3 SEM TDC CHM M 1

2 0 2 1

(March)

CHEMISTRY

(Major)

Course : 301

(Inorganic Chemistry—I)

Full Marks : 48
Pass Marks : 14

Time : 2 hours

The figures in the margin indicate full marks
for the questions

1. Select the correct answer : 1×5=5
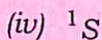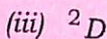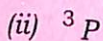
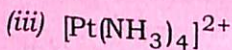   *(a)* The common oxidation state of lanthanides is

   (i) +2

   (ii) +3

   (iii) +4

   (iv) +1

(Turn Over)

(b) The spectroscopic free ion ground term for d^1-configuration is

    (i) ^5D

    (ii) ^3P

    (iii) ^2D

    (iv) ^1S

(c) The complex ion not obeying EAN rule is

    (i) $[Cr(CO)_4]^{4-}$

    (ii) $[Fe(CN)_6]^{4-}$

    (iii) $[Pt(NH_3)_4]^{2+}$
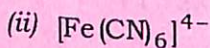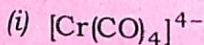
    (iv) None of the above

(d) Porphyrin is a/an

    (i) ambidentate ligand

    (ii) macrocyclic ligand

    (iii) chelating ligand

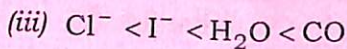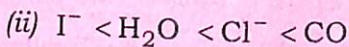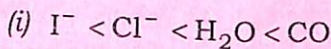   (iv) polydentate ligand

(e) The increasing order of the strength of the ligands I^-, CO, Cl^- and H_2O in the spectrochemical series is

   (i) $I^- < Cl^- < H_2O < CO$

   (ii) $I^- < H_2O < Cl^- < CO$

   (iii) $Cl^- < I^- < H_2O < CO$

   (iv) None of the above

2. Answer any *five* of the following questions :

$3 \times 5 = 15$

(a) What is ambidentate ligand? Write the structural formula of two compounds formed by an ambidentate ligand. Also name them according to IUPAC system.
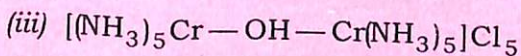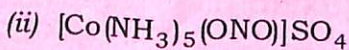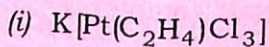
$1 + 1 + 1 = 3$

(b) $Ni(CO)_4$ and $[Ni(CN)_4]^{2-}$ have different geometry but same magnetic property. Explain.

$1\frac{1}{2} + 1\frac{1}{2} = 3$

(c) Write the IUPAC names of the following :

$1 \times 3 = 3$

   (i) $K[Pt(C_2H_4)Cl_3]$

   (ii) $[Co(NH_3)_5(ONO)]SO_4$

   (iii) $[(NH_3)_5 Cr - OH - Cr(NH_3)_5]Cl_5$

(d) Give the structural formulae of the following compounds : $1 \times 3 = 3$

    (i) Pentaammineazidocobalt (III) sulphate

    (ii) Potassium pentachlorido osmate (VI)

    (iii) trans-dichlorido bis-(triphenyl phosphine) palladium(II)

(e) Define stereoisomerism. Discuss the stereoisomerism exhibited by the complex $[Cr(gly)_3]$. $1 + 2 = 3$

(f) Calculate CFSE (in Δ_0-unit) for a d^7 ion in octahedral and tetrahedral complexes. $1\frac{1}{2} + 1\frac{1}{2} = 3$

3. Answer the following questions : $3 + 3 + 4 = 10$

(a) Draw the Orgel diagrams for the $[Ti(H_2O)_6]^{3+}$ ion. Assign the possible $(d\text{-}d)$ transition. $2 + 1 = 3$

(b) What is Mulliken symbol? Define A, B, E and T. $1 + 2 = 3$

(c) What is EAN rule? Find out the EAN for the following complexes : $1 + 3 = 4$

    (i) $[Mn(CO)(NO)_3]$

    (ii) $[FeCl_4]^-$

    (iii) $[Fe(C_5H_5)_2]$

4. *(a)* What is base hydrolysis reaction? Discuss the kinetics of the base hydrolysis reaction of an octahedral cobalt complex. $1+3=4$

(b) Explain S_N1 and S_N2 mechanisms briefly for ligand replacement reactions.

$1\frac{1}{2}+1\frac{1}{2}=3$

5. Answer any *two* of the following questions :

$2\frac{1}{2}\times2=5$

(a) What do you mean by inert and labile complexes? Explain the cause of inertness in the light of VBT. $1+1\frac{1}{2}=2\frac{1}{2}$

(b) Write a note on acid hydrolysis of cobalt(III) compounds with a suitable example. $2\frac{1}{2}$

(c) Discuss the mechanism of the following reaction : $2\frac{1}{2}$

$$[L_5MX] \xrightarrow{\text{slow}} [L_5M{<}^X_Y] \xrightarrow{\text{fast}} [L_5MY] + X$$
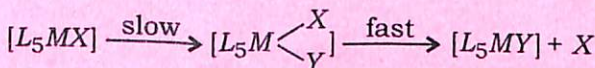
6. Answer any *three* of the following questions :

$2\times3=6$

(a) What are the problems in the separation of lanthanides from one another?

(b) Sm^{2+} is a good reducing agent and Ce^{4+} is a good oxidizing agent. Explain.

(c) Discuss two points of difference between the lanthanides and actinides.

(d) Zr($Z = 40$) and Hf($Z = 72$) have almost the same value of atomic radii. Explain.

★ ★ ★