B. MET. ENGG. EXAMINATION, 2017

(1st Year, 2nd Semester)

Chemistry-II

Full Marks: 100 **Time: Three Hours**

The figures in the margin indicate full marks

Answer any five questions

1. (a) Derive Poiseuille's equation for fluid flow through a tube of uniform radius r with length L. [10]

   (b) For a consecutive reaction: A $\rightarrow$ B $\rightarrow$ C with k_1 and k_2 as the first-order rate constants for the consecutive steps, derive the expression for [A], [B] and [C] at any time during the reaction. Draw the plot of [A], [B] and [C] versus time during the reaction. [10]

2. What is the nature of the plot of concentration of a reagent undergoing first-order decay versus time? Explain with proper derivation. This plot looks like a straight line at the beginning of the reaction. Why? What are the advantages of taking experimental data points at the beginning of the reaction for the purpose of analyses? [7 + 7 + 6]

3. Answer the following questions:

   (a) Show the possible coordination sites of the following ligands:
   $C_2O_4^{2-}$, SCN^-, $S_2O_3^{2-}$, H_2NCH_2COOH

   (b) Two complex salts **A** and **B** of cobalt are known with the empirical formula $CoBrSO_4.5NH_3$. A solution of **A** gives a precipitate with $BaCl_2$ but does not form any precipitate with $AgNO_3$. A solution of **B** gives a precipitate with $AgNO_3$ but does not form any precipitate with $BaCl_2$. Write the coordination formula of A and B and explain.

   (c) Predict the number of unpaired electrons and the magnetic moments of the following species:
   (i) $[Co(NH_3)_6]^{3+}$ (ii) $[CoF_6]^{3-}$

   (d) The stability of $[Ni(en)_3]^{2+}$ is much greater than that of $[Ni(NH_3)_6]^{2+}$, although both contains Ni-N bonds – Explain

   (e) Write the Werner theory of coordination compound and give evidence in favour of it.

   (f) How will you distinguish *cis* and *trans* isomers of a square planar coordination compound by physicochemical method ?

   (g) How will you distinguish between the following pair of isomers by conductance study?
   i) $[Cr(NH_3)_6][Cr(NO_2)_6]$ and (ii) $[Cr(NH_3)_4((NO_2)_2][Cr(NH_3)_2(NO_2)_4]$

2+(2+2)+2+(5+2)+3+2 = 20

4. Answer the following questions:

(a) What do you mean by "Ligand" ? Write down the structure of a hexadentate chelating ligand and its octahedral metal complex with M^{n+}.

(b) What do you mean by "Chelate complex" and "innermetallic complex"? Give one example each showing the use of chelating ligands in qualitative and quantitative analysis.

(c) Write short notes on

(i) Ligand isomerism (ii) Hydrate isomerism

d) Write the possible isomers of the coordination compound $[Ni(en)_2Cl_2]$ (en = ethylenediamine) and discuss their optical properties.

(e) Write the IUPAC nomenclature of the following coordination compounds:

(i) $[Co(en)_2Cl_2]Cl$ (ii) $[Co(NH_3)_5(NO_2)]Cl_2$ (iii) $[Pt(NH_3)_4][PtCl_4]$ (iv) $[Cr(acac)_3]$

(1+2)+(2+3)+(2+2)+(2+2)+4 = 20

5. (a) The freezing point of pure benzene is 5.44 ^{0}C and that of a solution containing 2.092 g benzaldehyde in 100 g benzene is 4.44^{0}C. Calculate the molecular weight of benzaldehyde. Given $K_f = 5.1$. 10

(b) A solution contains 5 g solute (MW 60) per 100 g of a solvent. What will be vapour pressure of the solution at 25^{0}C ? Given, vapour pressure of the solvent at 25^{0}C is 23.76 mm. 5

(c) A solution containing 0.5126 g naphthalene in 50 g CCl_4 yields a boiling point elevation of 0.402 K, while a solution of 0.6216 g of an unknown solute in the same mass of the solvent gives a boiling point elevation of 0.647 K. Find out the molar mass of the unknown solute. 5

6. (a) The melting point of phenol is 40^{0}C. A solution containing 13.5 g of acetanilide (C_8H_9ON) in 94 g phenol freezes at 38^{0}C. Calculate the freezing point constant and the latent heat of fusion of phenol. 10

(b) 2. 2.4 g urea and 3.4 g sucrose are dissolved in 180 g of water. Calculate the vapour pressure of the solution. The vapour pressure of water is 23.65 mm at that tempt. 10