Part III

CHEMISTRY

Time Allowed: 3 Hours

Instructions:
Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

Note:
Draw diagrams and write equations wherever necessary.

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Part I / PART - I

1. Choose and write the correct answer.

a) CsCl
b) ZnO

2. BN

3. NaCl

The crystal lattice with coordination number four is

a) CsCl
b) ZnO
c) BN
d) NaCl

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2. All the naturally occurring processes proceed spontaneously in a direction which lead to
a) decrease in entropy  b) increase in enthalpy
c) increase in free energy  d) decrease in free energy.

3. \[ \text{Sn (α, \text{13°C})} \rightleftharpoons \text{Sn (β, \text{13°C})} \]
\[ \Delta H_{\text{transferred}} = 2090 \text{ J.mol}^{-1} \]
The entropy change for the following process possessing \( \Delta H_{\text{transferred}} \) as

\[ \text{Sn (α, \text{13°C})} \rightleftharpoons \text{Sn (β, \text{13°C})} \]
is
a) 22.007 J.mol\(^{-1}\) K\(^{-1}\)  b) 7.307 J.mol\(^{-1}\) K\(^{-1}\)
c) 0.314 J.mol\(^{-1}\) K\(^{-1}\)  d) 109.52 J.mol\(^{-1}\) K\(^{-1}\).

4. In an equilibrium reaction, when \( Q < K_C \), then
a) forward reaction is favoured
b) reverse reaction is favoured
c) both forward and reverse reactions are favoured
d) none of these.
5. In which of the following gaseous reactions \( K_p < K_c \)?
   a) \( \text{PCl}_5 (g) \rightleftharpoons \text{PCl}_3 (g) + \text{Cl}_2 (g) \)
   b) \( \text{H}_2 (g) + \text{I}_2 (g) \rightleftharpoons 2\text{HI} (g) \)
   c) \( \text{N}_2 (g) + 3\text{H}_2 (g) \rightleftharpoons 2\text{NH}_3 (g) \)
   d) \( \text{CO} (g) + \text{H}_2 \text{O} (g) \rightleftharpoons \text{CO}_2 (g) + \text{H}_2 (g) \).

6. Nitrobenzene on electrolytic reduction in conc. sulphuric acid, the intermediate formed is
   a) \( \text{C}_6\text{H}_5\text{NH} - \text{NH} \text{C}_6\text{H}_5 \)  
   b) \( \text{C}_6\text{H}_5\text{NH} + \text{H}_2 \text{O} \) 
   c) \( \text{C}_6\text{H}_5\text{N} = \text{N} - \text{C}_6\text{H}_5 \)  
   d) \( \text{C}_6\text{H}_5\text{HSO}_4 \) 

7. Which one of the following is the most basic?
   a) Ammonia  
   b) Methylamine  
   c) Dimethylamine  
   d) Aniline.

8. The compound which does not undergo diazotisation reaction is
   a) \( m \)-toluidine  
   b) \( p \)-aminophenol  
   c) Aniline  
   d) Benzyllamine.
9. The building block of proteins are
   a) α-hydroxy acids
   b) α-amino acids
   c) β-hydroxy acids
   d) β-amino acids.

10. An example for reducing disaccharide is
   a) Glucose
   b) Fructose
   c) Sucrose
   d) Lactose.

11. The most malleable and ductile of all metals is
   a) silver
   b) gold
   c) copper
   d) zinc.

12. The maximum oxidation state exhibited by Lanthanide is
   a) +1
   b) +3
   c) +2
   d) +4.

13. Which is used in Gas lamp materials?
   a) Ceria
   b) Thoria
   c) Misch metal
   d) Both (a) & (b).
14. \[ \text{Co} \left( \text{NO}_2 \right) \left( \text{NH}_3 \right)_5 \text{SO}_4 \text{ and } \text{Co} \left( \text{SO}_4 \right) \left( \text{NH}_3 \right)_5 \text{NO}_2 \] 

The type of isomerism found in the complexes \[ \text{Co} \left( \text{NO}_2 \right) \left( \text{NH}_3 \right)_5 \text{SO}_4 \text{ and } \text{Co} \left( \text{SO}_4 \right) \left( \text{NH}_3 \right)_5 \text{NO}_2 \] is

a) Hydrate isomerism  

b) Coordination isomerism  

c) Linkage isomerism  

d) Ionisation isomerism.

15. कुल पहलवान कर्मचारी का मिश्र सूत्र के संयोग 24 जुलाई सिंकरे पर 0.125 दिन रहने के बाद बची गई अंश का होगा?

a) 0.8 मरीज  

b) 8 मरीज  

c) 100 मरीज  

d) 80 मरीज.

