Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	PHYSICAL CHEMISTRY
COURSE CODE	:	DAK 10303
PROGRAMME	:	1 DAK
EXAMINATION DATE	:	DECEMBER 2105 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN PART A
		B) ANSWER **TWO (2)** QUESTIONS IN PART B

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A: ANSWER ALL QUESTIONS

Q1 (a) A solution behave ideally if it is obey Raoult's Law and Henry's Law.

(i) Label each component of A, B and C in **Figure Q1 (a).**

(3 marks)

(ii) Write out the equation representing Raoult's law and Henry's law in chemical potential of ideal solution behavior.

(2 marks)

(b) Ethylene glycol (EG) $CH_2(OH)CH_2(OH)$ is a common automobile antifreeze. It is water soluble and is fairly nonvolatile (b.p 197°C).
[$K_b = 0.52°C/m$; $K_f = 1.86°C/m$]
[Relative atomic mass C = 12; O = 16; H = 1 g/mol]

(i) Calculate the freezing point of a solution containing 651 g of this substance in 2505 g of water.

(10 marks)

(ii) Point out whether this substance can be kept in car radiator during the summer.

(5 marks)

(c) A 0.05M aqueous solution of $FeCl_3$ has an osmotic pressure of 4.15atm at 25°C. Calculate the Van't Hoff factor, *i* for the solution.

(5 marks)

Q2 (a) Rates of reaction can be determined by monitoring the change in concentration of either reactant or product as a function of time. Explain **three (3)** factors that affect the reaction rates.

(6 marks)

(b) Two iodine atoms, I combine to form molecular iodine in the gas phase.

$$I\,(g) + I\,(g) \longrightarrow I_2\,(g)$$

This reaction follows second order kinetics and has the high rate constant of 7×10^9 /Ms at 23°C.

(i) If the initial concentration of I was 0,086M, calculate the final concentration after 2 minutes.

(5 marks)

(ii) Calculate the half-life of the reaction if the initial concentration of I is 0.60M and if it is 0.42M.

(6 marks)

(c) The rate constant of a first order reaction is 3.46×10^{-2} s^{-1} at 298K. Calculate the rate constant at 350K if the activation energy for the reaction in 50.2 kJ/mol.

(8 marks)

PART B

Q3 (a) Distinguish between atoms and molecules.

(4 marks)

(b) Urea [$(NH_2)_2CO$] is a chemical used for fertilizer and other compounds. Calculate the number of N, C, O and H atoms in 1.68 x 10^4g of urea. (Relative atomic mass C=12; O = 16; H = 1 ; N=14).

(10 marks)

(c) All alkali metals react with water to produce hydrogen gas and the corresponding alkali metal hydroxide. A typical example for this is the reaction is between lithium and water.

(i) Write the balance equation representing the reaction.

(2 marks)

(ii) Calculate the amount of H_2 in grams will be formed by the complete reaction of 85.57g of Li with water.
[Relative atomic mass of Li = 6.94 ; H = 1 ; O = 16 g/mol]

(9 marks)

Q4 (a) A sample of nitrogen gas kept in a container volume 2.3 L and at a temperature of 32°C exert a pressure of 4.7 atm. Calculate the mass of gas present.
(Relative atomic mass of N = 14 g/mol).

(4 marks)

(b) Sodium Azide (NaN_3) is used in some automobile air bags. The impact of a collision triggers the decomposition of NaN_3 produced solid sodium and nitrogen gas. The nitrogen gas produced quickly inflates the bag between the driver and the windshield. Calculate the volume of N_2 generated at 80°C and 823mmHg by the decomposition of 60.0 g of NaN_3.
(Relative atomic mass Na = 23, N = 14 g/mol).

(9 marks)

(c) The kinetic molecular theory of gases is the model used to explain the behavior of gases in nature.

(i) List **four (4)** physical properties of gases based on kinetic theory.

(4 marks)

(ii) The oxygen gas generated by the decomposition of potassium chlorate is collected at 25°C. The volume of gas is 246 mL measured at 1 atm. Calculate the amount of oxygen gas obtained. The pressure of water vapor at 25°C is 0.0313 atm.
(Relative atomic mass O = 16 g/mol).

(8 marks)

Q5 (a) Thermodynamic is the process study in which thermal energy is transferred as heat and work.

(i) Illustrate the energy transfer in **three (3)** types of thermodynamic system.

(ii) Explain each of the systems.

