MODEL PAPER – 5

Time : 3 Hours + 15 Minutes] **[Total Marks :** 70

INSTRUCTIONS TO THE CANDIDATES :

1. Candidates are required to give their answers in their own words as far as practicable.
2. Figure in the right hand margin indicate full marks.
3. While answering the questions, candidate should adhere to the word limit as far as practicable.
4. 15 Minutes of extra time has been allotted for the candidates to read the questions carefully.
5. This question paper is divided into two sections—**SECTION – A** and **SECTION – B**.
6. In **SECTION – A** there are **70 Objective Type Question**, out of which only 35 objective questions be answered. Darken the circle with blue/black ball pen against the correct option on OMR Sheet provided to you. Do not use Whitener/Liquid/Blade/ Nail on OMR paper, otherwise the result will be invalid.
7. In **SECTION – B**, there are **20 Short Answer Type Question** (each carrying 2 marks), out of which any 10 questions are be answered.
   Apart from this, there are **6 Long Answer Type Question** (Each Carrying 5 marks), out of which 3 questions are to be answered.
8. Use of any electronic device is prohibited.

SECTION – A : Objective Type Questions

Directions : *There are 70 Objective Type Questions, out of which only 35 objectives questions to be answered. For each question, mark the correct option on the OMR answer sheet.*

$35 \times 1 = 35$

1. The cell constant of a conductivity cell is :
(A) l/A (B) A/l
(C) $l \times A$ (D) $\frac{R}{A}$

2. Which of the following catalysts is used in the manufactures of NH_3 by Haber's process ?
(A) Finely divided iron
(B) Finely divided molybdenum
(C) Finely divided nickel
(D) Finely divided platinum

3. The important oxide ore of iron is :
(A) Siderite (B) Haematite
(C) Pyrite (D) Bauxite

4. Which of the following in a polar compound ?
(A) SO_2 (B) SO_3
(C) BF_3 (D) CO_2

5. Which of the following ions of transition elements is paramagnetic ?
(A) Ag^+ (B) Cu^{2+}
(C) Zn^{2+} (D) Au^+

6. Who gave the first important theory of coordination compounds ?
(A) Salter (B) Pauling
(C) Werner (D) Lewis

7. Butan-2-ol is a :
(A) Primary alcohol (B) Secondary alcohol
(C) Tertiary alcohol (D) Dihydric alcohol

8. Which of the following gives Acetone on oxidation ?
(A) CH_3CHO (B) C_2H_5OH
(C) $CH_3CHOHCH_3$ (D) CH_3OH

9. Which of the following is Hinsberg reagent ?
(A) Benzene sulphonic acid
(B) Benzene sulphonamide
(C) *p*-Toluence sulphonyl chloride
(D) None of these

10. Which of the following is a thermosetting plastic ?
(A) Nylon 6 (B) Nylon 6, 6
(C) Bakelite (D) P.V.C.

11. Which of the following vitamins are soluble in water ?
(A) A and B (B) C and D
(C) B and C (D) A and D

12. Which of the following is used as an antacid ?
(A) magnesium hydroxide (B) Phinacetin
(C) Penicillin (D) Sulphanilamide

13. Which of the following is a crystalline solid ?
(A) Diamond (B) Glass
(C) Rubber (D) All of these

14. Percentage of free space in bcc. unit cell is :
(A) 32% (B) 34%
(C) 28% (D) 30%

15. By osmosis Semipermeable membrane (S.P.M.) allows to pass
(A) solute molecules (B) solvent molecules
(C) complex ion (D) simple ion

16. The van't Hoff factor of $Ca(NO_3)_2$ is :
(A) 1 (B) 2
(C) 3 (D) 4

17. When flow of electric current in a conductor is through flow of electron then, the conductor is called :
(A) Metallic conductor (B) Electrolytic conductor
(C) Bad conductor (D) None of these

18. How much charge is required for reduction of 1 mole of Al^{3+} to Al ?
(A) 3.0×10^5C (B) 28.95×10^5C
(C) 289.5×10^5C (D) 2895×10^5C

19. Zn (s) | Zn^{2+} (aq) || Cu^{2+} (aq) | Cu (s) is :
(A) Weston cell (B) Daniel cell
(C) Calomel cell (D) None of these

