

B.Tech/BT/CE/CHE/EE/ME/2<sup>nd</sup> Sem/CHEM-1001/2015

2015

CHEMISTRY – 1

(CHEM 1001)

Time Alloted : 3 Hours

Full Marks : 70

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable*

**GROUP - A**

**(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following : [10×1=10]
- Internal energy change of a system in a process depends on the
    - states
    - path
    - intermediate steps
    - none of the above
  - An engine can have 100% efficiency if the temperature of the sink is
    - 273K
    - 0K
    - 298K
    - 300K
  - For a weak acid with  $\alpha$  as its degree of dissociation, the value of dissociation constant is given by (C is the concentration of acid in moles/litre)
    - $K_a = \alpha C$
    - $K_a = \alpha^2 C$
    - $K_a = \alpha C^2$
    - $K_a = \alpha^2 C^2$

- iv) Which one of the following defects in the crystals lowers its density?
- (a) F-centres (b) Schottky defect  
(c) Frenkel defect (d) Interstitial defect
- v) On increasing the temperature, the rate of reaction increases because
- (a) the activation energy of the reaction increases  
(b) the activation energy of the reaction decreases  
(c) concentration of the reacting molecules increases  
(d) a large fraction of the molecules attain energy equal to or greater than the threshold energy
- vi) Which ion has the greatest ionic mobility?
- (a) Na<sup>+</sup> (b) H<sub>3</sub>O<sup>+</sup>  
(c) Li<sup>+</sup> (d) K<sup>+</sup>
- vii) At 25°C, the standard hydrogen electrode has been assigned electrode potential
- (a) positive (b) negative  
(c) zero (d) no definite value
- viii) In India flash point of petrol engine is
- (a) -35°C (b) -44°C  
(c) -22.8°C (d) -27°C
- ix) Polyethylene is
- (a) Random copolymer (b) Alternate polymer  
(c) Homo polymer (d) Crosslinked copolymer
- x) Chain growth polymer is
- (a) PVC (b) Nylon  
(c) Bakelite (d) None of these

**GROUP - B**

2. (a) Derive Clausius-Clapeyron equation and mention its applications.
- (b) Explain the efficiency of Carnot Engine. Starting from the expression for the efficiency of a reversible Carnot Engine, find the concept of entropy.
- (c) On passing monochromatic light through a 0.01 (M) solution in a cell of 1 cm thickness, the intensity of the transmitted light was reduced to 10%. Calculate the molar extinction coefficient? **(3+2)+(1+3)+3 = 12**
3. (a) Derive the expression for entropy change of an ideal gas as a function of volume and temperature.
- (b) One mole of an ideal monoatomic gas is heated from 27°C to 227°C and volume expands from 10L to 100L. Calculate the change in molar entropy (Given  $C_v = 3/2R$ ).
- (c) Define Gibbs free energy and derive the Gibbs-Helmholtz equation.
- (d) Show, using labeled drawings of the water molecule :
- (i) symmetrical stretching
- (ii) asymmetrical stretching **3+3+(1+3)+(1+1) = 12**

**GROUP - C**

4. (a) Mention the hybridisation of the central Xe in  $XeF_6$  and geometry of the molecule.
- (b) Write a short note on metal excess defect.
- (c) Explain how does a buffer solution work. Define pH of a solution. Calculate pH of 0.085(N) monobasic acid which dissociates 25%.

B.

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- (d) Compare the Lewis basicity of 2,6-dimethyl-4-nitroaniline and 3,5-dimethyl-4-nitroaniline. Give justification for your answer.  $(1+1)+3+(2+2)+(1+2) = 12$
5. (a) Arrange n-pentane, isopentane and neopentane according to their increasing order of boiling point and give justification.
- (b) Distinguish between p-type and n-type semiconductors.
- (c) Write the electronic configuration of dioxygen molecule and calculate the bond order. Find out the number of unpaired electrons in it.
- (d) Explain degree of hydrolysis and hydrolysis constant.  $(1+1)+3+(2+1)+(2+2) = 12$

**Group - D**

6. (a) Deduce the expression for the rate constant of a second order reaction where the initial concentration of the reactants are same and show that time for 50% conversion is inversely proportional to the initial concentration.
- (b) When the values of the equivalent conductance of strong electrolytic solutions with varying concentrations of sodium acetate, sodium chloride and hydrochloric acid are plotted separately against  $\sqrt{c}$ , three intercepts with values 91, 127 and 426 respectively are obtained at 25°C. A 0.2M  $\text{CH}_3\text{COOH}$  in a cell having cell constant of  $0.36 \text{ cm}^{-1}$  offered a resistance of  $509\Omega$  at 25°C. Calculate the degree of dissociation of  $\text{CH}_3\text{COOH}$ .
- (c) Derive the Nernst equation for a Galvanic cell.

$$(2+2)+5+3 = 12$$



7. (a) What are the assumptions of the collision theory of reaction rates?
- (b) Explain the salient features of the conductometric titration graph for a precipitation titration, for example KCl vs AgNO<sub>3</sub>
- (c) The standard reduction potentials of the electrodes Fe<sup>3+</sup>, Fe<sup>2+</sup>; pt and Sn<sup>4+</sup>, Sn<sup>2+</sup>; pt at 25°C are respectively +0.77 and +0.15V. Depict the cell, write the cell reaction and calculate the equilibrium constant of the cell reaction.

3+3+6 = 12

GROUP - E

8. (a) Explain glass transition temperature and melting temperature of a polymer.
- (b) Differentiate between thermoplastic and thermosetting polymers.
- (c) What is CNG? What is the critical concentration for the combustion of CNG? Mention the advantages of CNG over gasoline for use in internal combustion engine.

(2+2)+4+(1+1+2) = 12

9. (a) Write structure and uses of Natural rubber and PVC.
- (b) Calculate the mass of air needed for complete combustion of 5kg. of coal sample containing 80% carbon, 15% hydrogen and rest is oxygen. Consider air contains 23% oxygen by weight.
- (c) Define cetane number.
- (d) What is biodiesel? Give the reaction involved in the preparation of biodiesel.

(2+2)+4+1+(2+1) = 12