

**B.Tech 2nd Semester Exam., 2015**

## ENGINEERING CHEMISTRY

Time : 3 hours

Full Marks : 70

*Instructions :*

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Fill in the blanks/answer any seven questions : 2×7=14

- (a) 50 ml of water sample require 1.5 ml  $M/50$  HCl solution using methyl orange indicator. The temporary hardness of water is — ppm.
- (b) Natural rubber is polymer of —.
- (c) Terylene is condensation polymer of — and —.
- (d) Arrange hydrogen gas, LPG, water gas and biogas in increasing order of their calorific value.
- (e) Aluminium vessels are used to store conc.  $\text{HNO}_3$ . Explain.

- (f) Why is boiling point of water increases when KCl added?
- (g) Large cathode and small anode area results in intense corrosion. Explain.
- (h) Arrange in increasing order of freezing point of 0.1 M solution of acetic acid, glucose, sodium chloride and calcium nitrate.
- (i) What is power alcohol?
- (j) Why are brass utensils tinned?
2. (a) Describe the principle of lime-soda process of softening of water. Give chemical reaction involved during softening of water. 5
- (b) What are advantages and disadvantages of lime-soda process? 2
- (c) A water sample containing the following in mg/litre :
- $\text{Ca}(\text{HCO}_3)_2 = 16.2$   
 $\text{Mg}(\text{HCO}_3)_2 = 14.6$   
 $\text{MgCl}_2 = 9.5$   
 $\text{MgSO}_4 = 1.2$   
 $\text{CaCl}_2 = 2.22$   
 $\text{HCl} = 3.65$   
 $\text{CO}_2 = 2.2$   
 $\text{NaHCO}_3 = 4.2$
- Calculate the amount of lime and soda required for softening  $10 \text{ m}^3$  water. 7

( Continued )

3. (a) What is flue gas? How is analysis of flue gas done by Orsat's apparatus? 2+4
- (b) What is the significance of the flue gas analysis. 2
- (c) A coal sample contains following percentage composition by weight :
- $\text{C} = 80, \text{H} = 6, \text{O} = 8, \text{N} = 6$
- Find the minimum amount of oxygen and air by weight for complete combustion of 1 kg of coal. Also calculate the weight of air if 15% excess air is supplied (air contains 23%  $\text{O}_2$  by weight). 6
4. (a) Derive Nernst equation and discuss its application. 6
- (b) Calculate the e.m.f. of a concentration cell at  $25^\circ\text{C}$  consisting two Ag electrode immersed in a solution of  $\text{Ag}^+$  of 0.01 M and 0.001 M concentration. 4
- (c) For a cell reaction
- $$2\text{A} + 3\text{B}^{+2} = 2\text{A}^{+3} + 3\text{B}$$
- at 298 K the equilibrium constant is  $1.0 \times 10^4$ . Calculate  $E^\circ$  cell. 4

5. (a) Define degree of polymerization. 3  
 (b) Explain the free radical polymerization mechanism. 3  
 (c) What is glass transition temperature? 4  
 (d) Write the preparation and uses of (i) neoprene and (ii) nylon-6,6. 4
6. (a) Discuss the mechanism of electrochemical corrosion. 3  
 (b) What are the factors that effect the rate of corrosion? 4  
 (c) How is corrosion prevented by cathodic protection? 3  
 (d) What is percentage of iron rusted ( $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ ) when its weight increased by 25%? 4
7. (a) Deduce the relationship between the boiling point elevation of a solution and mole fraction of dissolved solute. 6  
 (b) Explain the terms hypertonic, isotonic and hypotonic solutions. 4  
 (c) At  $100^\circ\text{C}$  the vapour pressure of solution of 4.5 g of solute in 108 g water is 742 mm. Find the boiling point of the solution ( $K_b$  of  $\text{H}_2\text{O} = 0.52$  and water vapour pressure at  $100^\circ\text{C}$  is 760 mm). 4

8. (a) Explain caustic embrittlement in boiler and how it can be prevented. 5  
 (b) What are the causes of boiler corrosion? How can the boiler corrosion be prevented? 5  
 (c) What are the causes of—  
 (i) scale formation; 4  
 (ii) priming and foaming?
9. Write short notes on :  $3\frac{1}{2} \times 4 = 14$   
 (a) Water-line corrosion  
 (b) Crevices corrosion  
 (c) Octane number  
 (d) Colligative properties

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