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Reg. No. : .....

Code No. : 5413 **Sub. Code : ZCHM 22**

M.Sc.(CBCS) DEGREE EXAMINATION, APRIL 2023.

Second Semester

Chemistry – Core

COORDINATION COMPOUNDS AND SOLID STATE CHEMISTRY

(For those who joined in July 2021 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Among $[Co(NH_3)_6]^{3+}$, $[Ir(NH_3)_6]^{3+}$, $[Fe(bpy)_3]^{3+}$ and $[Rh(NH_3)_6]^{3+}$, the Δ_0 is the highest for

(a) $[Co(NH_3)_6]^{3+}$ (b) $[Ir(NH_3)_6]^{3+}$

(c) $[Fe(bpy)_3]^{3+}$ (d) $[Rh(NH_3)_6]^{3+}$

2. In CrF_2, Cr(II) is octahedrally surrounded by six F ligands with two longer Cr-F bonds and four shorter ones because of ————.

(a) Jahn-Teller distortion

(b) Lattice energy

(c) Steric hindrance

(d) Repulsive energy

3. The final product containing chromium in the reaction between $[Co(NH_3)_5Cl]^{2+}$, $[Cr(H_2O)_6]^{3+}$ and H_3O^+ is ————

(a) $[Cr(NH_3)(H_2O)_4Cl]^{2+}$

(b) $[Cr(H_2O)_6]^{3+}$

(c) $[Co(NH_3)_5Cl]^{2+}$

(d) $[Cr(H_2O)_5Cl]^{2+}$

4. The CORRECT statement regarding the thermodynamic stability and kinetic reactivity of metal ion complexes is that

(a) Most stable complexes are less reactive

(b) There exists a dependance on the bulkiness of the ligand

(c) There exists no direct relation between these two phenomena

(d) There exists a dependance on the size of the metal ion

5. The spin-only magnetic moment (in BM) value of $[FeF_6]^{3-}$ and $[Co(CN)_5(H_2O)]^{3-}$ respectively are ————

(a) 0 and 1.73 (b) 5.92 and 1.73

(c) 4.47 and 1.73 (d) 5.92 and 3.87

6. The paramagnetic susceptibility is ———— to the absolute temperature.

(a) directly proportional

(b) inversely proportional

(c) remains constant

(d) same

7. The number of Schottky defects present in NaCl at room temperature is approximately ————.

(a) 10^{18} defects / cm^3 (b) 10^6 defects / cm^3

(c) 10^3 defects / cm^3 (d) 10^2 defects / cm^3

8. The ability of certain metals and alloys to conduct electricity without resistance is called

(a) semiconductivity (b) conductivity

(c) superconductivity (d) resistivity

9. An example for antifluorite structure is ————

(a) CaF_2 (b) Na_2O

(c) TeO_2 (d) $CaCO_3$

10. ———— is used to determine the nature of semiconductors.

(a) Mobility of charge carriers

(b) Concentration of charge carriers

(c) Hall coefficient

(d) Conductivity

PART B — (5 × 5 = 25 marks)

Answer ALL the questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) List the salient features of CFT.

Or

(b) Describe the factors affecting CFSE.

12. (a) What is trans effect? What product is obtained when $[PtCl_4]^{2-}$ is treated with

(i) NH_3 followed by R_3P

(ii) R_3P followed by NH_3

Or

(b) Write in detail about the complementary and non complementary electron transfer reactions.

13. (a) Give reasons for the following.

(i) Two distinct advantages of Faraday method over Guoy method

(ii) The magnetic moment of 3d transition elements corresponds to spin only value

Or

(b) Discuss the magnetic properties of lanthanides.

14. (a) Derive an expression to calculate number of Schottky defects in a crystal.

Or

(b) Sketch and explain the structure of

(i) Fluorite (ii) Zinc blende,

15. (a) Write briefly about the optical and electrical properties of semiconductors.

Or

(b) Illustrate hail effect. Explain the experimental setup for the measurement of hall voltage with its application.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).
Each answer should not exceed 600 words.

16. (a) Discuss the applications of CFT.

Or

(b) State Jahn-Teller effect. Explain it with suitable examples.

17. (a) Write briefly on chelate and template effect.

Or

(b) Explain the mechanism of the following reaction and speculate why the rate of electron transfer is slow

(K_{II} = 4L mol^{-1} s^{-1})

$[Fe(H_2O)_6]^{3+} + [*Fe(H_2O)_6]^{2+} \longrightarrow$

$[Fe(H_2O)_6]^{2+} + [*Fe(H_2O)_6]^{3+}$

18. (a) State and explain the types of magnetism in coordination complexes with A and E ground state.

Or

(b) Compare the magnetic properties of O_h and T_d complexes of Fe(II), Co(II), Ni(II) and Cu(II).

19. (a) Write the crystal structure of the following compounds

(i) CdI_2 (ii) CsC1 (iii) Wurtzite (iv) Rutile

Or

(b) (i) Explain briefly line defects and plane defects.

(ii) Elaborate on the determination of crystal structure by rotating crystal method.

20. (a) Discuss how band theory explains the conduction in metals, insulators and semiconductors.

Or

(b) Account on the properties and applications of superconductors.

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