20. The minimum amount of energy required to convert reactant molecules into products is :
(A) Kinetic energy
(B) Potential energy
(C) Activation energy
(D) Kinetic energy + Potential energy

21. Half life period of first order reaction is independent of :
(A) Initial concentration of reactant
(B) Temperature
(C) Pressure
(D) None of these

22. Chemical adsorption reaction is :
(A) reversible (B) irreversible
(C) polymerisation (D) none of these

23. Tyndall effect can be observed in a :
(A) solvent (B) precipitate
(C) colloidal solution (D) solution

24. P_2O_2 is a good :
(A) Absorbend (B) Absorbent
(C) Reducing agent (D) Bleaching of colour

25. Which of the following metals does not liberate hydrogen gas on reactions with acid ?
(A) Fe (B) Zn
(C) Cu (D) Mg

26. The chief ore of copper is :
(A) Copper pyrite (B) Copper Glance
(C) Galena (D) Siderite

27. Chief ore of Iron is :
(A) Magnetite (B) Siderite
(C) Haematite (D) All

28. When Quicklime is immersed in water the reaction is :
(A) exothermic (B) endothermic
(C) explosive (D) none of these

29. Which of the following method is used for the concentration of zinc blende ore ?
(A) Gravity separation process
(B) Magnetic separation process
(C) Froth floatation process
(D) None of these

30. The formula of Sulphur di-oxide gas is :
(A) SO_3 (B) SO_2
(C) SO_2^{2+} (D) SO_3^{2-}

31. Formula of tap water is :
(A) H_2O (B) H_3O
(C) $H_3O^{\oplus}$ (D) D_2O

32. The shape of XeF_4 is :
(A) tetrahedral (B) square planar
(C) pyramidal (D) linear

33. Which one of the following is least basic ?
(A) NCl_3 (B) NBr_3
(C) NI_3 (D) NF_3

34. Which of the following has maximum ionisation potential ?
(A) Al (B) P
(C) Si (D) Mg

35. Which has the largest paramagnetic moment ?
(A) NO (B) NO^+
(C) O_2 (D) O_2^-

36. Which compound has the largest dipole moment ?
(A) HF (B) HCl
(C) HBr (D) HI

37. The symbol of Helium is :
(A) He (B) Hi
(C) Hm (D) All

38. Oleum is composed of H_2SO_4 and which constituent ?
(A) SO_2 (B) SO_3
(C) H_2S (D) $HSO_4^{(-)}$

39. Which of the following is Tribasic?
(A) H_3PO_2 (B) H_3PO_3
(C) $H_4P_2O_7$ (D) H_3PO_4

40. The geometry of PCl_5 is:
(A) Trigonal bipyramidal (B) Octahedral
(C) Tetralledral (D) None

41. The molecule which has zero dipole moment is :
(A) NF_3 (B) BF_3
(C) ClO_3 (D) CH_2Cl_2

42. Oxidation number of gold metal is :
(A) +1 (B) 0
(C) −1 (D) all of these

43. Which block of elements are known as transition elements ?
(A) p-block (B) s-block
(C) d-block (D) f-block

44. Transition elements are also known as :
(A) *s*-block elements (B) *p*-block elements
(C) *d*-block elements (D) *p*-block elements

45. The general electronic configuration of transition elements is:
(A) $(n-1)d^5$ (B) $(n-)d^{(1-10)}ns^{0.1 \text{ or } 2}$
(C) $(n-)d^{(1-10)}ns^{1-2}$ (D) none of these

46. Which of the following is not a member of first transition elements series ?
(A) Cr (B) Fe
(C) Mg (D) Mn

47. Coordination number of Cr in $Na_3[Cr(C_2O_4)_3]$ is :
(A) 3 (B) 4
(C) 5 (D) 6

48. The number of possible isomers for the complex $[Co(C_2O_4)_2(NH_3)_2]^-$:
(A) 1 (B) 2
(C) 3 (D) 4

49. $K_3[Fe(CN)_6]$ is a :
(A) Double Salt (B) Complex compound
(C) Acidic Salt (D) Common Salt

50. Good conductor of electricity and heat is :
(A) Anthracite coke (B) Diamond
(C) Graphite (D) Charcoal

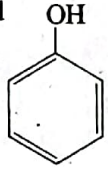
51. Single bond length between carbon-carbon is :
(A) 1.34 Å (B) 1.20 Å
(C) 1.54 Å (D) none of these

