

BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
B.E. 2nd Semester (CST, ETC, EE & IT) Final Examination, 2013
Chemistry (CH-1201)

Time : 3 hours

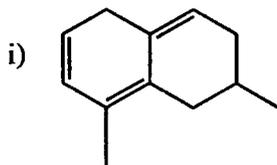
Full Marks : 70

Use separate answer scripts for each half

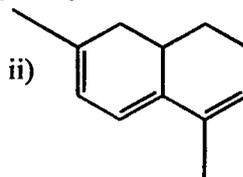
FIRST HALF

1. (a) State Lambert-Beer's law of absorption of light. With the help of this law, derive a mathematical expression showing relation between absorbance and molar extinction coefficient.

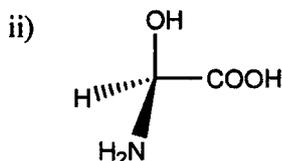
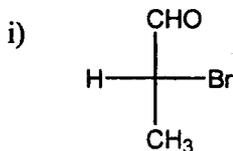
(b) Calculate the λ_{\max} in nm each of the following compounds:



and



- (c) Explain why the colour of *p*-nitrophenol is deeper in alkaline solution.
 (d) Find out the absolute configuration of following compounds:



(e) How Nylon 6 and Nylon 66 is prepared? Give reactions involved.

[5+4+1½+3+4]

2. (a) Explain why:

- (i) Vinyl chloride undergoes polymerization but ethyl chloride does not.
- (ii) *p*-Toluidine is more basic than *p*-nitroaniline.
- (iii) *p*-Nitroaniline has more λ_{\max} than aniline.
- (iv) Gauche form of ethylene glycol is more stable in solution.

(b) What are polymers? Classify them on the basis of *Tacticity*.

(c) Define the following terms with suitable example:

- (i) Bathochromic shift and (ii) Hypsochromic shift.

(d) Write a short note on Diels-Alder reaction.

[(2×4)+4+3+2½]

3. (a) Predict the bond order and the number of unpaired electrons in O₂, O₂²⁻, O₂⁻, O₂⁺, NO and CO.

(b) Write the conditions for the linear combination of atomic orbitals (LCAO). Explain

[(2×4 + 3½ × 2) + 2½]

OR

4. (a) Explain the following with help of MO theory:
- (i) Stability of H_2^+ molecule ion
 - (i) Inertness of N_2 molecule
 - (ii) Paramagnetism of B_2 molecule
 - (iii) Antibonding orbitals are more destabilizing than the stability of the corresponding bonding orbitals.
- (b) Illustrate the types of hybridization takes place in the following molecules – IF_7 , BrF_5 .
[(3×3)+4½+4]

SECOND HALF

5. (a) Define ionic mobility and transport number of an ion and show the relation between them.
- (b) For a potentiometric titration the points nearer to the end point are important – Justify.
- (c) The equivalent conductance of a 0.014 (M) solution of acetic acid is 109. The ion conductances at infinite dilution of acetate and hydrogen ions are 40.2 and 349.8, respectively. Calculate the (i) degree of dissociation and (ii) dissociation constant for the acid.
- (d) Calculate E^0 , ΔG^0 and K (equilibrium constant) for a system where a piece of Fe is dipped in a 0.005(M) solution of $NiSO_4$ at 25^0C . Also write down the cell and cell reaction for the system. Given that $E^0_{Fe^{2+}/Fe} = -0.441V$ and $E^0_{Ni^{2+}/Ni} = -0.24V$
[3 + 4 + 4½ + 6]

OR

6. (a) Describe reversible and irreversible cell with suitable examples.
- (b) Explain the Stern model of electrical double layer.
- (c) Illustrate the working principle of a Li-ion battery during charging and discharging cycle.
- (d) The mobility of Na^+ ion is $7.623 \times 10^{-8} m^2V^{-1} sec^{-1}$. (i) calculate the ion conductance of Na^+ ion. (ii) the velocity of the ion if 15 Volts are applied across the electrodes 25cm apart. (iii) the transport no. of the ions in NaCl if the mobility of Cl^- ion is $4.239 \times 10^{-8} m^2V^{-1} sec^{-1}$.
[4 + 3½ + 4 + 6]

7. (a) Write the Arrhenius equation and what type of graph do you expect between $\log(k/k^0)$ and $1/T$? What is its slope?

- (b) Suppose reactant A undergoes two parallel reactions to produce B and C according to $A \xrightarrow{k_1} B$, $A \xrightarrow{k_2} C$. Show that the observed activation energy for the

$$E_a = \frac{k_1 E_1 + k_2 E_2}{k_1 + k_2}$$

disappearance of A can be written as

Symbols have their usual significance.

- (c) Both the 1s and 2s orbital of the Be atom are filled, yet the Be crystal is conducting – Explain with diagram.
- (d) Draw and describe the energy band spectrum of a diamond crystal, starting from its atomic levels and then discuss why Silicon has band gap energy less than that of diamond.

[3½ + 5 + 3 + 6]

OR

8. (a) Show that for a reversible first-order reaction, $A \rightleftharpoons B$ the maximum yield of product B is obtained at equilibrium.
- (b) A drug is known to be ineffective when it decomposes to the extent of 30 %. The original concentration of the drug was 500 units / ml. After 20 months the concentration was found to be 420 units / ml. If the decomposition reaction of drug follows the first order kinetics find the expiration time of the drug.
- (c) A given sample of milk turns sour at room temperature (20°C) in 64 hours. In a refrigerator at 3°C, milk can be stored three times as long as before it sours. (i) Estimate the activation energy for souring of milk. (ii) How long it takes milk to sour at 40°C ?
- (d) Define the terms: (i) Insulator, (ii) Donor levels and (iii) Minority carriers.
- (e) Explain with band diagrams the electronic behavior of a Germanium crystal doped with Indium atoms, at $T = 0K$ and $T > 0K$.

[3 + 2½ + (3+1) + 3 + 5]