

**B.Tech. Civil (Construction Management)/
B.Tech. Civil (Water Resources Engineering)**

Term-End Examination

00155

June, 2015

ET-105 (B) : CHEMISTRY

Time : 3 hours

Maximum Marks : 70

Note : *Question no. 1 is compulsory. Attempt any five questions from question no. 2 to 10. Use of calculator is allowed.*

1. (a) Total number of σ and π bonds in acetylene is 2
- (i) $3\sigma, 2\pi$
 - (ii) $2\sigma, 3\pi$
 - (iii) $2\sigma, 2\pi$
 - (iv) $1\sigma, 3\pi$
- (b) Red absorption maxima for Chl-a occurs at 2
- (i) 670 nm
 - (ii) 642 nm
 - (iii) 662 nm
 - (iv) 652 nm

(c) The volume coefficient of thermal expansion is given by 2

(i) $\left(\frac{\partial V}{\partial T}\right)_P = \beta/V$

(ii) $\left(\frac{\partial V}{\partial T}\right)_P = V/\beta$

(iii) $\left(\frac{\partial V}{\partial T}\right)_P = \beta V$

(iv) $\left(\frac{\partial V}{\partial T}\right)_P = -\beta V$

(d) For an ideal gas undergoing adiabatic changes 2

(i) $T V^{\gamma-1} = \text{constant}$

(ii) $T^\gamma V^{\gamma-1} = \text{constant}$

(iii) $T V^{1-\gamma} = \text{constant}$

(iv) $T V^{1/\gamma} = \text{constant}$

(e) Correct Gibbs-Helmholtz equation is 2

(i) $\Delta G = \Delta H - T\Delta S$

(ii) $\Delta G = T\Delta S - \Delta H$

(iii) $-\Delta G = \Delta H + T\Delta S$

(iv) $\Delta G = \Delta H + T\Delta S$

(f) Total number of atoms per unit cell in a primitive cell is 2

(i) 1

(ii) 2

(iii) 3

(iv) 4

(g) Geometry of the complexes formed by transition metal ions using $d^2 sp^3$ hybridization is 2

(i) Tetrahedral

(ii) Octahedral

(iii) Square planar

(iv) Trigonal

(h) $\text{CaC}_2 + \text{N}_2 \longrightarrow \text{X}' + \text{CaNCN}$; 'X' is 2

(i) C

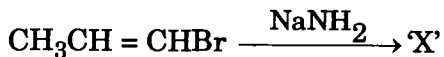
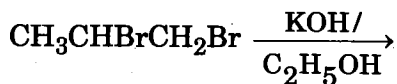
(ii) N_2

(iii) CaCN

(iv) CaN

(i) 'X' in the following reaction is

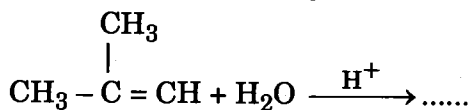
2



- (i) $\text{CH}_3\text{CH}_2\text{CH}_3$
- (ii) $\text{CH}_3\text{CH}=\text{CHNH}_2$
- (iii) $\text{CH}_3\text{C}\equiv\text{CH}$
- (iv) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

(j) Complete the following reaction :

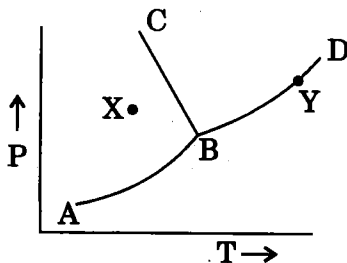
2



2. (a) Define Raoult's law.

2

(b) The phase diagram for a one-component system is shown in the figure :



- (i) Calculate the number of degrees of freedom at points B, X and Y. 3
- (ii) Find out the number of phase(s) along AB, BC and BD. 1
- (c) Draw the typical phase diagram for two partially miscible liquids. 4
3. (a) How is fuel cell represented? 2
- (b) For the galvanic cell
 $\text{Ag(s)} \mid \text{AgCl(s)} \mid \text{KCl (1.0 M)} \mid \text{Hg}_2\text{Cl}_2 \text{(s)} \mid \text{Hg (l)}$
 the EMF of the cell is 0.058 V at 298 K and 0.0614 V at 308 K.
- (i) Write down the cell reaction. 2
- (ii) Calculate ΔS° , ΔG° and ΔH° at 298 K. 2
- $2 \times 3 = 6$
4. (a) What is buffer solution? 2
- (b) For 0.1 M solution of NH_4Cl , the ionization constant K_b is 1.80×10^{-5} at 298 K. Calculate the
- (i) Hydrolysis constant (K_h) 2
- (ii) Degree of hydrolysis α 3
- (iii) pH of the 0.1 M NH_4Cl solution. 3
5. (a) Define specific growth rate (μ) for the microbial cell growth. 2

(b) Write short notes on any *four* of the following : 4×2=8

- (i) Transcription
- (ii) Totipotency
- (iii) Antibody
- (iv) Generation time
- (v) Enzyme
- (vi) Chemotherapy

6. (a) How is terylene synthesized ? Write down the reactions. 4

(b) What do you understand by the following : 3×2=6

- (i) Plasticizers
- (ii) Natural rubber
- (iii) Co-polymer

7. (a) (i) Calculate the coefficient of performance of a refrigerator which works between 273 K and 305 K. 2

(ii) Calculate the minimum amount of work required to freeze 0.5 kg of water at 273 K. Latent heat of fusion of ice at 273 K is 334.7 Jg^{-1} . 2

(iii) Calculate the quantity of heat given out to the surrounding. 2

(b) What do you mean by entropy changes ? Deduce the empirical equation for an isothermal change. 4

8. (a) $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 In a 20 L vessel at 250°C, the equilibrium mixture contains 0.5 mole PCl_3 , 0.3 mole PCl_5 , 0.5 mole Cl_2 . Find the equilibrium constant. 4
- (b) Calculate the free energy change for expansion of 2 moles of ideal gas from pressure 700 to 70 mm at 300 K. 4
- (c) Write the Helmholtz free energy expression. 2
9. (a) What is spectrochemical series? 2
- (b) What are the factors that affect crystal field splitting? 3
- (c) Draw the crystal field splitting (d-orbital) diagram for $[\text{Ti}(\text{OH})_6]^{3+}$ and calculate the CFSE. 4+1=5
10. (a) What do you mean by common ion effect? 2
- (b) How much $\text{KAl}(\text{SO}_4) \cdot 12\text{H}_2\text{O}$ could be formed by 100 g of K_2SO_4 , 100 g of $\text{Al}_2(\text{SO}_4)_3$ and 100 g of water?
 (At. wt. H = 1.0; O = 16.0; S = 32.0; K = 39.0; Al = 27.0) 4
- (c) Write the electronic configuration of an element with atomic number 61. 2
- (d) Why is SO_2 a gas and H_2O a liquid? 2