52. Number of π bonds in ethyne is :
(A) one (B) two
(C) three (D) four

53. Number of (σ) sigma bonds in CH_4 is :
(A) 4 (B) 3
(C) 2 (D) 1

54. Which one of the following is the main product of the reaction $CHCl_3 + O_2 \xrightarrow{\text{Light}} \ldots\ldots + HCl$?
(A) CO_2 (B) Cl_2
(C) $COCl_2$ (D) None of these

55. The general formula of monohydric alcohol is :
(A) $C_nH_{2n+1}OH$ (B) $C_nH_{2n+2}OH$
(C) $C_nH_{2n}OH$ (D) None of these

56. The name of the compound  is :
(A) Benzene hydroxide (B) Phenol
(C) Phenyl (D) Benzyl Alcohol

57. The formula of methanol is :
(A) CH_3OH (B) CH_3ONa
(C) HCHO (D) CH_4

58. Primary, Secondary and Tertiary alcohols are distinguished by :
(A) Oxidation Method (B) Lucas reagent Method
(C) Victor Meyer's Method (D) All of these

59. The general formula of ketone is :
(A) R—CH_2OH (B) R—CO—R^1
(C) R—COOH (D) None of these

60. Formaldehyde on heating with NaOH solution gives :
(A) Formic acid (B) Acetone
(C) Methyl alcohol (D) Ethyl formate

61. Which of the following undergoes Cannizaro's reaction?
(A) CH_3CHO (B) CH_3CH_2CHO
(C) $(CH_3)_2CHCHO$ (D) HCHO

62. Primary amine is detected by :
(A) HCl (B) $CHCl_3$ + KOH
(C) NaOH (D) $CHCl_3$

63. Imprical formula of benzene is :
(A) CH (B) C_2H_2
(C) C_6H_6 (D) None

64. Car tyres are made up of :
(A) Buna rubber (B) Polythene
(C) Teflon (D) P.V.A.

65. Which one of the following is an example of Co-polymer ?
(A) Teflon (B) PVC
(C) Buna-S (D) Poly propylene

66. Glucose is a :
(A) Mono-saccharide (B) Di-saccharide
(C) Oligo-saccharide (D) None of these

67. What is an enzyme ?
(A) Carbohydrate (B) Lipid
(C) Protein (D) None of these

68. Which of the following is artificial sweetening agent ?
(A) Saccharin (B) Aspartame
(C) Sodium cyclomate (D) All of these

69. 1–2% solution of Phenol of $KMnO_4$ is used as :
(A) Disifectant (B) Antiseptic
(C) Anti-malarial (D) All of these

70. Which of the following has magnesium ?
(A) Chlorophyll (B) Haemocyanin
(C) Carbonic anhydrase (D) Vitamin B_{12}

SECTION – B : Non-Objective Type Questions

SHORT ANSWER TYPE QUESTIONS

Directions : *Questions Nos. 1 to 20 are of short answer type. Each question carries 2 marks. Answer any ten question on your copy.* 10 × 2 = 20

1. What are Crystalline Solids ? Give examples.
2. What are reducing sugars ?
3. What are natural and synthetic polymers ? Give two examples of each type.
4. Why do soaps not work in hard water ?
5. Phenol is acidic in nature, Why ?
6. Define Calcination.
7. What do you mean by Molecularity of a reaction ?
8. Ethyne is more acidic than ethane, Why ?
9. Lithium forms BCC crystal. Calculate the atomic radius of Lithium if the length of the side of a unit cell of Lithium is 351 pm.
10. Define the term 'amorphous'. Give a few examples of amorphous solids.
11. Sodium chloride or calcium chloride is used to clear snow from the roads. Why ?
12. Why is a salt bridge or a porous plate not needed in a lead storage battery ?
13. Define 'shape-selective catalysis'.
14. What is Tyndall effect ? Discuss.
15. State colligative properties of dilute solution. Write down the different types of colligative properites.
16. What is meant by the term 'Chromatography?'
17. Define Leaching. Which ore is concentrated by leaching.
18. Explain why NH_3 is basic while BiH_3 is only feebly basic.
19. Why is an alkylamine more basic than ammonia ?
20. Name the bases present in RNA. Which one of these is not present in DNA ?

