'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 4th Semester Examination, 2022

GE2-P2-CHEMISTRY

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
All symbols are of usual significance.

Use separate Answer scripts for Section-A (Inorganic) and Section-B (Physical)

SECTION-A

Marks: 18

INORGANIC CHEMISTRY

GROUP-A

1. Answer any ***three*** questions from the following: $1\times3 = 3$

   (a) What is lanthanide contraction?

   (b) Write the IUPAC names of the following complexes:

   (i) $[Cr(NH_3)_6]\ [Co(CN)_6]$

   (ii) $K_3[Cr(C_2O_4)_3]$

   (c) How can a metal complex be differentiated from a double salt experimentally?

   (d) What is an ambidentate ligand? Give an example of such a ligand.

   (e) Cu^{2+} complexes are often distorted octahedral in geometry — Explain.

GROUP-B

2. Answer any ***one*** question from the following: $5\times1 = 5$

   (a) (i) Identify the type of isomerisms in the following pair of complexes: $(1\frac{1}{2}\times2)+2$

   (I) $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5(SO_4)]Br$

   (II) $[Pt(NH_3)_2Cl_2]$ and $[Pt(NH_3)_4]\ [PtCl_4]$

   (ii) Most of the 4-coordinated complexes of Ni^{2+} ion are square planar rather than tetrahedral — Explain.

   (b) Schematically represent the splitting of *d*-orbitals in octahedral and tetrahedral fields. Write down the factors on which the crystal field splitting energy (Δ_0) depends? $2\frac{1}{2}+2\frac{1}{2}$

GROUP-C

3. Answer any ***one*** question from the following: $10\times1 = 10$

   (a) Define and explain 'inner orbital and outer orbital complexes' with suitable examples. Most often transition elements have variable valency — Explain. 3+2+3+2

   Aqueous solution of $[Ti(H_2O)_6]^{3+}$ ion is purple coloured — Explain.

   What is spectrochemical series? Mention its utility.

   (b) Discuss the assumptions and limitations of valence bond theory (VBT). How does crystal field theory (CFT) differ from valence bond theory (VBT)? What will be the CFSE values for octahedral d^7 and tetrahedral d^7 configurations in Δ_0 units? 5+2+3

SECTION-B

Marks: 22

PHYSICAL CHEMISTRY

GROUP-A

4. Answer any ***two*** questions from the following: 1×2 = 2

(a) Can a gas of the type $P(V-b)=RT$ be liquefied?

(b) The SI unit of Surface Tension is _____.

(c) The half-life period of a reaction is independent of the initial concentration of the reactants. The reaction is of:

(i) First Order (ii) Second Order (iii) Zero Order (iv) Fractional Order

GROUP-B

5. Answer any ***two*** questions from the following: 5×2 = 10

(a) (i) For the first order reaction derive the equation: 3+2

$$k=\frac{2.303}{t}\log\frac{a}{a-x}$$

(ii) Define Boyle Temperature.

(b) (i) Define Surface Tension. 2+3

(ii) How does Surface Tension of a liquid vary with temperature?

(c) (i) Define Critical Temperature. 1+4

(ii) Derive T_c, V_c and P_c from Van der Waal's equation of state.

GROUP-C

6. Answer any ***one*** question from the following: 10×1 = 10

(a) (i) State the significance of the Van der Waal's constants 'a' and 'b'. 2+2+(2+2)+2

(ii) Give the SI units of the Van der Waal's constants 'a' and 'b'.

(iii) What do you mean by Collision Number and Collision Frequency?

(iv) State the Law of Corresponding States.

(b) (i) Differentiate between Order and Molecularity. 3+4+3

(ii) The co-efficient of viscosity of two liquids at 300 K are 1.4×10^{-3} and 1.6×10^{-3} kg m^{-1} s^{-1} and their densities at the same temperature are 8×10^2 and 10×10^2 kg m^{-3} respectively. If the time of flow in the Ostwald's viscometer for the first liquid is 100 seconds, calculate the time of flow for the second liquid.

(iii) Show that in case of a first order reaction, the time required for 99.9% of the reaction to take place is about 10 times than that required for half-life of the reaction.

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