53 (CY 201) ENCH

2017

ENGINEERING CHEMISTRY

Paper : CY 201

Full Marks : 100

Time : Three hours

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

Answer Q. No. ***1*** *and* ***any four*** *from the rest.*

1. *(a)* Fill in the blanks : 1×5=5

   (i) Unit of rate-constant of 3rd order reaction is _____.

   (ii) The value of Mark-Houwink exponent lies between _____ and _____.

   (iii) The monomer units of terylene are ethylene glycol and _____.

   (iv) If rate law of a chemical reaction is $K = [C_{12}H_{22}O_{11}][H_2O]$ then the order of the reaction is _____.

(b) Match the following : 1×5=5

Group A	Group B
(i) The electrode potential of hydrogen electrode has been assigned value	(i) 0·1 V
(ii) A cell that converts electrical energy into chemical energy is called	(ii) 0·0 V
(iii) A cell that converts chemical energy of H_2 gas into electrical energy is called	(iii) electrolytic cell
(iv) H_2, O_2, N_2 etc. are	(iv) Fuel cell
(v) UV-visible region of the electromagnetic spectrum can induce	(v) Infrared-active
	(vi) Infrared-inactive
	(vii) bond breaking
	(viii) Electronic transitions
	(ix) 1 V

(c) Give the answers of following questions :

(i) What is degree of polymerisation ? What are the names of monomers of Bakelite ? 1+1=2

(ii) What is activation energy? Draw the energy profile diagram for catalysed and un-catalysed chemical reactions. 1+2=3

(iii) Give an account of the factors influencing corrosion. 5

2. (a) What is P.D.I. of a polymer? Equal masses of polymer molecules with $M_1 = 1 \times 10^4$ and $M_2 = 1 \times 10^5$ are mixed. Calculate P.D.I. of the polymer. 1+3=4

(b) Define the terms electrode and electrolytes. What are strong and weak electrolytes? Give examples. 1+1+4=6

(c) "Acetolysis of both 4-methoxy-1-pentyl brosylate and 5-methoxy-2-pentyl brosylate give the same mixture of products due to neighbouring group participation." Give proper reaction-mechanism for above reactions. 2+2=4

(d) What is a pseudo-unimolecular reaction? Give example. 2+1=3

(e) Mention the differences between EMF and Potential difference. 3

3. (a) Write short notes on: Urea-formaldehyde resin, bakelite and Neoprene. 2×3=6

(b) Define pH. Kw for H_2O at $313K$ is $2{\cdot}92\times10^{-14}$. What are $[H_3O^{\oplus}]$, $[OH^{\ominus}]$ and pH of pure water at this temperature? 1+3=4

(c) Write down Nernst's equation and mention *two* of its applications. 5

(d) Describe the instrumentation of NMR spectrometer with a suitable diagram. 5

4. (a) What is the molecular weight of Teflon; when DP is 1×10^6 ? What is the ratio of its molecular weight to that of polyethylene with the same DP? 2+3=5

(b) Write short notes on : Carbonisation of coal, Octane number and cetane number. 1+2+2=5

(c) Mention the properties of ionic and covalent compounds. 6

(d) What are secondary cells ? Mention the application of lead acid storage battery. 4

5. (a) Distinguish between thermoplastic and thermosetting plastics. Give examples. 3+1=4

(b) Why osmotic pressure is used for determination of number-average molar mass $(\overline{M}_N)$ of a polymer ? 1

(c) What is Saytzeff rule ? Write down the reaction products A and B for the following : 1+2+2=5

$$CH_3 - \underset{Cl}{C}H - CH_2 - CH_3 \xrightarrow[CH_3OH]{CH_3O^{\ominus}} \begin{matrix} \nearrow A \\ \searrow B \end{matrix}$$

Give proper mechanistic pathway.

(d) Give points of differences between dry and wet corrosion. 4

(e) Write short notes on ionic crystal and crystal defects. 3+3=6

6. (a) Distinguish between unimolecular nucleophilic and bimolecular nucleophilic substitution reactions with proper energy-profile diagram. 2

(b) Prove that, for a n^{th}-order reaction $t_{1/2} \propto \frac{1}{a^{n-1}}$ where, $t_{1/2}$ is half-life period of n^{th}-order reaction and a is initial concentration of reactant. 4

(c) From the thermodynamic aspects of transition state theory, prove that,

$$K_2 = \frac{RT}{Nh}\left[exp\left(\frac{-AH^{\neq}}{RT}\right).exp\left(\frac{AS^{\neq}}{R}\right)\right]$$ for a second order reaction of type $A + B \rightarrow P$. 4

(d) Give a schematic diagram representing the instrumentation of a IR spectrophotometer. 4

(e) Describe the types of hybridisation associated with CH_4, C_2H_4 and C_2H_2. 6

7. (a) Find the order of a reaction, if the time of half-completion for a certain reaction is found to change from 50*secs* to 25 *secs.*, when the initial concentration is changed from 0·5 to 1*M*. 3

(b) Give Arrhenius equation to explain dependance of rate-constant on temperature. Calculate temperature for reaction at which its half-life is 2 minutes. Given $A = 5 \times 10^{13} S^{-1}$ and $Ea = 10^5 S/mole$. 1+3=4

(c) What is Chichibabin reaction? Give example with proper reaction mechanism. 1+1=2

(d) What is a hydrogen bond? Define various types of hydrogen bonds with suitable examples. 2+4=6

(e) Calculate the frequency of C-H stretch, given that $K = 5 \times 10^5 \, gm\,sec^{-2}$, $M_C = 20 \times 10^{-24} \, gm$ and $M_H = 1{\cdot}6 \times 10^{-24} \, gm$. 5