After 24 hours, only 0.125 g out of the initial quantity of 1 g of a radioisotope remains behind. Then its half-life period is

a) 0.8 hour  

b) 8 hours  

c) 100 hours  

d) 80 hours.

16. कसुनान क चालक का अल्कोहल के सीलिफेनिन भूमि में प्रविष्ट नहीं होता तरीका है?

a) 1° < 2° < 3° अल्कोहलीक  

b) 1° > 2° < 3° अल्कोहलीक  

c) 1° > 2° > 3° अल्कोहलीक  

d) 1° < 2° > 3° अल्कोहलीक.

Order of reactivity of Alcohol towards sodium metal is

a) primary < secondary > tertiary  

b) primary > secondary < tertiary  

c) primary > secondary > tertiary  

d) primary < secondary < tertiary.
17. When diethyl ether reacts with chlorine in presence of sunlight it gives:
   a) α-chlorodiethyl ether
   b) α, α'-dichlorodiethyl ether
   c) perchlorodiethyl ether
   d) both (a) & (b)

18. Which of the following is most likely to form hydrogen bonds?
   a) CH₃COOH
   b) C₂H₅-O-C₂H₅
   c) CH₃CH₂OH
   d) C₂H₅NH₂

   Intermolecular hydrogen bonds are not present in
   a) CH₃COOH
   b) C₂H₅-O-C₂H₅
   c) CH₃CH₂OH
   d) C₂H₅NH₂

19. 3CH₃COCH₃ \( \xrightarrow{\text{conc. H₂SO₄}} \) the product is
   a) Mesitylene
   b) Mesityl oxide
   c) Phorone
   d) Paraldehyde.

20. The acid that cannot be prepared by Grignard reagent is
   a) Acetic acid
   b) Formic acid
   c) Butyric acid
   d) Benzoic acid.
21. In the Bohr model, the wavelength of a electron is determined by the equation:

\[ \lambda = \frac{mv}{h} \]

\[ \lambda = \frac{h_n}{m} \]

The de Broglie equation is:

\[ \lambda = \frac{h}{mv} \]

The correct option is:

a) \[ \lambda = \frac{mv}{h} \]

b) \[ \lambda = \frac{h_n}{m} \]

c) \[ \lambda = \frac{h}{mv} \]

d) \[ \lambda = \frac{m}{nv} \]

22. The hybridisation in \( \text{ICl}_4^- \) ion is:

a) \( sp^3 \)

b) \( sp^3d \)

c) \( sp^3d^2 \)

d) \( sp^3d^3 \)

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23. Noble gases have..................... electron affinity.

a) high

b) low

c) zero

d) very low

24. Which of the following is the second most abundant element in earth's crust?

a) Carbon

b) Silicon

c) Germanium

d) Tin

25. When excess of KCN is added to an aqueous solution of copper sulphate, it gives:

a) \( \text{Cu} (\text{CN})_2 \)

b) \( K_2 [\text{Cu} (\text{CN})_6] \)

c) \( K [\text{Cu} (\text{CN})_2] \)

d) \( \text{Cu}_2 (\text{CN})_2 + (\text{CN})_2 \)
26. The Arrhenius equation is

\[ K = A \cdot e^{-\frac{E_a}{RT}} \]

Arrhenius equation is

a) \[ K = A \cdot e^{-\frac{1}{RT}} \]

b) \[ K = A \cdot e^{-\frac{RT}{E_a}} \]

c) \[ K = A \cdot e^{-\frac{E_a}{RT}} \]

d) \[ K = A \cdot e^{\frac{E_a}{RT}} \]

27. What is fog?

- a) Gas in liquid
- b) Liquid in gas
- c) Gas in solid
- d) Solid in gas.

28. Which of the following is used in the synthesis of ammonia in Haber’s process?

- a) \( \text{As}_2\text{O}_3 \)
- b) \( \text{V}_2\text{O}_5 \)
- c) \( \text{H}_2\text{S} \)
- d) Glycerine.

The iron catalyst used in the synthesis of ammonia in Haber’s process is poisoned by

- a) \( \text{As}_2\text{O}_3 \)
- b) \( \text{V}_2\text{O}_5 \)
- c) \( \text{H}_2\text{S} \)
- d) Glycerine.

29. Migrate colloidal particles under the influence of an electric field.

- a) Electro-osmosis
- b) Brownian movement
- c) Electro-dialysis
- d) Cataphoresis.

30. When the pH of a solution is 2, the hydrogen ion concentration in moles/litre is

- a) \( 1 \times 10^{-12} \)
- b) \( 1 \times 10^{-2} \)
- c) \( 1 \times 10^{-7} \)
- d) \( 1 \times 10^{-4} \).
31. What is the significance of negative electronic energy?

