TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BTRE, BTAP, BMLS, BSEH AND BSFO-16S

ACH 4109: PHYSICAL CHEMISTRY

SPECIAL /SUPPLEMENTARY EXAMINATION

SERIES:AUGUST2017

TIME:2HOURS

DATE: Pick DateSep2017

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Answer question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Use the following Data where applicable.

$0^oC = 273K$, N = 14, O = 16, C = 12, H= 1

$R = 8.314\ JK^{-1}mol^{-1} = 0.08206$ or $0.0821\ L\ atm\ K^{-1}\ mol^{-1}$

Question ONE

a) State and explain three factors that determine the rate of reaction (6 marks)

(b) A 3.00 litre Helium gas container at 33^oC is corked with a piston whose pressure is 4.15 atm. If the piston is slightly lifted to attain a new pressure of 665mmHg, the temperature of the Helium gas drops to 15.0 ^oC .Determine the final volume of the gas (4 marks)

(c) Calculate:

(i) The mass of ammonia gas enclosed in a 0.5 litre flask at 30 ^0C that exerts a pressure of 5 atm. (3 marks)

(ii) The number of molecules of carbon dioxide enclosed in a $0.1M^3$ flask at 25 ^0C that exerts a pressure of 25000 NM^2 (3 marks)

(iii) Compare the pressure exerted by 2.8 l of 0.72 moles CO at 337 K using;

(a) The ideal gas equation

(b) The Van der wall's equation

The Van der Walls constants are
a= 3.5 dm^3 atm $mo1^{-2}$
b= 0.0437 dm^3 $mo1^{-1}$ (10 marks)

(d) State the Le Chartelier's Principle. (4 marks)

Question TWO

a) What is a buffer solution? (2 marks)

b) Explain, using a suitable example, the working of a buffer solution. (6 marks)

(c) Give an expression for pH (2 marks)

(d) Calculate the pH of the following solutions and state whether they are acids or bases.

(i)$[H^+]$ = 10-6 moles/ litre

(ii) $[OH^-] = 10^{-4}$ moles/ litre

(iii) O.3 M HCl

(iv) 0.2M NaOH

(v) 0.1M HNO_3 (10 marks)

Question THREE

(a) Explain two reasons why real gases deviate from the ideal behavour. (4 marks)

(b) State Graham's law of diffusion. (2 marks)

(c) Oxygen gas diffuses through an aperture in 5 minutes. How long will the same amount of nitrogen gas take to diffuse through the same aperture at the same pressure and temperature? (4 marks)

(d) For the equilibrium:

$2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$,

$K_c = 4.07 \times 10^{-3}$ mole $litre^{-1}$ at 1000K. Compute K_p for the reaction at the same temperature. (5 marks)

(e) From the equation $PV = \frac{1}{3} mNu^2$ for an ideal gas show that the kinetic energy, K.e for a mole of a gas is given by K.e=3/2 RT. (5 marks)

Question FOUR

(a) State Dalton's Law of partial pressures. (2 marks)

(b) If the pressure exerted by a mixture of CO_2 and O_2 is 280 mmHg. Calculate the partial pressure of 96g O_2 and 112g CO_2. (4 marks)

(c) Given the following half equations

$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$ $E^o = -0.76$ V

$Ag^+ + e^- \longrightarrow Ag_{(s)}$ $E^o = 0.80$ V

(i) Which substance is oxidized and which is reduced in the cell during discharge? [2marks]
(ii) Which is the cathode and which is the anode (2marks)
(iii) Write the overall cell reaction. (3marks)
(iv) Determine the emf of the cell at 25°C. (2marks)
(v) Predict, with reasons, whether the cell reaction is spontaneous. (2marks)
(vi) Determine the equilibrium constant for the cell at 25°C. (3mark)

Question FIVE

a) (i) State the first law of thermodynamics (2 marks)
(ii) Explain the meaning of the terms; energy, heat, open and closed system (8 marks)

b) (i) With an illustration explain the Hess's law of constant heat summation (4 marks)
(ii) Calculate the enthalpy of the reaction below at 298 K using the given data.

$C_2H_{4(g)} + H_2 \longrightarrow C_2H_{6(g)}$

at 298 K from the following data:

(i) $C_2H_4 + 3O_2(g)$ $2CO_{2(g)} + 2H_2O_{(g)}$ $\Delta H = -1411.47$ kJ
(ii) $H_2(g) + 1/2O_2(g)$ $H_2O_{(g)}$ $\Delta H = -285.56$ Kj
(iii) $C_2H_6 + 7/2O_2(g)$ $2CO_2 + 3H_2O_{(g)}$ $\Delta H = -1558.30$ Kj

(6 marks)