(9 marks)

(b) Calculate the ΔH^o for the reaction of $H\ (g) + Br\ (g) \longrightarrow HBr\ (g)$, given the following information:

$H_2\ (g) \longrightarrow 2\ H\ (g)$ $\quad \Delta H^o = 436.4$ kJ
$Br_2\ (g) \longrightarrow 2\ Br\ (g)$ $\quad \Delta H^o = 192.5$ kJ
$H_2\ (g) + Br_2\ (g) \longrightarrow 2HBr\ (g)$ $\quad \Delta H^o = -72.4$ kJ

(10 marks)

(c) Calculate the change in internal energy of 1 mole of CO at 1atm and 25°C.

$C\ (graphite) + \frac{1}{2}\ O_2\ (g) \longrightarrow CO\ (g)$ $\quad \Delta H^o = -110.5$ kJ

(6 marks)

Q6 (a) State the second and third law of thermodynamics in words and express it mathematically.

(5 marks)

(b) Consider the reaction:

$$PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2\ (g)$$

The standard free energy of formation values for PCl_3 (g) and PCl_5 (g) are -281 kJ/mol and -325 kJ/mol respectively. Calculate the equilibrium constant K_P for the following reaction at 25°C.

(10 marks)

(c) The production of CaO in rotary kiln is a reversible reaction.

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

Calculate the ΔG^o for the reaction under standard state condition at 25°C by using the following data:

Compound	H_f^o (kJ/mol)	S^o (J/K.mol)
CaO	-635.6	39.8
CO_2	-393.5	231.6
$CaCO_3$	-1206.9	92.9

(10 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER/SESSION : I/2015/2016 PROGRAMME : 1 DAK

COURSE NAME : PHYSICAL CHEMISTRY COURSE CODE : DAK 10303

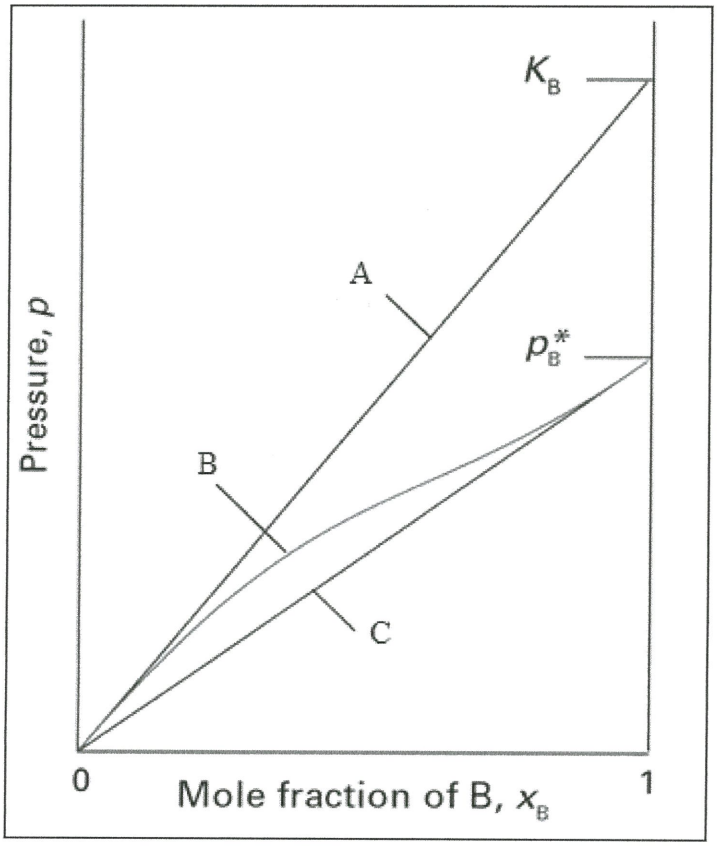

Figure Q1(a)

FINAL EXAMINATION

SEMESTER/SESSION: I/2015/201 PROGRAMME : 1 DAK

COURSE NAME : PHYSICAL CHEMISTRY COURSE CODE : DAK 10303

Formulas

$PV = nRT$

$H = U + PV$

$\Delta U = \Delta H + RT\Delta n$

$\Delta G = \Delta G^o + RT \ln Q$

$\Delta G^o = \Delta H^o - T\Delta S^o$

$\Delta G^o = -RT\ln K$

$\ln k_1/k_2 = E_a / R\ (1/T_2 - 1/T_1)$

$\Delta T_f = K_f m$

$\Delta T_b = K_b m$

$\Pi = MRT$

Universal gas constant = 0.0821 L.atm/(mol.K) = 8.314 J/(mol.K)