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

1. *(a)* Choose the correct answers : 1×3=3

   (i) Corrosion of metals take place because

   (a) Reduction

   (b) Oxidation

   (c) both reduction and oxidation

   (d) it depends on the metal.

(ii) Which of the following is an weak electrolyte ?

(a) $NaCl$

(b) HCl

(c) KOH

(d) NH_4OH.

(iii) The potential of standard hydrogen electrode

(a) 1

(b) 1·5

(c) 0

(d) None of these.

(b) Write down the units of the rate constant for a $4 \times \frac{1}{2} = 2$

(i) Zeroth-order reaction

(ii) Half-order reaction

(iii) First-order reaction

(iv) $(3/2)^{th}$-order reaction.

(c) Give definitions and applications of inductive effect and mesomeric effect. $2+2=4$

(d) Write short notes on octane number and cetane number with examples. 2·5+2·5=5

(e) Describe the stretching and bending vibrations involved in infra-red spectroscopy. 6

2. (a) What is a Catalyst? Explain homogeneous and heterogeneous catalysis with examples. 2+4=6

(b) Calculate the cell *emf* of the following cell $Zn/Zn^{+2}//Cu^{2+}/Cu$. [Given $E^{ox.pot.}\left(Zn/Zn^{+2}\right) = +0{\cdot}76V$ and $E^{ox.pot.}\left(Cu/Cu^{+2}\right) = -0{\cdot}34V$]. Write down the factors, which affect the potential of an electrode. 2+3=5

(c) What is Saytzeff rule? Write down the reaction products *A* and *B* for the following with mechanism

$$A \xleftarrow{OH^-} CH_3-CH_2-CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3 \xrightarrow{OH^-} B$$

2-Bromopentane

1+2+2=5

(d) The intrinsic viscosity of a polymer is $317 cm^3 g^{-1}$. Calculate the approximate concentration of the polymer in water which would have a relative viscosity of 1·5. 4

3. (a) What is hybridisation ? Explain Sp, Sp^2 and Sp^3 types of hybridisation with examples. 1+6=7

(b) Write down the Nernst equation for the following reaction

$$Zn + Cu^{+2} = Zn^{2+} + Cu$$

What are the application of Nernst equation ? 2+3=5

(c) Give the differences between $SN1$ and $SN2$, and the energy profile diagram for each of the reaction. 3+3=6

(d) Equal numbers of molecules with $M_1 = 10000$ and $M_2 = 100000$ are mixed. Calculate $\overline{M}_m$ (mass-average molar mass) 2

4. *(a)* State the Gibb's phase rule. Calculate the number of components, number of phases and degrees of freedom for the following system

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

2+3=5

(b) Define oxidation potential and reduction potential of a electrode. What are the differences between *emf* and potential differences? 2+3=5

(c) Give *three* differences between E1 and E2 and the energy profile diagram for each of the reaction. 3+3=6

(d) Write the mathematical expression for viscosity-average molar mass. How intrinsic viscosity is interrelated with Mark-Houwink exponent?

2+2=4

5. *(a)* What are *n*-type and *p*-type of semiconductors? Explain with examples. 2+2=4

(b) What is reference electrode? Discuss calomel electrode with diagram.

1+4=5

(c) How electron displacement effects are classified? Define permanent and temporary effects. 2+2=4

(d) Prove that for a n^{th}-order reaction

$$t_{1/2} = \frac{2^{n-1} - 1}{k_n (n-1) a_0^{n-1}}$$

5

(e) Write a short note on ionic crystals. 2

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

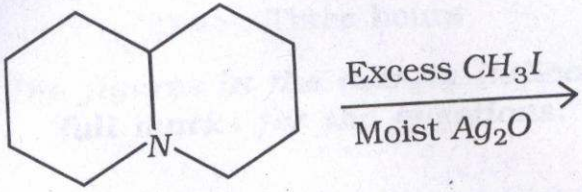
(b) What are the factors, which influence corrosion? Write down the differences between dry corrosion and wet corrosion. 2+3=5

(c) What is aldol condensation? Give example. Give proper mechanistic path way. 1+2+2=5

(d) Explain effect of catalyst on rate of a reaction. Give proper energy profile diagram. 2+3=5

7. (a) Describe the instrumentation of Mass spectrometer with a suitable diagram. 5

(b) What is the Hofmann exhaustive elimination reaction? Write down the product of the following reaction and give the proper mechanism for this elimination reaction. 1+1+4=6



(c) Write short notes on : 2×3=6

(i) Polymethylmethacrylate

(ii) Polystyrene

(iii) Nylon-6,6.

(d) Give Arrhenius equation. Calculate the activation energy of a reaction whose rate constant is tripled by a 10°C rate in temperature in the vicinity of 27°C. 1+2=3