

7. Attempt any one of the following :

- (a) (i) Differentiate between an electrochemical cell and an electrolytic cell.
- (ii) Calculate the electrode potential of the copper wire dipped in 0.1M CuSO_4 solution at 25°C. The standard electrode potential of copper is 0.34 V.
- (b) What is meant by corrosion inhibitors ? How is corrosion prevented by cathodic protection ?
- (c) (i) Write a short note on biogas.
- (ii) Write a short note on softening of water by Zeolites.

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B. Tech.

(SEM. II) THEORY EXAMINATION 2010-11

ENGINEERING CHEMISTRY

Time : 3 Hours

Total Marks : 100

Note : Attempt all questions.

SECTION—A

1. Choose/Fill correct answer : **(20×1=20)**

(i) Which of the following molecule possesses the smallest bond length ?

(a) F_2 (b) Cl_2

(c) Br_2 (d) I_2

(ii) Which one is not the allotropy of carbon ?

(a) Graphite (b) Fullerene

(c) Diamond (d) Bakelite

(iii) The rate of a reaction does not depend upon :

(a) Temperature (b) Pressure

(c) Concentration (d) Catalyst

(iv) For a system $\text{Ice} \rightleftharpoons \text{Water} \rightleftharpoons \text{Vapur}$, degree of freedom, is

- (v) S_N^2 reaction is accompanied by of configuration.
- (vi) Optical isomerism in compounds due to restricted rotation around a single bond is called
- (vii) The number of conformation of ethane is :
 (a) 3 (b) 5
 (c) 7 (d) None
- (viii) Polypyrrol is Polymer.
- (ix) $F_2C = CF_2$ is a monomer of :
 (a) Teflon (b) Glyptal
 (c) Nylon-6 (d) Buna-S
- (x) The electrode potential of SHE (Standard Hydrogen Electrode) is :
 (a) 1 (b) 2
 (c) 1.018 (d) Zero
- (xi) The chemical formula of Zeolite is :
 (a) $FeSO_4 \cdot 7H_2O$
 (b) $Al_2(SO_4)_3 \cdot 18H_2O$
 (c) $Na_2Al_2O_4$
 (d) $Na_2O \cdot Al_2O_3 \cdot x SiO_2 \cdot y H_2O$
- (xii) Corrosion is a process of :
 (a) Oxidation (b) Reduction
 (c) Electrolysis (d) Erosion
- (xiii) Finger Print region of IR spectroscopy is

- (xiv) A good fuel should possess :
 (a) High calorific value
 (b) Low ignition temperature
 (c) High moisture content
 (d) Both (a) and (b)
- (xv) The oxidation number of Fe in $K_4[Fe(CN)_6]$ is :
 (a) +2 (b) +3
 (c) +1 (d) +4
- (xvi) The relation between HCV and LCV is :
 (a) $LCV = HCV - 0.09HL$
 (b) $LCV = HCV + 0.09HL$
 (c) $HCV = LCV - 0.09HL$
 (d) $HCV = LCV + 0.09HL$
- (xvii) For preparation of N/20 $K_2Cr_2O_7$ solution, the amount of $K_2Cr_2O_7$ required to dissolve in 250 ml water is :
 (a) 0.6125 g (b) 6.125 g
 (c) 61.25 g (d) 612.5 g
- (xviii) The total number of NMR signals in 2-bromopropane is :
 (a) 3 (b) 2
 (c) 4 (d) 1
- (xix) The reaction $N_2O_5(g) \rightarrow N_2O_4(g) + \frac{1}{2}O_2(g)$ is :
 (a) Zero order (b) First order
 (c) Second order (d) Fractional order
- (xx) Carbon having four different groups attached to it is called carbon.

SECTION—B

2. Attempt any three of the following : (10×3=30)
- (a) (i) Explain metallic bond on the basis of molecular orbital theory.
- (ii) Calculate the bond order of O_2 , O^{+2} , O^{-2} , and O_2^{-2} and arrange them in increasing order of their stability.
- (b) (i) Explain the structure of graphite. Also explain the reasons for its electrical and lubricating properties.
- (ii) A body centered cubic element of density 10.3 g cm^{-3} has a cell edge of 314 pm. Calculate the atomic mass of the element. (Avogadro's constant = $6.023 \times 10^{23} \text{ mol}^{-1}$).
- (c) (i) Give the mechanism of following reactions :
Beckmann rearrangement
Diels-Alder reaction.
- (ii) Show, how does S_N^2 reaction give rise to inverted product.
- (d) A sample of coal was analysed as follows : Exactly 1.51 gm of coal was weighed into a silica crucible. After heating for 1 hr at 110°C , the residue weighed 1.415 gm. The crucible was then strongly heated for exactly 7 min. at 950°C . The residue weighed 0.528 gm. The crucible was then heated until a constt weight of residue was obtained. The lost residue was found to be 0.254 gm. Calculate the percentage results of above analysis.
- (e) (i) What is optical activity ? Give the stereoisomers of Tartaric acid.

