant for drinking water.

Q9. Define sulpha drugs and analgesics.

Ans. Sulpha drug : Sulpha drugs work like antibiotics, used for antibacterial powers. Some important sulpha drugs are sulphadiazine, sulpha-thiazole, sulphanilamide etc.

Analgesics : Chemical substances used for relieving pain are called analgesics.

(i) Narcotic analgesics

(ii) Non-narcotic analgesics

(i) **Narcotic analgesics :** Drugs which administered in small doses relieve pain and produce sleep are called narcotics. But in large doses, they produce laziness, coma, convulsions and death. These are mainly used for the relief of post operative pain, cardiac pain and pains in terminal cancer patients. Most of them are obtained from opium poppy. These are morphine, codeine, pethidine hydrochloride, heroin (morphine diacetate).

(ii) **Non-narcotics :** Aspirin and paracetamol are most important examples of this type. Aspirin inhibits the synthesis of prostaglandin which stimulates inflammation in the tissue and cause pain. These drugs are quite effective in relieving skeletal pain such as arthritis. Aspirin is also used for prevention of heart attacks as it has anti blood clotting action.

Q10. Briefly discuss the cleaning action of detergents.

Ans. The detergents e.g. sodium lauryl sulphate viz $\text{CH}_3(\text{CH}_2)_{11}\text{OSO}_3^- \text{Na}^+$, the polar group is OSO_3^- along with long hydrocarbon chain. It is an anionic detergent, as an ion associate together to form an ionic micelle, similar to that of soap.

When grease or oil is sticking on the surface of a cloth and in contact with soap or detergent solution, the stearate ions arrange themselves around it in such way that the hydrophobic part of the stearate ions are in oil (or grease) and the hydrophilic parts project outside the grease droplet. As hydrophilic part is polar, these polar groups interact with water present around the oil droplet. As a result the oil droplet is pulled away from the surface of the cloth into water to form ionic micelle which is washed away with excess water.

