Date: 26.09.2007

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering
1st Year 1st Semester Final Examination (Spring 2007)
Course No.: Chem-115. Course Title: Chemistry
Full Marks:70 Time: 3 Hours

There are 8(eight) questions. Answer any 5(five) questions.

Marks allotted are indicated in the margin.

1. a) Explain the Rutherford's solar system atom model. Why it was necessary to modify? 3

   b) State the postulates of Bohr atom model. With the help of these postulates derive the equation $\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$. Where the symbols are of their usual meaning. 4

   c) What are the four quantum numbers? Write down their physical significances. 3

   d) Calculate the wavelength of light emitted from hydrogen atom for the electronic transition from energy level, n = 3 to n = 2 using $R = 109600 cm^{-1}$. 4

2. a) In connection with the molecular orbital theory define the terms. 4
   i) Bonding molecular orbital
   ii) Anti-bonding molecular orbital
   iii) Bonding electron
   iv) Anti-bonding electron

   b) For the formation of N_2 and O_2 molecules 6
   (i) Draw the molecular orbital diagrams
   (ii) Write down their molecular electronic configurations
   (iii) Calculate the bond orders and
   (iv) Comment on their magnetic properties

   c) Explain SP , SP^2 and SP^3 hybridizations taking examples of Be, B and C atoms respectively. 4

3. a) Discuss the "electron sea model" of metallic bonding. Based on this model, explain why the metals are
   i) good conductors of electricity (ii) good conductors of heat (iii) malleable and ductile. 3×2 = 6

   b) Compare the properties of electrovalent and covalent compounds. 4

   c) Explain with examples, the formation of electrovalent, covalent and coordinate covalent bond. 4

4. a) What do you mean by the term "heat of reaction" ? Establish a relation between heat of reaction at constant pressure and that at constant volume. 4

   b) How could you calculate the standard heat of reaction from standard heat of formation? 2

c) The heat of neutralization of a strong acid and a strong base is found to be nearly the same in all cases-Explain why? 4

d) Calculate the heat of formation of benzene at 25^0C, if the heat of combustion of benzene, carbon and hydrogen are – 780.98, -74.05 and -68.32 kcal respectively at 25^0C. 4

5. a) Derive an expression for the elevation of boiling point of a liquid when a non-volatile solute is dissolved in it and explain how would you calculate the molecular weight from the elevation of boiling point. 5

b) State the laws osmotic pressure and explain how the laws are closely related to the gas laws. 5

c) The molecular weight of a water soluble non-electrolyte solute is 58. Compute the boiling point if the solution contains 24 g of the solute and 600 g of water at atmospheric pressure (k_{1000} for water = 0.573). 4

6. a) Differentiate between 'order' and 'molecularity' of a reaction. 2

b) Deduce the equation for the rate constant of a first order reaction and derive the expression for half-change. 6

c) Explain, why a first order reaction is never completed. 2

d) In a first order reaction half of the reactant is decomposed in 1000 seconds. How long will it be until only one-third of the reactant is left? 4

7. a) State and explain the law of mass action and derive the relation between K_p and K_c. 4

b) Explain how the equilibrium constant changes with temperature? 2

c) Derive an expression for the equilibrium constant of the reaction N_2O_4 (g) $\rightleftharpoons 2NO_2$(s) in term of partial pressures. 4

d) Five moles of PCl_5 were found to be 60% dissociated at 227^0C in a vessel of 5-litre capacity. Calculate K_p and K_c for the reaction. 4

8. a) How would you establish the p^H scale from the ion product of pure water at 25^0C? 5

b) How many phases and components are present in each of the following systems? 3
(i) Ice, water and steam are in equilibrium.
(ii) A mixture of oxygen and nitrogen gasses
(iii) Aqueous solution of NaCl.

c) Write at least on important use of the following inert gases. 4
(i) He (ii) Ne (iii) Ar (iv) Kr

d) Give an example of each of the following important organic reactions. 2
(i) Substitution (ii) Addition (iii) Elimination (i) Rearrangement.

Date: 03.11.2007

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

1st Year, 1st Semester Clearance/Improvement/Carry Over Examination (Spring 07)

Course No: Chem 115, Course Title: Chemistry

Full Marks: 70 Time: 3 Hours

There are 8 (eight) questions. Answer any 5 (five) questions.

Marks allotted are indicted in the margin.

1. (a) Give experimental evidences that i) the nucleus of an atom is positively charged: ii) the nucleus of an atom occupies a very small volume and iii) the electrons are negatively charged and they occupy a vast space surrounding the nucleus. 6

   (b) State Ratherford's solar system atom model and explain the reasons for modification of this model. 4

   (c) Write down the electronic configuration of the following (i) Mg^{+2} (ii) Cr (iii) Sc and (iv) Ar 4

2. (a) State periodic law. Classify the elements of the periodic table on the basis of the electronic configuration. 4

   (b) Discuss the variation of properties of the elements within groups and periods. 6

   (c) Write with examples, the formation of (i) electrovalent (ii) Covalent and (iii) Coordinate covalent bond. 4

3. (a) The heat evolved or absorbed in a given reaction must be independent of the manner in which the reaction is brought about-justify the statement. 5

   (b) How does the 'heat of reaction' vary with temperature? Mention Kirchoff's equation in this connection. 5

