JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATION 2012/2013

1ST YEAR 1ST SEMESTER EXAMINATION FOR BACHELORS (REGULAR)

COURSE CODE: SCH 101/SCH 3111

TITLE: BASIC PHYSICAL CHEMISTRY

DATE: 23/4/2013 **TIME: 9.00-11.00AM**

DURATION: 2 HOURS

INSTRUCTIONS

1. **Answer ALL questions in Section A**
2. **Answer ANY two Questions from Section B**
3. **Use illustrations where possible**

Useful information

1 Faraday = 96500 coulombs
Volume of molar mass of gas at s.t.p =22.4 dm^3 = 22400 cm^3
Gas constant =0.082 L atm K^{-1} mol^{-1}= 8.314 J $K^{-1}mol^{-1}$

SECTION A:

Answer all questions (30 marks)

QUESTION 1

(a) With reference to any **FIVE** schools of thought, define the term 'Physical Chemistry.'(5 marks)

(b) Distinguish between each of the following pairs of terms: (6 marks)

(i) Isobar and Isotherm
(ii) Gas and reaction stoichiometry
(iii) Spontaneous and non-spontaneous reaction
(iv) Velocity constant and rate equation

(c) Give any **FIVE** postulates of the Kinetic theory. (2½ marks)

(d) 707 cm^3 of an unknown gas diffuses through a porous plug within the same time as it takes 250 cm^3 of oxygen to diffuse under the same conditions of pressure and temperature. Calculate the relative molecular mass of the unknown gas. (Hint; RMM of O_2 = 32). (4 marks)

(e) Briefly discuss any **FIVE** factors that can affect the rate of a chemical reaction (10 marks)

SECTION B: ANSWER ANY TWO QUESTIONS FROM THIS SECTION- EACH QUESTION CARRIES 20 MARKS

QUESTION 2

(a) Derive the ideal gas law. (4 marks)
(b) The density of a gaseous compound was found to be 1.23g L^{-1} at 330k and 150Torr. What is the molar mass of the compound? (6 marks)
(c) State Dalton's law of partial pressures. (2 marks)
(d) The rate of decomposition of azomethane was studied by monitoring the partial pressure of the reactant as a function of time. The data obtained at 300°C are given below:

Time (s)	Partial pressure of azomethane (mmHg)
1	284
100	220
150	193
200	170
250	150

Determine the rate constant for this reaction and verify whether the reaction is of order 1.
8 marks)

QUESTION 3

(a) Consider the reaction

$$2NO_{2(g)} \rightleftharpoons N_{2(g)} + 2O_{2(g)}$$ which is exothermic.

A vessel contains $NO_{2(g)}$, $N_{2(g)}$ and $O_{2(g)}$ at equilibrium. Explain briefly how each of the following stresses will affect the equilibrium position.

(i) $O_{2(g)}$ is added (2marks)
(ii) $NO_{2(g)}$ is added (2marks)
(iii) $N_{2(g)}$ is removed (2marks)
(iv) The volume is halved (2marks)
(vi) The temperature is increased (2marks)

(b) The molar conductivity of 0.100 M KCl (aq) at 298 K is 129 Scm^2Mol^{-1}. The measured resistance in a conductivity cell was 28.44 Ω. The resistance was 31.60 Ω when the same cell contained 0.0500 M NaOH (aq). Calculate the molar conductivity of NaOH (aq) at that concentration. (10marks)

QUESTION 4

(a) Define the following terms: (10 marks)

(i) Equilibrium constant
(ii) Colligative properties
(iii) Order of a reaction
(iv) Molar conductivity
(v) Molecularity

(b) Explain each of the following statements:

(i) Gases are more compressible than liquids.
(ii) Liquids diffuse very slowly.
(iii) If a catalyst did affect K_c/K_p, it would defy the law of conservation of energy. (3 marks)

(c) What is a redox reaction? Explain using an example. (3 marks)

(d) The lowering of vapour pressure of a solution of 108.2 g of a substance X in 1 Kg of water at 20°C is 24.79 Nm^{-2}. The vapour pressure of water at this same temperature is 2.338 kNm^{-2}. Calculate the RMM of X. (4 marks)

QUESTION 5

a) 5 moles of ethanol, 6 moles of ethanoic acid, 6 moles of ethylacetate and 4 moles of water were mixed together in a stoppered bottle at 15°C. After equilibrium was attained, the bottle was found to contain only 4 moles of the acid.

(i) Write the chemical equation for the reaction. (2marks)

(ii) Give the expression for the equilibrium constant for the reaction. (2 marks)

(iii) How many moles of ethanol, ethylacetate and water were present in the equilibrium mixture? Explain your answer. (2 marks)

(iv) If 1 mole of ethylacetate was added after the equilibrium was established, what would happen? (2 marks)

(v) Explain the term "dynamic equilibrium". (2 marks)

b) Two flasks of equal volumes are connected by a narrow tube of negligible volume. Initially, both flasks are 27°C and contain 0.70 moles of H_2 gas, the pressure being 0.50 atm. One of the flasks is then immersed in a hot oil bath at 127°C while the other is kept at 27°C. Calculate the final pressure and the moles of H_2 in each flask. (10 marks)

E*******N**********D***