LONG ANSWER TYPE QUESTIONS

Directions : *Questions Nos. 21 to 26 are Long Answer Type Questions. Answer any 3 questions out of them.* 3 × 5 = 15

21. Discuss the valence bond theory.
22. Show half life Period of a first order reaction is Independent of the initial concentration of the reaction.
23. Write the following name reactions :
    (i) Tollen's Test
    (ii) Wurtz Synthesis
24. Give the method of preparation, properties and uses of H_2SO_4.
25. What happens when :
    (i) Chloroform is exposed to air ?
    (ii) Aniline reacts with a mixture of sulphuric acid and nitric acid.
26. Describe the kinetics of a first order reaction. Why is a first order reaction never completed ?

ANSWER WITH EXPLANATION

SECTION – A

OMR ANSWER-SHEET

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

ANSWER

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

SECTION – B

1. The substances whose contituents are arranged in a definite orderly arrangement are called crystalline solids. For example, NaCl, S, diamond, sugar etc. The crystalline substance have sharp melting points and have physical properties different in different directions. i.e., crystalline substances are Anistropic. They have long range and short range order.
2. Reducing sugars are those which reduce Fehling's solution and Tollen's reagent. All monosaccharides whether aldoses or ketoses are reducing sugars. They contain free aldehyde or ketone group.
3. (i) **Natural polymers** are high molecular mass macromolecules and are found in plants and animals. The examples are proteins and nucleic acids.
   (ii) **Synthetic polymers**—They are man-made high molecular mass macromolecules. These include synthetic plastics, fibres and synthetic rubber. The two specific examples are polyethene and dacron.
4. Hard water contains calcium and magnesium ions. These form insoluble calcium and magnesium soaps respectively.

   $2C_{17}H_{35}COONa + CaCl_2 \rightarrow 2NaCl + (C_{17}H_{35}COO)_2Ca$

   (Calcium chloride in hard water) — (Insoluble calcium stearate soap)

   These insoluble soaps are useless as cleansing agent. In fact these are hindrance to good washing, because this precipitate adheres on to the fibres of the cloth as gummy mass.
5. Phenol looses its H^+ when kept in an acidic medium. Due to which phenolate ion is formed. This ion formed is more stable than phenol due to its resonating character. Hence phenolate formation is favoured and releases of H^+ make phenol acidic.
6. **Calcination**—The process in which an ore is heated strongly in the absence or in the presence of limited amount of air is called calcination. Ores are calcined to,
   - convert a carbonate ore to oxide, as it is easier to obtain metal from oxides than from carbonates.
   - remove water from the wet/hydrated ores
   - remove volatile impurities from the ore.
7. **Molecularity of a reaction**—The molecularity of a reaction is the number of molecules, atoms or ions that participate in the reaction leading to the formation of the product(s).
8. Ethyne contains SP hybridized carbons, while ethane contain SP^3 hybridized carbons. The SP hybrid orbitals have greater S character than SP^3 which allows negative charge to be held closer to the nucleus and increasing the acidic character that is why ethyne is more acidic then ethane.
9. For bcc structure, edge = 351 pm

   radius $= \frac{\sqrt{3}}{4}a$ (a = edge length of a unit cell)

   $= \left(\frac{\sqrt{3}}{4} \times 351\right)$ pm

   $= \sqrt{3} \times 87.75$ pm

   = 152 pm **Ans.**
10. A solid is said to be amorphous if the constituent particles are not arranged in any regular manner. They may have only short range order. Some examples of amorphous solids are glass, plastics, rubber etc.
11. These salts depress the freezing point of water to such an extent that it cannot freeze to form ice. Hence, it melts off easily at the prevailing temperature.
12. The half cells in a cell must be separated only if the oxidizing and reducing agent can migrate to the other half cell. In lead storage cell, the oxidizing agent, PbO_2 and the reducing agent, Pb as well as their oxidation and reduction products $PbSO_4$ are solids. Therefore, their is no need to separate half cells.
13. The ability of a catalyst to yield a particular product depending upon the openess of the structures permitting cavities of different sizes is called shape-selective catalysis.
14. When a beam of light is passed through a colloidal solution the beam is illuminated such phenomena are not observed in true solution. Tyndall effect is observed when a beam of sunlight enter a earth room.
    Illuminating dust particles in beam scatter light.
15. The property, which depends upon number of atom or molecule of the solute and hot on their nature is called colligative properties. There are four type of colligative properties—
    (i) Relative lowering of vapour pressure.
    (ii) Elevation in boiling point.
    (iii) Depression in freezing point.
    (iv) Osmosis or Osmotic pressure.
16. **Chromatography**—It is defined as a technique of separating the components of a mixture in which separation is achieved by the differential movement of individual components through a stationary phase under the influence of a mobile phase.
17. Leaching is a process by which a particular ore can be dissolved selectively by using certain acids, bases or other reagents.
    Bauxite ore [Al_2O_3] is concentrated by leaching by removing the iron impurities [Fe_2O_3] and silicon present in the bauxite ore.
18. Due to the presence of lone pair of electrons on the central atom both NH_3 and BiH_3 are Lewis Bases. The decreases in basic character from NH_3 to BiH_3 can be explained in terms of electron density on the central atom. As the size of Bi atom is very large as compared to N, the lone pair of electrons occupies a larger volume, i.e., electron density on central atom decreases and consequently its tendency to donate a pair of electrons decreases and hence basic strength decreases in BiH_3.