- (ii) Distinguish between hydrogen evolution and oxygen absorption theory of corrosion.

SECTION—C

Note : Attempt all five questions. (10×5=50)

3. Attempt any one of the following :
- (a) (i) Distinguish between thermoplastic and thermosetting polymers.
- (ii) How will you prepare Bakelite and Persplex polymers ?
- (b) (i) Assign E, Z and R, S configuration of the following :
- $$\begin{array}{c} \text{Ph} \quad \quad \text{Ph} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{COOH} \end{array}, \quad \begin{array}{c} \text{Cl} \quad \quad \text{COOH} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H}_2\text{N} \quad \text{Br} \end{array}$$
- $$\begin{array}{c} \text{CHO} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}, \quad \begin{array}{c} \text{Cl} \\ | \\ \text{Br}-\text{C}-\text{COOH} \\ | \\ \text{H} \end{array}$$
- (ii) Explain the term chirality. What is the condition essential for optical activity ?
- (c) The following data is obtained in a bomb calorimeter experiments :
- | | |
|---------------------------------|-----------|
| Weight of crucible | = 3.649 g |
| Weight of fuel | = 1.029 g |
| Mass of water in calorimeter | = 2200 g |
| Water equivalent of calorimeter | = 570 g |

Observed rise in temperature = 2.3°C
 Cooling correction = 0.047°C
 Acid correction = 62.6 calories
 Fuse wire correction = 3.8 calories
 Cotton thread correction = 1.6 calories
 Calculate GCV of fuel sample. If the fuel contains 6.0% H, determine the NCV.

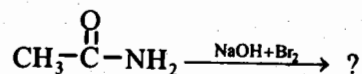
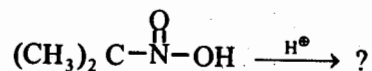
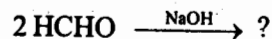
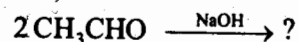
4. Attempt any one of the following :

(a) Calculate the temporary, permanent and total hardness of a sample of water that is analysed as :

$\text{Mg}(\text{HCO}_3)_2 = 7.3 \text{ mg/L}$, $\text{Ca}(\text{HCO}_3)_2 = 16.2 \text{ mg/L}$

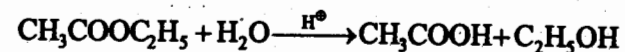
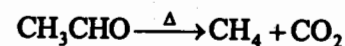
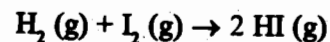
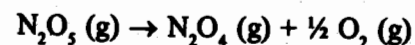
$\text{MgCl}_2 = 9.5 \text{ mg/L}$ and $\text{CaSO}_4 = 13.6 \text{ mg/L}$.

- (b) (i) Explain the term chemical shift.
 (ii) Indicate the number and splitting of signals in the NMR spectra of the anhydrous ethanol.
 (c) (i) Explain $\text{S}_{\text{N}}1$ reaction with an example.
 (ii) Complete and name the following reactions :



5. Attempt any one of the following :

- (a) (i) Distinguish between order and Molecularity of a reaction.
 (ii) Calculate the order and molecularity of the following reactions :



- (b) What is phase rule ? Draw and explain phase diagram of water.
 (c) Discuss the titrimetric analysis of Acid-base and Redox titration.

6. Attempt any one of the following :

- (a) (i) For a first order reaction, the rate constant is found to be 7×10^{-7} at 7°C and 9×10^{-4} at 57°C. Calculate the energy of activation of the reaction.

$$(\log_{10} 7 = 0.8451, \log_{10} 9 = 0.9542)$$

- (ii) What are biopolymers ? Give their uses.
 (b) What are organometallic compounds ? Give the classification and preparation of organometallics.
 (c) Define the term liquid crystals. Describe the classification and applications of liquid crystals.