BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
B.E. (AE, CE, ME, MET & MIN) **1st Semester Final Examination 2012**

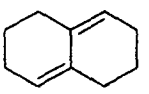
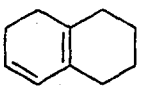
Chemistry (CH-1201)

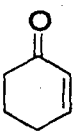
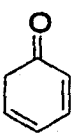
Time : 3 hours **Full Marks : 70**

Use separate answer scripts for each Group

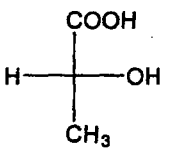
Group A

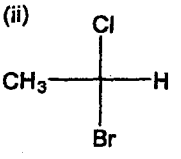
1. (a) Azulene shows deep blue colour, but its isomer naphthalene is colorless–Explain.
   (b) Distinguish the following pairs of compounds with the help of UV spectroscopy:

(i)  and 

(ii)  and 

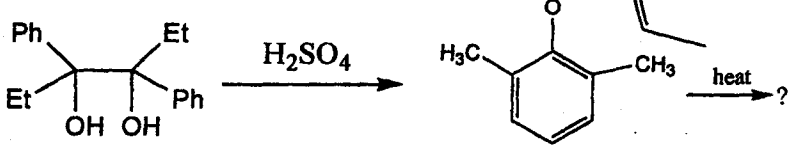
   (c) Designate R-S for the following chiral molecules:

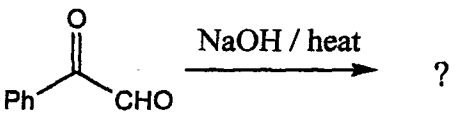
(i) 

(ii) 

   (d) What type of electronic transitions do you expect from each of the following compounds? (i) Acetone and (ii) *para*-nitroaniline

   (e) Predict the product(s) in the following reactions and give the mechanism of product(s) formation in each case. (Answer any **two**)

i) 

ii) 

[2½+ (2½×2)+ (1½×2)+2+(2½×2)]

OR

2. (a) Cholic acid, the major steroid found in bile, was found to have a rotation of $+2.22^0$ when a 5.00 gm sample was dissolved in 12 mL of alcohol in a sample tube with a 2.5 cm path length. Calculate the specific rotation of cholic acid.

   (b) Define the terms with suitable examples
   (i) Diastereomer and Enantiomer.
   (ii) Bathochromic shift and Hypsochromic shift.

   (c) Explain why –
   (i) In alkaline medium *p*-nitrophenol shows red shift.
   (ii) In acid medium aniline and benzene shows same spectra.

   (d) Write notes on the following:
   (i) Beckmann rearrangement, and (ii) Centre of symmetry.

   [2½+(2½×2)+ (2×2)+ (3×2)]

3. (a) Discuss the criteria that a chelating antidote should satisfy for its use in metal ion detoxifications?
   (b) Write down the names and chemical structures of chelating antidotes for removal of
   (i) lead (ii) copper and (iii) mercury, from living system.
   (c) What are Lewisite and British anti Lewisite? Also give example a water soluble analogue of British anti Lewisite.

   [4+(2½+ 2½+2½)+(2+2+2)]

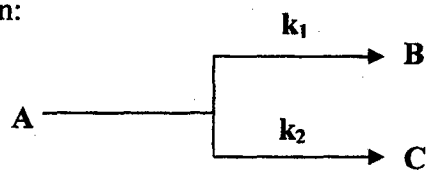
OR

4. (a) Graphically represent the effect of essential and toxic metal ions on the metabolic activities of living systems and explain the salient features of the graph.
   (b) Write down criteria for choice of radioelement for use as radiodiagnostic agent or radiotherapeutic agent. Give examples of radionuclides used as radiodiagnostic agent and radiotherapeutic agent.
   (c) Why Ni^{2+} prefers octahedral geometry, whereas Co^{2+} prefers tetrahedral geometry in presence of weak field ligands?
   (d) Consider four metal ions with d^3, d^5, d^7, and d^8 configurations. Which of the four metal ions can have both high spin and low spin configurations in their complexes?

   [4+(2+2)+5+4½]

Group B

5. (a) Consider the parallel reaction:



In an experiment, it was observed that 60% decomposition of **A** takes place in 20 min and analysis of product showed that 75% of **B** and 25% of **C** are present. Calculate k_1 and k_2.

(b) The rate of a reaction is given by $\log k = A - \frac{B}{T} + C \log T$. Find the value of activation energy.

(c) What do you understand by the term Fermi Level?

(d) Describe with diagram how band splitting occurs (into valence and conduction bands) in a tetrahedral carbon structure (diamond), starting from discrete atomic levels.

(e) Explain why intrinsic silicon would be more resistive than extrinsic silicon?

[5+5+ 1 + 4 + 2½]

OR

6. (a) What do you understand by consecutive/sequential reactions?
(b) For the reactions,

$$A \xrightarrow{k_1} B$$

$$B \xrightarrow{k_1'} C$$

derive the expressions

$$[A] = [A]_0 \exp(-k_1 t)$$

$$[B] = [A]_0 \left(\frac{k_1}{k_1' - k_1}\right)\left\{\exp(-k_1 t) - \exp\left(-k_1' t\right)\right\}$$

$$[C] = [A]_0 \left[1 - \frac{k_1}{k_1' - k_1}\left\{k_1' \exp(-k_1 t) - k_1 \exp\left(-k_1' t\right)\right\}\right]$$

Draw a graph illustrating the typical variations of concentrations of A, B and C with time.

(c) Define the terms: i) Insulator, ii) Acceptor levels, iii) Hall voltage

(d) Discuss the behaviour of an Arsenic doped Germanium crystal at T = 0 K and T > 0 K.

[1+8+3+5½]

7. (a) Given the two cell configurations:

Zn | $ZnSO_4$ (aq) || $CuSO_4$ (aq) | Cu

Zn | H_2SO_4 (aq) | Cu

Explain with reasons which is reversible and which is irreversible.

(b) What is a standard reference electrode? Illustrate with example and with proper electrode reaction.

(c) Considering ion-transport under applied field, give an account of the Relaxation Effect.

(d) Calculate the free energy, heat of reaction and entropy change at 25 ^{0}C for the cell:

Ag - AgBr (s) | KBr | Hg_2Br_2 | Hg.

The emf value for the cell reaction: $2Ag + Hg_2Br_2 \leftrightarrow 2AgBr + 2Hg$ are 0.0684 volt and 0.0705 volt at 25 ^{0}C and 30 ^{0}C respectively.

[5+4+2½ +6]

OR

8. (a) Illustrate the typical plot for strong acid-strong base titration by conductometry.

(b) At 18 ^{0}C, the mobilities of NH_4^+ and ClO_4^- ions are 6.6×10^{-4} and 5.7×10^{-4} cm^2 $volt^{-1}$ sec^{-1}, respectively. Calculate equivalent conductance of ammonium chlorate and transport number of the two ions.

(c) Explain how,

(i) The electrochemical reaction in Lithium ion battery works on 'Rocking Chair Principle'.

(ii) Polymer Electrolyte Membrane is vital for PEM fuel cell.

[4+3+(6½+4)]