19. Alkyl groups are electron-releasing groups. Due to +I effect of the alkyl groups attached to the N atom, the electron density at the N atom increases. As a result alkyl amines can donate their lone-pair of electrons more easily than ammonia. Therefore aliphatic amines (alkylamines) are more basic than ammonia.

20. Bases present in RNA are :

- Purine bases : Adenine, Guanine
- Pyrimidine bases : Cytosine, Uracil

DNA does not contain the base Uracil.

21. Assumption :

1. The ligand must have a lone pair of electrons to donate to the central metal atom/ion.
2. The metal atom ion must have empty sites to accept lone pair of electrons donated by LIGANDS.

Valence Bond Theory—The valence bond treatment of coordinatioin compound was developed by **Pauling.** The brief outlines of the theory are as follow :

(i) A suitable number of vacant orbitals must be present on the central metal atom for the formation of co-ordinate bonds with suitable ligand orbitals.

(ii) Depending on the total number of bonds to be formed the central metal ion can use appropriate number of atomic orbitals i.e., s, p or d for hybridisation yielding a set of equivalent orbitals called hybrid orbitals.

(iii) The hybridised orbitals are then allowed to overlap with those ligand orbitals that can donate an electron pair for bonding.

(iv) The outer orbital (high spin) or inner orbital (low sin) complexes are formed depending upon whether the d-orbital of outer shell or the d-orbitals of the inner shell are used in hybridisation scheme.

22. Half Life Period of a Reaction—Half life period of a reaction is defined as the time during which the concentration of a reactant is reduced to one half of its initial concentration. It is grenerally denoted as $t_{1/2}$. The half life period of a first order reaction may be calculated as given below :

For the first order reaction,

$$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$

Now half life period corresponds to time during which the initial concentration, $[A]_0 = a$, is reduced to half i.e. $[A]=a/2$.

The half life period, $t_{1/2}$ becomes

$$t_{1/2} = \frac{2.303}{k} \log \frac{a}{a/2} = \frac{2.303}{k} \log 2 \quad \text{or} \quad t_{1/2} = \frac{0.693}{k}$$

Thus, half life period of a first order reaction is independent of the initial concentration of the reactant.

Similarly, the relation for the time required to reduce the concentration of the reactant to any fraction of the initial concentration can be calculated. For example,

$$\therefore \quad t_{3/4} = \frac{2.303}{k} \log \frac{a}{c/4} = \frac{2.303}{k} \log$$

23. (i) Tollen's Test—Ammoniacal silver nitrate solution is called **Tollen's reagent.** It is obtained by adding dilute solution of ammonium hydroxide (NH_4OH) to silver nitrate solution till the precipitate once formed gets dissolved.

$$AgNO_3 + NH_4OH \longrightarrow \underset{\text{dirty white ppt.}}{AgOH(s)} + NH_4NO_3$$

$$AgOH(s) + 2NH_4OH \longrightarrow \underset{\text{Tollen's reagent}}{[Ag(NH_3)_2]^+OH^-} + 2H_2O$$

When Tollen's reagent is warmed with an aldehyde, it gets reduced to metallic silver. This metallic silver gets deposited on the inner wall of the test-tube to form a silver mirror. This reaction, therefore, is also known as silver mirror test.

$$\underset{\text{in solution}}{2Ag(NH_3)_2^+} + 3OH^- + \underset{\text{aldehyde}}{RCHO} \longrightarrow$$

$$RCOO^- + \underset{\text{silver mirror}}{2Ag} + 4NH_3 + 2H_2O$$

Ketones do not give silver mirror test. Benzaldehyde gives this test.

