

- (vi) Lead impurity is removed from the internal combustion engine by adding  
 (a) 1, 2-dibromoethane (b) oxane  
 (c) mercaptan (d) n-heptane.
- (vii) Due to the presence of an unpaired electron, free radicals are  
 (a) chemically inactive (b) chemically reactive  
 (c) cations (d) anions.
- (viii) Polyethylene is an example of  
 (a) random copolymer (b) homopolymer  
 (c) crosslinked copolymer (d) alternate polymer.
- (ix) The unit of rate constant for a nth order reaction is  
 (a)  $\text{mol}^{1-n}\text{litre}^{n-1}\text{sec}^{-1}$  (b)  $\text{mol}^{n-1}\text{litre}^{1-n}\text{sec}^{-1}$   
 (c)  $\text{time}^{-1}$  (d)  $\text{mol}^{1-n}\text{litre}^{n-1}\text{sec}^{-2}$ .
- (x) The pH of a solution is enhanced from 2 to 3. The concentration of  $\text{H}^+$  in the new solution  
 (a) is three times that of original solution  
 (b) is 1.5 times that of original solution  
 (c) is 1/10th that of original solution  
 (d) 10 times that of original solution.

**Group - B**

2. (a) Write, without derivation, the expression for efficiency of a reversible Carnot engine and use this expression for deriving the mathematical definition of change of entropy.  
 (b) One mole of an ideal mono-atomic gas at 27°C expands reversibly and adiabatically from a volume of 10 dm<sup>3</sup> to a volume of 20 dm<sup>3</sup>. Calculate  $\Delta U$  and  $\Delta H$  in Joule. (Assume that  $C_v = 3/2 R$ )  
 (c) The absorption coefficient of a solution of glycogen-iodine complex is found to be 0.20 by using a light of 450 nm wavelength. Calculate the concentration of the solution when the transmission is 40 % in a cuvette of 2 cm.
- (1 + 3) + (2 + 2) + 4 = 12**
3. (a) Establish the condition that  $\Delta G=0$  at equilibrium and use this condition to derive the Clapeyron–Clausius equation for a liquid-vapour equilibrium.

- (b) Explain what is meant by chemical potential and state whether this is an extensive or an intensive property.  
 (c) One mole of an ideal monoatomic gas is heated from 27°C to 227°C and volume expands from 10L to 100L. What is the change in molar entropy (Given  $C_v = 3/2R$ ).  
 (d) Show, using labeled drawings of the water molecule:  
 (i) symmetrical stretching (ii) asymmetrical stretching.
- (2 + 3) + 2 + 3 + 2 = 12**

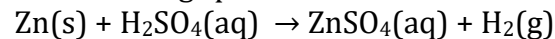
**Group - C**

4. (a) Draw the MO diagram of O<sub>2</sub>. How will you distinguish cis-1, 2 dichloroethene and trans-1, 2 dichloroethene with the help of dipole moment?  
 (b) Discuss Schottky and Frenkel defects with the help of diagrams.  
 (c) "Melting point of maleic acid is lower than that of fumaric acid though they have same molecular formula (HO<sub>2</sub>CCH = CHCO<sub>2</sub>H)" – justify.  
 (d) "Phenolphthalein changes its colour in acidic and alkaline medium" – explain with the help of common ion effect.
- (2 + 2) + 3 + 2 + 3 = 12**
5. (a) Find the approximate pH of the solution formed by mixing equal volumes of solution of 0.1M sodium propanoate and 0.1M Propanoic acid. ( $K_a = 1.3 \times 10^{-5} \text{ mol Dm}^{-3}$ )  
 (b) What are non-stoichiometric defects? Discuss any one of them.  
 (c) S<sub>N</sub>2 reaction occurs with inversion of configuration and S<sub>N</sub>1 reaction occurs with retention of configuration. Why?  
 (d) According to the VSEPR theory with increase in electronegativity of terminal atoms bond angle decrease. But the bond angle in H<sub>2</sub>O molecule is 104.5° while that in Cl<sub>2</sub>O is 111° – explain.
- 3 + (1 + 3) + 3 + 2 = 12**

**Group - D**

6. (a) Derive an integrated rate equation of a zero order reaction and also show that half life period of zero order reaction is directly proportional to the initial concentration.

- (b) State the Kohlrausch's law of independent migration of ions.
- (c) Draw the conductometric titration curve for strong acid (eg. HCl) vs. weak base (eg. NH<sub>4</sub>OH) and explain the salient features of the curve.
- (d) Write the half cell reactions and construct the galvanic cell for the following spontaneous reaction:



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

7. (a) Write short note on any one of the following:  
 (i) Threshold energy (ii) Proper orientation.
- (b) Explain the effect of dilution on equivalent conductance of a strong and a weak electrolyte.
- (c) Derive the Nernst equation for a Galvanic cell.
- (d) Write the factors affecting the magnitude of electrode potential.

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

#### Group - E

8. (a) What is fuel and its calorific value?
- (b) What do you mean by carbonisation? Discuss the differences between HTC and LTC? Why coke is preferred to coal in metallurgical operations?
- (c) What do you mean by critical concentration related to CNG combustion?
- (d) Why PVC is soft and flexible but Bakelite is hard and brittle?
9. (a) What do you mean by knocking? How does TEL function in IC engine? What do you mean by octane number?
- (b) What is sweetening of petrol? Give chemical reaction involved.
- (c) Explain vulcanization of natural rubber. Why vulcanization of raw rubber is necessary?
- (d) Equal number of polymer molecules with molecular weights 100,000 gm/mole and 10,000 gm/mole are mixed. Calculate  $\bar{M}_n$  and  $\bar{M}_w$ .

$$(1 + 2 + 1) + 2 + 3 + 3 = 12$$

### CHEMISTRY - I (CHEM 1001)

Time Allotted : 3 hrs

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
- (i) Hydrolysis of ethyl acetate with a base follows the  
 (a) zero order rate kinetics  
 (b) second order rate kinetics  
 (c) pseudo first order rate kinetics  
 (d) first order rate kinetics.
- (ii) The half life period of a reaction is found to be directly proportional to the initial concentration. The order of the reaction is  
 (a) zero (b) one (c) two (d) three.
- (iii) Which one of the following is not a primary fuel?  
 (a) Wood (b) Natural gas  
 (c) Coke (d) Crude oil.
- (iv) Which of the following has least bond angle?  
 (a) NH<sub>3</sub> (b) H<sub>2</sub>O (c) CH<sub>4</sub> (d) BeF<sub>2</sub>.
- (v) Van der Waals type of bond is formed by  
 (a) sharing of electrons  
 (b) transfer of electrons from one atom to the other  
 (c) sharing of electrons by one atom only  
 (d) weak electrostatic force of attraction among fluctuating dipoles.