32. Calculate the effective nuclear charge experienced by the 4s electron in potassium atom.

33. Prove that $P_2O_5$ is a dehydrating agent.

34. Write three uses of fluorine.

35. Why are $Zn^{2+}$ salts white, while $Ni^{2+}$ salts are coloured?

36. How is lunar caustic prepared?

37. What is binding energy of nucleus?

38. How are glasses formed?

39. Write Kelvin statement of second law of thermodynamics.

40. Degree of dissociation of $PCl_5$ at 1 atm and 25°C is 0.2. Calculate the $K_p$ value for equilibrium $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ at 25°C.
41. What is meant by consecutive reaction? Give an example.

42. Give three examples for first order reaction.

43. Define colloidal solution.

44. State Kohlrausch's law.

45. Distinguish racemic form from meso form.

46. Give a brief account of coupling reaction.

47. How is formic acid obtained from glycerol?

48. What happens when Benzaldehyde is heated with concentrated NaOH?

49. Write two tests of carboxylic acid.

50. An organic compound 'A' C₇H₇NO when treated with Br₂/alkali gives 'B' C₆H₇N. 'B' undergoes diazotisation reaction. Identify 'A' & 'B'.

51. What are anaesthetics? Give an example.
**PART - III**

**Note:** Answer any seven questions choosing at least two questions from each section. \[7 \times 5 = 35\]

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**SECTION - A**

52. **Briefly explain molecular orbital theory.**

53. **Explain how is gold extracted from its ore.**

54. **Write the consequences of lanthanide contraction.**

55. **In what way \([\text{FeF}_6]^{4-}\) differs from \([\text{Fe(CN)}_6]^{4-}\)? Explain.**

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**SECTION - B**

56. **Write the characteristics of Entropy.**

57. **Explain the effect of temperature and pressure on the following equilibrium:**

\[
N_2O_4 (g) \rightleftharpoons 2NO_2 (g); \Delta H = +59.0 \text{ kJ/mol}
\]

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[Turn over]
58. Explain the experimental determination of rate constant of acid hydrolysis of methyl acetate.

59. Calculate the potential of a half-cell consisting of zinc electrode in 0.01 M ZnSO₄ solution at 25°C | E° = 0.763 V |

60. Mention three methods of preparing anisole.

61. Illustrate the reducing property of acetaldehyde with examples.

62. Explain the mechanism of esterification.

63. Explain chromophore and auxochrome theory about dyes.
64. **a)** Explain Pauling's scale to calculate electronegativity.

**b)** Write the uses of silicones.

65. **a)** Write the postulates of Werner's theory of coordination compounds.

**b)** Explain nuclear reactions taking place in sun.

66. **a)** Explain Schottky and Frenkel defects.

**b)** Discuss the factors affecting adsorption.
67. a) Explain the buffer action of a basic buffer with an example.

b) Derive Nernst equation.

68. a) Explain cis-trans isomerism with an example.

b) Explain the following:
   i) Hell-Volhard-Zelinsky reaction (HVZ)
   ii) Claisen ester condensation.

69. a) Write any three methods of preparing Benzyllamine.

b) Explain the functions of lipids in Biosystems.
70. (a) A compound $A \left(C_2H_6O_2\right)$ reacts with sodium to liberate hydrogen. The reaction with anhydrous zinc chloride ultimately gives $B \left(C_2H_4O\right)$ whereas when heated with conc. phosphoric acid gives $C \left(C_4H_10O_3\right)$. A on oxidation with acidified $K_2Cr_2O_7$ gives compound $D \left(CH_2O_2\right)$. Identify $A$, $B$, $C$ and $D$. Explain the reactions involved.

(b) An element $A$ present in Period No. 4 and Group No. 12, on treatment with dil. $HNO_3$ forms $B$ with the liberation of $N_2O$. $A$ when heated with air at 773 K gives $C$ which is known as philosopher’s wool. Identify $A$, $B$ and $C$. Explain the reactions involved.

**A**
2) A \( \text{C}_2\text{H}_3\text{N} \) \( \text{SnCl}_2/\text{HCl} \) gives B \( \text{C}_2\text{H}_4\text{O} \) which reduces Tollens' reagent. Compound B on reduction with \( \text{N}_2\text{H}_4/\text{C}_2\text{H}_5\text{O} \text{Na} \) gives C \( \text{C}_2\text{H}_6 \). Identify the compounds A, B and C. Explain the reactions involved.

d) An electric current is passed through three cells in series containing solutions of \( \text{CuSO}_4 \), \( \text{AgNO}_3 \) and KI respectively. What weights of silver and iodine will be liberated while 1.25 g of copper is being deposited?

\[ \text{At. wt. of Ag} = 108, \text{Cu} = 63.4, \text{I} = 127. \]