JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF HEALTH SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMMUNITY DEVELOPMENT AND PUBLIC HEALTH

1ST YEAR 1ST SEMESTER 2013/2014 ACADEMIC YEAR

KISUMU L.C

COURSE CODE: SCH 3111

COURSE TITLE: PHYSICAL CHEMISTRY

EXAM VENUE:LR **STREAM: (BSc. CH & D/PH)**

DATE: 12/8/14 **EXAM SESSION: 2.00 – 4.00PM**

TIME: 2 HOURS

Instructions:

1. **Answer questions 1 in and any other 3 questions .**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

Answer question ONE and any other THREE questions in this question paper

1. (a.) Define the following terms

i) Chemical equilibrium (1mark)

ii) Reversible reactions (1mark)

iii) Equilibrium constant (1mark)

iv) Isolated system (1mark)

v) Exothermic process (1mark)

vi) Entropy (1mark)

(b.) i) State the Chaterliers Principle (2marks)

ii) Consider the following equation

$N_2 (g) + 3H_2 (g) \leftrightharpoons 2NH_3 (g)$

What is the effect of increasing pressure to this equation? (2marks)

2.(a.) Dimerization of butadiene is second order:

$$2\ C_4H_6\ (g) \longrightarrow C_8H_{12}\ (g).$$

The *rate constant k*at some temperature is 0.100 /min. The initial concentration of butadiene [B] is 2.0 M.

i) Calculate the *time t* required for [B] = 0.5 M (5marks)

ii) Calculate concentration of butadiene when *t* = 30minutes. (5marks)

(b.) Starting from the ideal gas equation show that

$Kp = Kc(RT)^{-2}$ (4marks)

(c.) The equilibrium constant for a reaction at 620K is 2mol/dm^3

i) What is the value of K_P of this reaction at 620K (R=0.082atm/K/mol) (3marks)

ii) What are the units of K_P in this reaction (3marks)

3. (a) The Table below shows the variation of the product of pressure and volume (PV) with pressure for hydrogen at 0^{o}C and carbon dioxide at 40^{o}C.

Pressure in atms	**PV in atm cm^3**	
	H_2 at 0^{o}C	**CO_2 at 40^{o}C**
1	1.000	1.000
50	1.033	0.741
100	1.064	0.270
200	1.134	0.409
400	1.277	0.718
800	1.566	1.299

(i) Plot a graph of PV against P for both gases and the ideal gas on the same set of axis. (10 marks)

(ii) Explain the shapes of the curves. (3 marks)

(b) One mole of carbon dioxide was found to occupy 1.32 litres at 48^oC and a pressure of 18.40 atms. Calculate the pressure that would have been expected:

(i) From the ideal gas equation (3 marks)

(ii) From Van der Waals equation:
($a = 3.60\ L^2\ atm.mol^{-2}$, $b = 4.28 \times 10^{-2}\ Lmol^{-1}$,
$R = 0.082\ L\ atm\ K^{-1}mol^{-1}$) (4 marks)

4. (a) (i) Define the term reaction quotient as used in chemical equilibria. (2 marks)

(ii) Explain the importance of the reaction quotient. (4 marks)

(b) For the reaction $N_2\ (g) + 3H2\ (g) \leftrightharpoons 2NH_3\ (g)$, K_c is 69 at 500^oC. Analysis of a 10 litre container of the equilibrium mixture at 500^oC revealed the presence of 4.0 moles of H_2, and 5.0 moles of NH_3.

(i) Calculate the number of moles of N_2 in the container; (4 marks)

(ii) Calculate $K_P$for the equilibrium mixture. (3 marks)

(c) For the reaction: $SO_2\ (g) + NO_2\ (g) \leftrightharpoons SO_3\ (g) + NO\ (g)$, $K_c = 9.00$ at 973 K. If 1.00 mole of SO_3 and 1 mole of NO are injected into a 1.00 litre flask at 973 K:

(i) Predict the direction in which the reaction would proceed; (2 marks)

(ii) Determine the concentration of all the species in the equilibrium mixture. (5 marks)

5. (a) State the first and second law of thermodynamics (4 marks)

(b) For the reaction:
$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCO_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$
Calculate the change in internal energy Δu (ΔH^o = - 217 KJ). (4 marks)

c) Show that $dH=(dq)_p$ (3marks)

d) The reaction:

$2\ NO_2\ (g) \longrightarrow 2NO\ (g) + O_2\ (g)$

The rate constant $k= 1.0\times10^{-10}s^{-1}$ at 300 K and the activation energy $E_a = 111\ kJ\ mol^{-1}$. What are A, k at 273 K and T when $k = 1\times10^{-11}$. (9marks)