2016

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 x 1=10]

i) If the temperature of both the heat source and sink are increased by the same amount, then the efficiency of the carnot engine would

   a) increase   b) decrease   c) remain the same

   d) may increase or decrease depending on the nature of the working substance

ii) The major product obtained when 2-bromobutane is treated with ethanolic KOH is

   a) trans-2-butene   b) cis-2-butene
   c) 1-butene   d) 2-butanol

iii) Which of the following is not a buffer solution ?

   a) $NH_4Cl + NH_4OH$ b) $CH_3COONa + CH_3CHOOH$
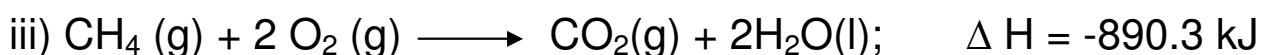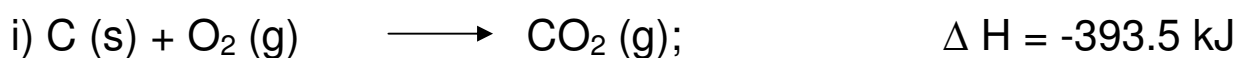
   c) $NaOH + HCL$ d) $HCOONa + HCOOH$

iv) Consider a P-V diagram for the isothermal and adiabatic expansion of an ideal gas. The slope for

a) isothermal is P-V and adiabatic is $+\gamma P/V$

b) isothermal is $+(P/V)^{\gamma}$ and adiabatic is $-\gamma P/V$

c) isothermal is $-P/V$ and adiabatic is $-\gamma P/V$

d) isothermal is $+P/V$ and adiabatic is $(P/V)^{\gamma}$

v) In a solution of $AgNO_3$, speed ratio of Ag^+ and NO_3^- is 0.84; the transport number of NO_3^- will be

a) 0.16   b) 0.46   c) 0.84   d) 0.54

vi) The half-life period for a reaction is independent of initial concentration, choose the correct order of the reaction from the following:

a) zero order b) first order   c) second order   d) all of the above

vii) An example of step-growth polymer is

a) PVC   b) Teflon   c) Bakelite   d) Poly-butadiene

viii) Which ion has the greatest ionic mobility ?

a) Na^+ b) H_3O^+ c) Li^+ d) K^+

ix) The boiling point of p-nitro phenol is greater than that of o-nitro phenol because of

a) ionic bonding   b) intermolecular H-bonding

c) Vander waals attractive force   d) intramolecular H-bonding

x) An essential condition for a molecule to be IR active is

a) molecule should be polar

b) molecule has an oscillating dipole moment

c) molecule has a permanent dipole

d) none of these

GROUP - B

2 a) What do you mean by a reversible & irreversible process? Prove that for a reversible adiabatic process $TV^{\gamma-1}$ = constant.

b) Calculate the enthalpy of formation of methane from the following data:

   i) $C (s) + O_2 (g) \longrightarrow CO_2 (g)$; $\Delta H = -393.5$ kJ

   ii) $H_2 (g) + 1/2 O_2 (g) \longrightarrow H_2O (l)$; $\Delta H = -286$ kJ

   iii) $CH_4 (g) + 2 O_2 (g) \longrightarrow CO_2(g) + 2H_2O(l)$; $\Delta H = -890.3$ kJ

c) Define work function and free energy .

d) On passing monochromatic light through a 0.01(M) solution in a cell of 1cm thickness, the intensity of the transmitted light was reduced to 10%. Calculate the molar extinction coefficient.

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

3 a) Gibbs free energy is defined as G= H-TS. Define each term of this equation and obtain the Gibb's Helmoltz equation in terms of Δ G and its temperature coefficient.

b) Calculate Δ G, Δ H and Δ S for expansion of 1 mol of an ideal gas at 27ºC from 10 to 100 dm^3.

c) What are the different electronic transitions? Explain with diagram.

3+4+2+3=12

GROUP - C

4 a) What do you understand by imperfections in ionic crystals? Name the type of imperfections which generally occur in ionic crystals.

b) Discuss the role of solvents in $_{SN}1$ reaction.

c) What are the roles of silicon and germanium in the field of semiconductor?

d) Comment on the stability of N_2, N_2^+ and N_2^- on the basis of MO theory.

e) What will be the pH of a buffer solution produced by mixing equal volumes of 0.01(M) NH_4Cl solution and 0.1(M) NH_4OH solution ($pK_b=5$) ?

2+3+2+3+2=12

5   a) Arrange the hydrides of group-16 (O, S, Se,Te) in decreasing order of their boiling point and give explanation for your answer.

b) What do you mean by metal excess defect? Explain with diagram.

c) Do you expect the pH of pure water at 100ºC to be less than 7 or more than 7 ? Explain your answer.

d) Predict the product(s) obtained when ethyl acetate is heated at 500ºC in a sealed tube. Name the reaction mechanism involved.

e) Show the reaction involved with mechanism when isobutyl chloride is treated with aqueous NaOH solution.

(1+2)+3+2+(1+1)+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 half decomposition is inversely proportional to the initial concentration.

b) The equivalent conductance at infinite dilution (Λ_o) of HCl, CH_3COONa and NaCl are 426.16, 91.0 and 126.45 ohm^{-1}cm^2 eq^{-1} at 25ºC. Calculate Λ_o of CH_3COOH.

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

3+4+2+3=12

7   a)   Discuss any one of the following in connection with a chemical reaction: (i) effective collision, (ii) proper orientation of the colliding species, (iii) activation energy.

     b)   Calculate the activation energy of a reaction whose rate constant is doubled when the temperature is increased from 300K to 310K.

     c)   Define specific conductance and equivalent conductance. How are they related?

     d)   Draw the conductometric titration curve for strong acid (eg HCl) vs strong base (eg NaOH) and explain the salient features of the curve.

     e)   What are reference electrodes?

2+2+3+3+2=12

GROUP-E

8   a)   Calculate the mass of theoretical air needed for complete combustion of 10kg of coal sample containing 75% carbon, 15% hydrogen and rest oxygen. Consider air contains 23% oxygen by weight.

     b)   Write down the differences between thermoplastics and thermosetting polymers.

     c)   Explain glass-transition temperature (T_g) of a polymer.

     d)   Write the structural unit and two important applications of each of the following:

           (i) Teflon   ii) Bakelite

4+2+2+4=12

9   a) Define number average molecular weight with mathematical expression.

b) Classify polymers based on tacticity taking a suitable example.

c) What is vulcanization ?

d) Deduce a relation between GCV and NCV of a coal sample. Distinguish between HTC and LTC.

e) What do you mean by knocking? How would you remove Pb impurity from internal combustion engine using fuel containing TEL?

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

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