   (c) The heat of combustion of methane is -212 Kcals. If the heats of formation of carbondioxide and water are -94.3 Kcals and -68.5 Kcals respectively. Calculate the heat of formation of methane. 4

4. (a) Define the rate of reaction in terms of concentration. 3

   (b) Derive the integrated rate laws for the following reactions. (i) $A \rightarrow P$ (ii) $2A \rightarrow P$ 5

   (c) Define the half life of a reaction and relate it to reaction order. 3

   (d) The half life of a first order reaction is 10 min. Calculate the specific rate constant. 3

5. (a) What are the Colligative Properties? Deduce an expression relating the molecular weight of a solute with the lowering of vapour pressure of the solution. 6

   (b) Describe briefly the experimental details of the cryoscopic method. 4

(c) 10g of urea is dissolved in 100 gm of water. If the vapour Pressure of water at the working temperature is 27.32 mm Hg, what will be the vapour pressure of the solution? 4

6. (a) State the law of mass action. Establish the relation between K_p and K_c. Explain, with the help of Le Chatelier's principle, the effect of temperature and pressure on the reaction. 7

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + 21.4\ Kcal$$

(b) What are the factors that influence the chemical equilibrium? 3

(c) Discuss the mathematical equations that show the relation of the equilibrium constant to temperature. 4

7. (a) Define the terms phase, component and degrees of freedom. 4

(b) Describe the mono component system water with the help of the phase diagram. Show the various zones in the diagram. 6

(c) How many phases and components are present in each of the following systems? 4

i) ice $\rightleftharpoons$ water $\rightleftharpoons$ steam
ii) a mixture of oxygen and nitrogen gases
iii) aqueous solution of sodium Chloride
iv) saturated solution of sodium Chloride in contact with solid sodium Chloride.

8. (a) What do you mean by dynamic equilibrium? Give at least one evidence of the existence of dynamic equilibrium in a saturated solution. 4

(b) Discuss the mechanism of dissolution of sodium Chloride in water and show theoretically how the evolution and absorption of heat arises. 4

(c) By how many ways you can express the percent composition of solution? 2

(d) A solution contains 25% water, 25% ethanol and 50% acetic acid by weight. Calculate the mole fraction of each component. 4

Date: 27.03.2007

Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

1st Year 1st Semester Final Examination (Fall-2006)

Course No.: Chem-115, Course Title: Chemistry

Time: 3 Hrs.

Full Marks: 70

There are 8 (eight) questions. Answer any 5 (five) questions.

Marks allotted are indicated in the margin.

1. (a) Discuss quantum numbers with their significance. 6
   (b) Write the limitations of Bohr model. 3
   (c) What are the differences between orbit and orbital? 3
   (d) Write the possible values of four quantum number for the electron in 3rd orbit. 2

2. (a) What is a chemical bond? Why does a chemical bond form between atoms? 5
   (b) Explain SP^2, SP^3 and SP^3d hybridization with example. 6
   (c) Write M.O. structure for He_2, N_2. 3

3. (a) Derive Gibbs phase rule. 2
   (b) Explain Salient features of phase diagram of a monocomponent system (H_2O). 6
   (c) Indicate degree of freedom of given reactions– 3

   (i) $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$;

   (ii) Ice $\rightleftharpoons$ water $\rightleftharpoons$ Vapour;

   (iii) Ice $\rightleftharpoons$ water.

   (d) What are homogeneous and heterogeneous system? 3

4. (a) Discuss Markovnikov and anti Markovnikov addition of alkene. 4
   (b) What type of aldehyde undergo Aldol condensation? Give example. 2
   (c) Derive K_p and K_c for the given reaction – 5

   $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

   (d) Calculate K_c of the reaction $A+B \rightleftharpoons 2C$, where initial concentration of A and B is 2 mole/litre and equilibrium concentration of C is 0.32 mole/litre. 3

5. (a) What are the differences between order and molecularity? 3
   (b) What is 2nd order reaction? Derive rate expression for 2nd order reaction having same initial concentration of reactants. 5
   (c) For decomposition of Acetaldehyde a plot of logK Vs 1/T gives a straight line having slope-5070K. Calculate E_a. 3
   (d) Explain exothermic and endothermic reaction (with diagram) in terms of transition state theory of reaction rate. 3

6. (a) Define enthalpy and internal energy of a system. Give their relation. 3
(b) The standard heat of formation of $C_2H_5OH(l)$, $CO_2(g)$ and $H_2O(l)$ are-277.0,-393.5 and –285 KJ. Calculate heat change for the reaction. 4

$$C_2H_5OH(l) + 3O_2(g) \rightleftharpoons 2CO_2(g) + 3H_2O(l)$$

(c) Heat of neutralization of strong acid and strong base is nearly same in all case. Explain it. 3
(d) Compare size of any element M with M^+ and M^- with respect to periodic variation. 4

7. (a) What are colligative properties? Why are they called so? 4
(b) Explain VantHoff's law of osmotic pressure. 3
(c) Define lowering of vapour pressure and relative lowering of vapour pressure. 3
(d) 5 g of NaCl was dissolved in 1000 g of water, where density of solution is 0.997 g/ml. Calculate its molality and molarity. 4

3.5×4=14

8. Write short notes on any 4 (four):
(a) Pyrolysis
(b) Buffer solution
(c) Limitations of periodic table
(d) Arrhenius equation
(e) Properties of inert gas
(f) Bond order.