(ii) Wurtz Synthesis—This reaction is used for obtaining higher alkanes from the halogen derivatives, preferably bromides or iodides of lower alkanes. The halides of the lower alkanes are treated with sodium metal in dry ether.

$$\underset{\substack{\text{haloalkane}\\(\text{alkyl halide})}}{RX} + 2Na + \underset{\text{haloalkane}}{XR'} \xrightarrow{\text{dry ether}} \underset{\text{alkane}}{R-R'} + 2NaX$$

For example : when an alkyl halide is heated with sodium in dry ether, a higher alkane is obtained.

$$\underset{\substack{\text{iodomethane}\\(\text{methyl iodide})}}{CH_3I} + 2Na + ICH_3 \xrightarrow{\text{dry ether}} \underset{\text{ethane}}{CH_3-CH_3} + 2NaI$$

$$\underset{\text{iodoethane}}{C_2H_5I} + 2Na + \underset{\text{iodoethane}}{IC_2H_5} \xrightarrow{\text{dry ether}} \underset{\text{butane}}{C_2H_5-C_2H_5} + 2NaI$$

However, if a mixture containg two different alkyl halides is heated with sodium metal in dry ether then a mixture of alkanes is obtained.

For examples : When a mixture containing methyl iodide (CH_3I) and ethyl iodide (C_2H_5I) is heated with sodium in dry ether, a mixture of alkanes, e.g., ethane, propane and butane is obtained.

$$\underset{\text{iodomethane}}{CH_3I} + 2Na + \underset{\text{iodomethane}}{ICH_3} \xrightarrow{\text{dry ether}} \underset{\text{ethane}}{CH_3-CH_3} + 2NaI$$

$$\underset{\text{iodomethane}}{CH_3I} + 2Na + \underset{\text{iodoethane}}{ICH_2CH_3} \xrightarrow{\text{dry ether}} \underset{\text{propane}}{CH_3-CH_2-CH_3} + 2NaI$$

$$\underset{\text{iodoethane}}{CH_3CH_2I} + 2Na + \underset{\text{iodoethane}}{ICH_2CH_3} \xrightarrow{\text{dry ether}} \underset{\text{butane}}{CH_3-CH_2-CH_2-CH_3} + 2NaI$$

This reaction gives good yield of the product in the case of higher alkanes containing even number of carbon atoms. This method is not suitable for preparing alkanes with odd number of carbon atoms. Tertiary alkyl halides do not give this reaction. Methane (one carbon alkane) cannot be prepared by this method.

24. Sulphuric Acid (H_2SO_4)—It is called the king of chemicals and is one of the most widely used industrial chemicals.

Manufacture—Sulphuric acid is manufactured by Contact Process which involves 3 steps :

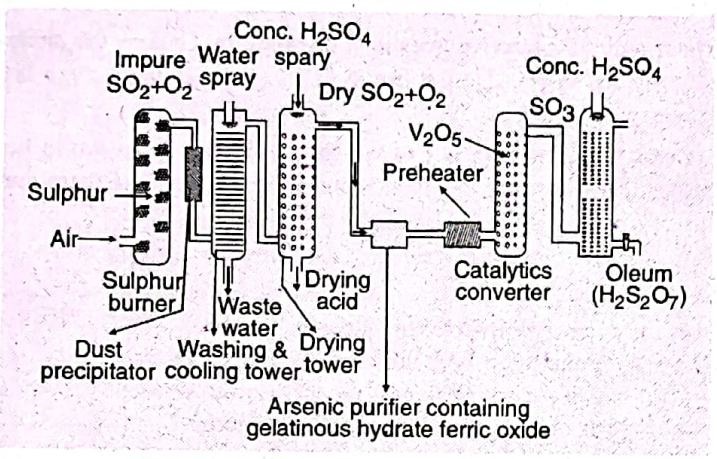
(i) Burning of Sulphur or Sulphide ores in air to produce SO_2.

