2015

CHEMISTRY I

(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 alternatives for the following : **[10×1=10]**

   i) Which statement is not correct regarding reversible process?

   (a) it is imaginary process
   (b) it takes infinite time
   (c) Work obtained is maximum
   (d) it is sponteneous

   ii) Entropy of an ideal gas depends upon its

   (a) Pressure (b) Temperature
   (c) Both (a) and (b) (d) Neither (a) nor (b)

   iii) If the vapour pressure at two temperatures of a solid phase in equilibrium with its liquid phase are known, then the latent heat of fusion can be calculated by the

   (a) Maxwell's equation
   (b) Clayperon Claussius equation
   (c) Van Laar equation
   (d) Nernst Heat Theorem

   iv) Which of the following has zero dipole moment?

   (a) PF_3Cl_2 (b) XeO_3F_2
   (c) SF_4 (d) ClF_3

   v) Which of the following polymers is used for preparing overhead tanks for water storage?

   (a) PET (b) LDPE
   (c) HDPE (d) Teflon

   vi) The half-life of a first order reaction is 20 minutes. The time required for 75% completion of the reaction is

   (a) 30 minutes (b) 40 minutes
   (c) 50 minutes (d) 60 minutes

   vii) The conductance and specific conductance of a solution is the same if the cell constant is

   (a) 0 (b) 1
   (c) 10 (d) 100

   viii) Which type of radiation has the highest energy?

   (a) UV (b) IR
   (c) Microwave (d) X-ray

ix) The electrophilic substitution in aromatic ring involve the formation of

(a) Two σ-complex, one π-complex

(b) Two π-complex, one σ-complex

(c) One σ-complex, one π-complex

(d) None of these

x) The molecule having see saw structure is

(a) XeF_4 (b) SiF_4

(c) SF_4 (d) CF_4

GROUP - B

2. (a) What do you mean by a reversible & irreversible process? Prove that for a reversible adiabatic process PV^{γ} = Constant.

(b) A sample of gas initially at 25°C is compressed from 50 L to 5 L adiabatically and reversibly. Calculate the final temperature (C_V = 10 Cal. Mol^{-1})

(c) What is the relation between internal energy and enthalpy? Describe the expression for change in enthalpy for ideal gas.

(d) How is electronic spectra obtained? Write down mathematical form of Lambert-Beer Law.

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

3. (a) What do you mean by Carnot cycle? Show that for an ideal gas P-V curve for adiabatic reversible process is steeper than that for isothermal reversible one.

(b) State the 2nd law of thermodynamics. Why a heat engine can not have 100% efficiency? What is Helmholtz work function(A)?

(c) Explain what is meant by chemical potential? Derive Gibbs Duhem relations.

(d) What are the objectives of IR spectroscopy?

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

GROUP - C

4. (a) Arrange the trihalides of phosphorus according to the decreasing order of bond angles and justify using VSEPR theory.

(b) Calculate the pH of a solution made by mixing 50 ml of 0.01(N) NaOH solution with 50 ml of water.

(c) Derive an expression between dissociation constant of a weak monobasic acid and its degree of dissociation in aqueous solution.

(d) Give the stepwise mechanism involved in the addition reaction of HBr to propene in presence of benzoyl peroxide.

(e) Why phenolphthalein is not a suitable indicator for the titration of ammonium hydroxide with HCl?

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

5. (a) Give a brief comparison of the salient features of SN1 and SN2 mechanism.

(b) Arrange the ortho halophenols according to their decreasing order of acidity and justity your answer.

(c) Draw the molecular orbital energy level diagram of N_2

(d) Differentiate between Schottky and Frenkel defects with the help of diagram.

3+3+2+4 = 12

Group - D

6. (a) Distinguish between 'order' and 'molecularity' of a reaction.

   (b) If 25% of a certain second order reaction is completed in 5 minutes, find out the half-life period. The reaction was started with equi-molar mixture of the reactants.

   (c) The limiting equivalent conductances of KCl, KNO_3 and $AgNO_3$ are 149.9, 145.0 and 133.4 $ohm^{-1}\ cm^2\ eq^{-1}$ at 25°C. Calculate the limiting equivalent conductance of AgCl at this temperature.

   (d) Construct galvanic cell and calculate the emf at 25°C from the following pair of half-cells.

   $Pb(s)|PbCl_2(1M)$, $\quad E^0_{Pb^{2+}|Pb} = -0.13V$

   $Fe(s)|FeSO_4(1M)$, $\quad E^0_{Fe^{2+}|Fe} = -0.44V$

   3+3+3+3 = 12

7. (a) Deduce the expression for the rate constant of a second order reaction where the initial concentrations of the two reactants are not same and from that expression show that if concentration of one of the reactants is much higher than the other, it follows a first-order rate law.

   (b) Define specific conductance and equivalent conductance. Show how are they related?

   (c) What are the differences between an electrolytic cell and galvanic cell?

   (3+2)+3+4 = 12

GROUP - E

8. (a) 500 gm of a polymer with molecular weight 10^4 gm/mole is mixed with 1000 gm of another polymer of molecular weight 10^5 gm/mole. What is the ratio of M_W/M_n.

   (b) Explain vulcanization of rubber.

   (c) Explain why thermosetting resins cannot be reused and reshaped?

   (d) Define B.Th.U and C.H.U.

   (e) What are the main constituents of LPG? What is the source of the foul smell during the leakage of LPG?

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

9. (a) What is tacticity? Classify polymers based on its tacticity by taking suitable examples.

   (b) Outline the procedure and reaction involved in percentage analysis of a coal sample by Kieldahl method.

   (c) Define octane number.

   (d) What do you meanby GCV and NCV of a solid fuel?

   (1+3)+4+2+2 = 12
