53 (CY-201) ENCH

2018

ENGINEERING CHEMISTRY

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer question ***1*** *and* ***any four*** *from the rest.*

1. *(a)* Define hyperchromic and hypochromic shift. 2

(b) What do you mean by space lattice and unit cell ? 2

(c) Write a brief note on bio-catalysts. 2

(d) Define inductive effect and give *two* applications. 1+2

(e) Define nucleophilic and electrophilic reagents. Give examples of positively and negatively charged species. 2+2

Contd.

(f) If $t_{1/2} \propto \frac{1}{k}$ (where $t_{1/2}$ is half life period of a reaction and k is rate constant). What is the order of the reaction? 1

(g) Is the following reaction possible to take place? Give answer with justification.

$$Ag + H_2SO_4 \rightarrow AgSO_4 + H_2$$ 2

(h) Deduce the rate constant expression for zero order reaction and write down the expression for half life period of a zero order reaction. 2

(i) What are the differences between electrochemical cell and electrolytic cell? 2

2. (a) What are the differences between metallic conduction and electrolytic conduction? 2

(b) Define strong electrolyte, weak electrolyte and non-electrolyte with proper example. 3

(c) Write down the equation between free energy change (ΔG) and e.m.f.(E) of an electrochemical cell. What is the significance of this equation? 1+2

(d) The standard reduction potential $\left(E^0_{red}\right)$ of Mn^{2+}/Mn electrode is $-1{\cdot}18V$ and that of Ni^{2+}/Ni electrode is $-0{\cdot}25V$. What will be the standard *e.m.f.* of the cell when these two electrodes are coupled with each other? 2

(e) What is the *e.m.f.* of the following cell?

$$Zn/Zn^{2+}\,(0{\cdot}01M)\,\|\,Ni^{2+}\,(0{\cdot}5M)/Ni$$

[Given : Standard reduction potential of *Zn* and *Ni* electrodes are $-0{\cdot}76V$ and $-0{\cdot}25V$ respectively] 5

(f) What is standard hydrogen electrode and how does it work? Describe with proper diagram and reaction. 5

3. (a) Explain the terms parent ion peak and base peak taking the fragmentation pattern of neopentane. 4

(b) Describe the splitting pattern of 'HNMR signals of the following compounds :

$(CH_3)_2CHCN$ and $(CH_3)_2CCH_2$

4

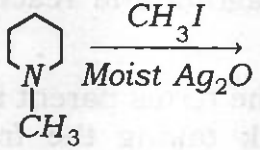
(c) Describe the instrumentation of UV-vis spectrophotometer with a suitable schematic diagram. 4

(d) State the absorption laws associated with UV-vis spectroscopy. 4

(e) Describe the instrumentation of IR spectrometer with suitable diagram. 4

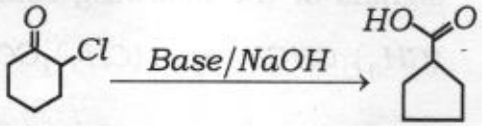
4. (a) Write types of hybridizations, shapes of carbanion, singlet and triplet carbene with examples. 3+3+3

(b) What is Hofmann Exhausted Elimination reaction? Name the product formed in the following reaction along with reaction mechanism.



1+1+4

(c) What is favorskii rearrangement? Give mechanism of the following reaction.



1+4

5. *(a)* What are polar and non-polar co-valent bonds ? Explain with example. 4

(b) What are co-ordinate or dative bonds ? Explain the formation of NH_4^+ ion. 4

(c) Give points of differences between ionic and co-valent compounds. 4

(d) Using phase rule, calculate the number of components, phases and degree of freedom for the following equilibrium system.

$$CaCO_3 \rightleftharpoons CaO(s) + CO_2(g)$$ 4

(e) Define the terms chromophores and auxochromes. Give examples. 4

6. *(a)* What are the differences between dry corrosion and wet corrosion ? 4

(b) Deduce the rate constant equation for a second order reaction in which there is only one reactant present. 4

(c) What is the effect of temperature on reaction rate ? Write down Arrhenius equations with proper meaning of each term. Explain the concept of activation energy. How will you evaluate activation energy of a reaction graphically ? 1+2+3

(d) Prove that in case of first order reaction, time required for 99·9% completion of a reaction is about 10 times than that required for half completion. 2

(e) A first order reaction is 50% complete in 25 minutes at 27°*C* and in 5 minutes at 37°*C*. Calculate the activation energy. [$R = 1{\cdot}987$ *calories/K/mole*] 4

7. (a) Write short notes on Buna-S-rubber and Buna-N-rubber. What is the main difference between these two rubbers ? 2+2+1

(b) In a polymer, there are 100 molecules of molecular weight 100, 200 molecules of molecular weight 1000 and 300 molecules of molecular weight 10,000. Find *Mn*, *Mw* and *PDI*. 5

(c) Give structure and examples of linear, branched and cross linked polymers. 2+2+2

(d) Write short notes on :

(i) Number-average molecular weight. 2

(ii) Weight-average molecular weight. 2

8. *(a)* Write short notes on : 2×5=10

(i) Octane number

(ii) Water gas

(iii) Producer gas

(iv) Cetane number

(v) Aviation fuel.

(b) What is Calorific Value ? Distinguish between Net and Gross calorific value. 2+3=5

(c) A polymer sample consists of 10% by weight of macromolecules of molecular weight 10,000 and 90% by weight of macromolecules with molecular weight 100,000. Calculate *Mn* and *Mw*. 5