(ii) Conversion of SO_2 into SO_3 by reaction with air in the presence of catalyst V_2O_5.

$$2SO_2(g) + O_2(g) \overset{V_2O_5}{\rightleftharpoons} 2SO_3(g); \Delta_r H^\circ = -196.5 \text{ kJ mol}^{-1}.$$

The reaction is exothermic, reversible and proceeds with a decrease in volume. ∴ Low temperature (720 K) and high pressure (2 bar) are the favourable conditions for maximum yield.

(iii) Absorption of SO_3 in H_2SO_4 to give Oleum ($H_2S_2O_7$).



The SO_3 gas from the catalytical converter is absorbed in concentrated H_2SO_4 to produced Oleum ($H_2S_2O_7$) which on dilution with water gives H_2SO_4 of desired concentration.

$$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7 \text{ (oleum)}$$

$$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$$

The sulphuric acid obtained by the contact process is 96–98% pure.

Physical properties :

(i) H_2SO_4 is a colourless, dense, oily liquid.

(ii) It dissolves in water producing large amount of heat. Hence it should be slowly added to water (and never water in acid)

Chemical properties of H_2SO_4 are due to its (a) low volatility, (b) strong acidic character, (c) strong affinity for water, (d) ability to act as an oxidizing agent.

In water, it ionises in 2 steps :

(i) $H_2SO_4\ (aq) + H_2O(l) \rightarrow H_3O^+\ (aq) + HSO_4^-\ (aq)$

K_{a_1} = very large (> 10)

(ii) $HSO_4^-\ (aq) + H_2O\ (l) \rightarrow H_3O^+\ (aq) + SO_4^{2-}\ (aq)$;

$K_{a_2} = 1.2 \times 10^{-2}$

(A) It is used to prepare more volatile acids :

$$NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$$

$$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$$

(B) Conc. H_2SO_4 is a strong dehydrating agent

$$C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H_2SO_4} 12C + 11H_2O$$

(C) Hot conc. H_2SO_4 is a strong oxidising agent

$$H_2SO_4 \rightarrow H_2O + SO_2 + O$$

(D) Reaction with metals and non-metals : Both metals and non-metals are oxidised by conc. H_2SO_4, which is reduced to SO_2.

$$Cu + \underset{\text{(conc.)}}{2H_2SO_4} \rightarrow CuSO_4 + SO_2 + 2H_2O$$

$$C + \underset{\text{(conc.)}}{2H_2SO_4} \rightarrow CO_2 + 2SO_2 + 2H_2O$$

Uses of H_2SO_4 :

1. It is used in the manufacture of hundreds of other compounds and also in many industrial processes.
2. Manufacture of fertilizers.
3. Petroleum refining and manufacture of pigments, paints and dye stuff intermediates.
4. Detergent industry.
5. Metallurgical applications.
6. Storage batteries and so on.

25. (i) $\underset{\text{Chloroform}}{CHCl_3} + O_2\ (g) \rightarrow \underset{\text{Phosgene}}{COCl_2} + HCl$

(ii) When aniline is reacted with a mixture of sulphuric and nitric acids, a mixture containing o-, p- and trans nitroanilines is obtained.

26. If the rate of reaction depends upon one concentration term only is called the first order reacton.

For the reaction :

	A →	Product.
$t = 0$	a	0
$t = t$	$a - x$	x

Let Initial concentration a and after time 't' concentration becomes '$a - x$' mol/lit.

$$\text{rate} = \frac{-d[A]}{dt} = k[A] \quad \text{or,} \quad \frac{-d[A]}{[A]} = +\,kdt$$

Integrating both sides,

$$-\int_a^{a-x} \frac{d[A]}{[A]} = \int_0^t kdt; \qquad -\{\ln[A]_a^{a-x}\} = k\,(t-0)$$

$$-\ln\,(a-x) - (-\ln a) = kt; \quad -\ln(a-x) + \ln a = kt$$

$$\ln \frac{a}{a-x} = kt \qquad (\because \ln = 2.303 \log)$$

$$\therefore 2.303 \log \frac{a}{a-x} = kt \quad \text{or,} \quad k = \frac{2.303}{t} \log_{10} \frac{a}{a-x} \qquad \text{(i)}$$

where k is the rate constant.

Equation (i) is called mathematical expression of first order reaction.

First order reaction is never completed because $t_{1/2} = 0.693/k$ and $t_{1/2}$ is independent of initial concentration e.g. All nuclear reaction.

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