

19.11.19

Indian Institute of Engineering Science and Technology, Shibpur  
B.Tech. (AM & AE, CE, ME, Met, Min) 1<sup>st</sup> Semester Final Examinations, November 2019  
Chemistry (CH 1101)

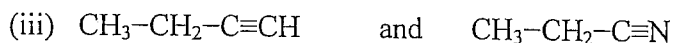
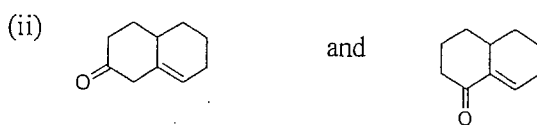
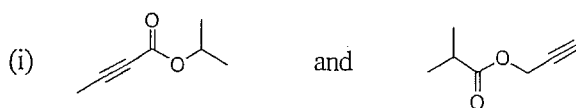
Full Marks: 50

Time: 3 h

*Use separate answer scripts for each half*

**FIRST HALF**  
**UNIT I**  
(Answer all questions)

1. (a) How could you distinguish the following pairs of compounds with the help of IR spectroscopy (any two)?

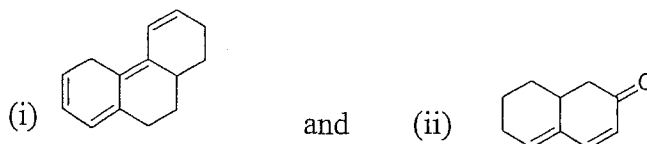


[1½×2]

- (b) The C–H stretching vibrations in dimethyl sulfoxides occur at 2997 and 2909  $\text{cm}^{-1}$ . Using Hooke's law, and assuming that the C–H bond is of the same strength as the C–D bond (same force constant,  $k$ ), calculate the stretching frequencies of the C–D bonds in dimethyl sulfoxides- $d_6$ .

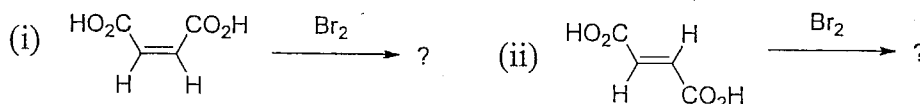
[2]

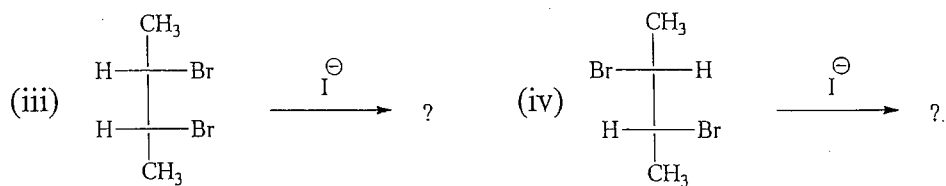
- (c) Calculate the  $\lambda_{\text{max}}$  value in nm for the following compounds:



[1½×2]

- (d) Write the products with the stereochemistry of the following reactions and explain with mechanism (any two).





[1½×2]

(e) Define Number average molecular weight ( $M_n$ ), and Weight average molecular ( $M_w$ ) and Polydispersity Index (PDI) for a polymer.

[2]

(f) Consider a polymer sample comprising of 5 mols of polymer molecules having a molecular weight of 40,000 g/mol and 15 moles of polymer molecules having a molecular weight of 30,000 g/mol. Find out  $M_n$  and  $M_w$ .

[2]

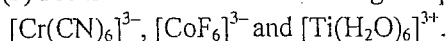
(g) Give a schematic presentation of Bakelite preparation and its uses.

[2]

## UNIT II

(Answer Question No. 2 and any two from the rest)

2. (a) Predict which of the following compounds will undergo Jahn-Teller distortion



(b) Anhydrous  $\text{CoCl}_2$  (sky blue) changes colour to pink when dissolved in water or exposed to moisture.— Discuss.

[3+2]

OR

Explain the following:

(c)  $\text{K}_3[\text{CoF}_6]$  is paramagnetic, whereas  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$  is diamagnetic.

(d)  $\Delta_o$  value for  $[\text{Ru}(\text{H}_2\text{O})_6]^{3+}$  is greater than  $[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$ .

[2½+2½]

3. (a) What diseases are likely to occur for the deficiency of Co and Fe in the body and what would happen if excess of them accumulate in the body?

(b) What are the basic requirements of a chelating agent to be used in chelation therapy?

(c) Write names and structures of two chelating agents for the removal of As and Pb from the body.

[2+2+2]

4. (a) What are MRI contrast agents? Write the structure of an MRI contrast agent.

(b) Write names and structures of two vanadium complexes used as insulin mimetics.

(c) What are the essential criteria that a radioisotope must satisfy to be considered for radio diagnosis?

[2+2+2]

5. (a) Write down the names and structures of two platinum-based anti-cancer drugs and discuss their limitation. Why is trans-platin inactive in curing cancer cells?  
(b) Write a brief note on Boron Neutron Capture Therapy (BNCT).

[3+3]

## SECOND HALF

(Answer any two)

6. (a) Write down the mechanism for the hydrogen and bromine chain reaction. Using this mechanism deduce the rate law for the reaction with the help of the following experimental observations:  
(i) First-order with respect to the  $H_2$  concentration.  
(ii) Nearly independent of the HBr concentration at low HBr concentrations, and then decreases with increasing HBr concentrations at high HBr concentrations.  
(iii) Three-halves order in  $Br_2$  at low  $Br_2$  concentrations and one-half-order in  $Br_2$  at high  $Br_2$  concentrations.  
(b) What is the Michaelis-Menten kinetic scheme and how does this explain generally the observed kinetics? Also show that the rate of an enzyme-catalyzed reaction reaches a maximum value at high substrate concentration?

[(2+2+1)+(2+1)]

7. (a) Sketch the activation energy diagrams for simple reactions that are endothermic or exothermic. Explain the significance of the activation energy term that appears in the Arrhenius Law. How can the activation energy be graphically determined by manipulating the Arrhenius equation?  
(b) Show that the activation energy can also be calculated algebraically if  $k$  is known at two different temperatures. For a particular reaction, the rate constant doubles when the temperature is raised by 10 K from 300 K. Calculate the activation energy. Given  $R = 8.314 \text{ J/mol K}$ .  
(c) What are the components of a Li-ion battery? Write down the charging-discharging reaction of such battery.  
(d) What is the standard hydrogen electrode? How do you construct it?

[2+2+2+2]

9. (a) Find out the standard cell potential for the cell consisting of two electrodes:  $Cd/Cd^{+2}$  and  $Zn/Zn^{+2}$  if  $E_{Cd/Cd^{+2}}^0 = 0.40 \text{ V}$  and  $E_{Zn/Zn^{+2}}^0 = 0.76 \text{ V}$  and write down the cell configuration and spontaneous reaction for the cell.  
Calculate the free energy change and equilibrium constant for the cell reaction under standard condition.  
(b) Explain the following  
(i) Double-layer structure at the electrode solution interface.  
(ii) Reversible and Irreversible cells.

[4+(2+2)]