B.E. (CST, EE, ETC & IT) 2nd Semester Final Examinations, May 2012

Chemistry (CH-1201)

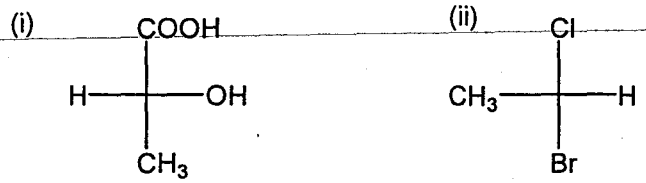
Time : 3 hours **Full Marks : 70**

Use separate answer scripts for each Group

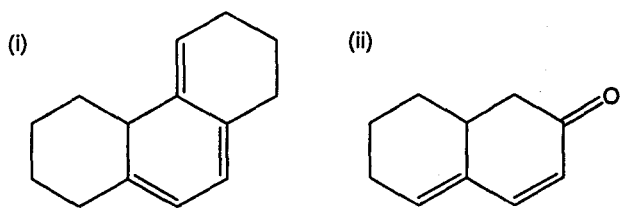
Group A

1. (a) Write all possible stereoisomers of tartaric acid and indicates the relationship among the isomers.

(b) Designate R-S of the following chiral molecules:



(c) Calculate λ_{max} for the following compounds:



(d) What type of electronic transitions do you expect from each of the following compounds?
(i) Acetaldehyde and (ii) Aniline

(e) Differentiate between addition and condensation polymerization with examples.

[5 + (1½×2) + (2×2) + 2 + 3½]

OR

2. (a) Explain with reasons:

(i) PVC is soft and flexible, whereas Bakelite is hard and brittle.
(ii) Teflon is an additional polymer but it behaves somewhat like a thermosetting polymer.
(iii) All simple organic molecules do not produce polymers.

(b) Write short notes on:

(i) Plane of symmetry, (ii) Enantiomers and (iii) Diastereomers

(c) Explain with reasons:

(i) *p*-Nitrophenol shows red shift in alkaline medium.
(ii) Aniline shows blue shift in acid medium.

(d) Cyclohexylamine is more basic than aniline. Explain.

[(2×3) + (2×3) + (2×2) + 1½]

3. (a) Write down the essential criterion of radio-nuclides to be used as radio-diagnostic and radio-therapeutic agent. Give examples.

(b) $[CoF_6]^{3-}$ is paramagnetic, whereas $[Co(CN)_6]^{3-}$ is diamagnetic – explain from crystal field theory.

(c) Calculate the CFSE for a d^8 Ni^{2+} ion in octahedral and tetrahedral crystal field in the units of Δ_O. Also calculate the OSSE.

[5 + 5 + 7½]

OR

4. (a) Draw a diagram to show how the d–orbitals are split in octahedral field.

(b) The high spin octahedral and tetrahedral CFSE for Mn^{2+} are identical –Explain.

(c) Draw energy level diagram and occupancy of the orbitals in the following complexes:

(i) d^6, low spin octahedral and tetrahedral

(ii) d^7, high spin octahedral and tetrahedral

(iii) d^5, octahedral high spin and low spin

[2½ + 3 + (4×3)]

Group B

5. (a) Write Arrhenius equation for rate constant. Arrhenius pre-exponential factor, A always has the same unit as the rate constant. Comment and explain.

(b) What is the relationship between Arrhenius activation energy and pre-exponential factor with the parameters (E_1, m and B) appear in $k = B\,T^m \exp(-E_1 / RT)$?

(c) Decomposition of acetaldehyde is a 3/2 order reaction involving chain mechanism and has a rate constant $k_2\left(\frac{k_1}{k_4}\right)^{\frac{1}{2}}$ where k_1, k_2 and k_4 are the rate constants of the respective steps of the reaction. If energy of the activation of the corresponding steps are respectively E_1, E_2 and E_4, find out the overall energy of activation of the reaction.

(d) Draw the energy band spectrum of Lithium crystal, starting from its atomic levels.

(e) Carbon has a partially filled 2p orbital, yet in the diamond form it is an insulator – Explain with band diagram, and then discuss what would be the electronic property of the next element (Silicon) in the same group.

[1½ + 4 + 3 + 3 + 6]

OR

6. (a) For the reaction scheme, $R \rightarrow I \rightarrow P$ with successive first-order rate constants k_1 and k_2 derive the necessary equation describing the temporal behavior of [P]. Draw a graph illustrating the typical variations of concentrations of R, I and P with time. Show that the rate of formation of P depends solely on the first-step of the reaction provided $k_1 << k_2$.

(b) Explain how heat of a reaction is related to the activation energies of a reversible reaction.

(c) Define the terms: i) Acceptor levels, ii) Recombination, iii) Surface states.

(d) Discuss the behaviour of a Germanium crystal doped with Indium atoms, at T = 0K and T > 0K.

[(2½ +1+2) + 3 + 3 + 6]

7. (a) What is the difference between primary and secondary batteries? What is the function of ammonium chloride in the primary Leclanche cell?

(b) Give the cell configuration of a Pb-acid storage cell and write down the half cell reactions.

(c) Give an account of a H_2–O_2 Fuel Cell and briefly illustrate the different component of such cell. What is the function of Proton Exchange Membrane in such cell?

[5 + 6 + 6½]

OR

8. (a) The e.m.f of the cell

$Cd / CdCl_2$ (satd.)// AgCl (s) / Ag

is found to be 0.6753 V at 25 °C and 0.6915 V at 0 °C. Calculate ΔG, ΔH and ΔS of the cell reaction.

(b) Write the cell reaction for the following:

(i) Pt, H_2 (g) / HCl (aq) // KCl, AgCl (s) / Ag

(ii) Hg / Hg_2Cl_2 /KCl // Fe^{+3} / Fe^{+2} / Pt

(c) Give an example of a metal-sparingly soluble salt electrode and write the electrode reaction.

(d) Write a short note on Weston Cadmium Cell.

[7 + 5 + 3½ + 2]