Question Paper

Exam Date & Time: 29-Nov-2019 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATION NOVEMBER/DECEMBER 2019
II SEMESTER B.Sc.(Applied sciences) in engg.
Chemistry [ICH 121]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

1) A) i Define lattice energy. How it is calculated for an ionic crystal using Born Haber cycle? (4)

ii Mention the factors governing the formation of ionic bond. Write two characteristic features of these compounds. (4)

B) i Distinguish between the conductors, semiconductors and insulators based on band theory of solids. (4)

ii Explain the following with suitable example (4)
a) Ionic product of water
b) common ion effect

C) Show that t ½ of a first order reaction is independent on the concentration of the reactant.A buffer solution contains 0.50 M acetic acid and 0.50 M sodium acetate at 25 ºC. Calculate the pH. (Given K_a for acetic acid $=1.74\times10^{-5}$ at 25 ºC). (4)

2) A) i Define energy of activation? Explain how energy of activation is determined using Arrhenius equation. (4)

ii State the law of mass action.Apply Le-Chaterlier's principle to find out the effect of temperature and concentration on the following systems: (4)

$$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g) + X \text{ cals.}$$

B) i Calculate the degree of hydrolysis of 0.10 M sodium acetate at 25 ºC. Give $k_a=1.75\text{x}10^{-5}$ and $K_w= 1.008\text{x}10^{-14}$. Calculate the pH and pOH of 0.03 M solution of HCl at 25 ºC. (4)

ii Explain the construction and working of Weston cadmium cell. Write any two advantages and disadvantages. (4)

C) Deduce a relation between hydrolysis constant (K_h) and dissociation constants of acid (K_a) and base (K^b) for a salt weak acid and weak base. (4)

3) State law of mass action. Derive the relation between K_p and K_c. (4)

A) i

ii Explain the sp^3 hybridization for the formation of methane molecule. What is the shape of the molecule? (4)

B) Derive Gibb's Helmholtz equation in term of Gibb's free (4)

i

ii Give an example for acidic buffer and basic buffer. Explain the buffering action when small amounts of acid and base is added to it. (4)

C) The emf of a cell, $Mg \mid Mg^{2+}$ (0.01M) $\| Cu^{2+}$ (1M) $\mid Cu$, is measured to be 2.78V at 298K.The standard electrode potential of magnesium electrode is – 2.37 V. Calculate the electrode potential of Copper electrode. Write the cell reactions. (4)

4) Derive Nernst equation for electrode potential. (4)

A) i

ii The cell Ag |AgCl | HCl (0.1 N) |Glass |Buffer ||saturated calomel gave emf values 0.112 V and 0.186 V with buffer having pH 4.0 and unknown pH buffer solution respectively. What is the pH value of the unknown solution? Find out the emf of the cell when pH=2.5. (4)

B) Describe the structures of H_2O and NH_3 molecules in terms of VSEPR (4)

i theory. Explain the decrease in bond angle from NH_3 to H_2O.

ii What is hydrogen bonding ? Explain an intra-molecular and intermolecular hydrogen bonding. (4)

C) Calculate the entropy change involved in the isothermal reversible expansion of 5 moles of an ideal gas from a volume of 10 litres to a volume of 100 litres at 300 K. (4)

5) What is rate of reaction? Explain the factors which effect the rate reaction. (4)

A) i

ii Differentiate the following (4)
a) Homogeneous and heterogeneous system
b) Dipole-dipole interaction and dipole-induced dipole interaction

B) What is VSEPR theory of molecular model? Explain with suitable examples (4)

i

ii Explain the transition state theory of bimolecular reactions. (4)

C) The solubility of silver chloride in water at 25°C is 0.00179 g /L. Calculate its solubility product at 25° C. List two applications of solubility product principle. (4)

6) For the reaction, $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$. Calculate ΔH^0_{rxn} from ΔH^0_f values. Given: $\Delta H^0_f\ NO(g) = 90.3$ kJ/mol, $\Delta H^0_f\ H_2O(g) = -241.8$ kJ/mol, $\Delta H^0_f\ NH3(g) = -45.9$ kJ/mol (4)

A)

i

ii State and explain the first law of thermodynamics (4)

B) What is a glass electrode? Explain the origin of potential of glass electrode. (4)

i

ii Explain the physical significance and calculation of absolute entropy. (4)

C) What are the conditions for an electrochemical cell to act as a standard cell? (4)

7) Describe the construction and working of Calomel electrode. Why it is called a secondary electrode (4)

A) i

ii What is resonance? Draw the resonance structures of NCO- ion. (4)

B) For an ideal gas, show that $C_p - C_v = R$. (4)

i

ii What is liquid junction potential? How does it arise? How can it be avoided? (4)

C) Define the terms: degree of hydrolysis and hydrolysis constant? Deduce the relation between them for a salt of strong acid and weak base (4)

8) Explain Morkovnikov's rule and metamerism with an example (4)

A) i

ii How does Molecular Orbital Theory explain the bond order of CO and N_2 molecules. (4)

B) Explain geometrical isomersm in alkenes. (4)

i

ii Differentiate between heat capacity, specific heat capacity and molar heat capacity.Write their units. (4)

C) Draw the structure of each of the following compounds. (4)
(a) 4- fluorotoulene
(b) 4, 6-Diethyl-2-methyloctane
(c) 2, 3-dimethylbutane
(d) 2-isopropyl hexane

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