UNIVERSITY OF NORTH BENGAL

B.Sc. Honours Part-III Examination, 2021

CHEMISTRY

PAPER-VIII

Full Marks: 65

ASSIGNMENT

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

1 mark for neat and precise presentation

Answer any *four* questions 16×4 = 64

1. (a) Write down the Schrödinger wave equation for hydrogen atom and briefly explain all the terms associated with it. 2

   (b) Sketch the shape of molecular orbitals obtained by overlap of two p_x atomic orbitals where x is the molecular axis. 2

   (c) How does metallic bond differ from covalent and ionic bond? 3

   (d) Discuss the band theory of metals and explain the conditions for conductors, non-conductors and semiconductors. 2+3

   (e) Explain why bond length of O_2 is 121 pm but that of O_2^{2-} is 141 pm. 2

   (f) What is called trial wave function? 2

2. (a) Discuss the factors on which the stability of a complex depends. Give examples. 4

   (b) How is conductance measurement used to detect complex formation? 3

   (c) Discuss the following types of isomerism using suitable examples: 2+2

   (i) Ionization isomerism and

   (ii) Coordination isomerism.

   (d) How many isomers are possible for $[Co(en)_3]^{3+}$? 2

   (e) Write IUPAC name of $[(CO)_3Fe(CO)_3Fe(CO)_3]$. 1

   (f) What are flexidentate ligands? Give examples. 2

3. (a) Give three examples of trace elements and their uses in the human body. 3

   (b) What changes occur in the heme groups of haemoglobin on going from deoxy to oxyhaemoglobin? 4

   (c) Successive O_2-binding constants of haemoglobin increase in the order: 3
   $k_1 < k_2 < k_3 < k_4$. — Explain.

   (d) Using a schematic formula, show how CO affects the basic function of haemoglobin. 2

   (e) Give one example each for metalloprotein containing zinc and copper. State their functions. 2+2

4. (a) For lanthanides the most stable oxidation state is +3 with the exceptions of Eu^{2+}, Yb^{2+}, Ce^{4+} and Tb^{4+}. — Explain. 3

(b) Give a brief outline of the ion-exchange method of separation of lanthanide ions. 4

(c) What are inner metallic complexes? Explain its significance in analytical chemistry. 4

(d) How will you account for the non-existence of tetrahedral complex with low-spin configuration? $2\frac{1}{2}$

(e) Square planar d^8 paramagnetic complexes are rare. — Explain. $2\frac{1}{2}$

5. (a) Write down the formula for the mononuclear metal carbonyls formed by Fe and Ni based on 18-electron rule. 2

(b) Discuss the bonding in linear metal carbonyls with evidences in support of the bonding. 4

(c) Discuss the structure and bonding in ferrocene, explaining all its important facts. 5

(d) With the increase in temperature, the electrical conductivity of metals decreases while it increases in semiconductors. — Explain. $2\frac{1}{2}$

(e) Discuss the allotropes of tin. $2\frac{1}{2}$

6. (a) $[Cr(H_2O)_6]^{3+}$ ions are pale violet but the CrO_4^{2-} is a strong yellow. Characterize the origin of the transitions and explain the relative intensities. 3

(b) Explain why $K_2[NiF_6]$ is diamagnetic but $K_4[NiF_6]$ is paramagnetic. 3

(c) Which of the following has more Δ_0 value and why: 3

$[Fe(H_2O)_6]Cl_3$ and $K_3[Fe(CN)_6]$

(d) Although OH^- is a stronger base than NH_3, it reacts more slowly than NH_3 with square planar complexes. 3

(e) Although HF is acidic, but it can behave as an amphoteric solvent — Discuss. $2\frac{1}{2}$

(f) What is CFSE? $1\frac{1}{2}$

7. (a) Give outline flowchart for extraction of uranium from its ore. 4

(b) What are actinides? Why do actinides form oxocation but lanthanides do not? 1+2

(c) The brown ring complex $[Fe(H_2O)_5NO]SO_4$ has a magnetic moment of 3.7 BM. What is the valence of iron in this complex? 2

(d) What is Roussin's salt? 2

(e) Show the reactivity differences of ferrocene and benzene with two specific examples. 3

(f) The V-C bond lengths in $[V(CO)_6]^-$ and $[V(CO)_6]$ are 193 pm and 200 pm respectively. — Explain. 2

8. (a) The ability of a heme-group to bind O_2 is annulled if the iron atom becomes oxidized to Fe(III) state. — Explain. 3

(b) Why is liquid NH_3 called the most water-like solvent? 3

(c) Write down the formula of sodium nitroprusside and also the formula of the complex formed with sulphide radical. 1+1

(d) Discuss the order of π-acidity of CN^-, CO and NO^+. 3

(e) Write briefly about preparation and structure of dimeric trimethyl aluminum. 1+2

(f) Mention the important sources of platinum. 2

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