

KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (FORENSIC SCIENCE)

SCH 108: FUNDAMENTALS OF PHYSICAL CHEMISTRY

DATE: Tuesday, 3rd April, 2012

TIME: 11.00 a.m. – 1.00 p.m.

USEFUL INFORMATION

$$R = 8.314 \text{ Jmole}^{-1}\text{K}^{-1}$$

$$= 0.08206 \text{ litre-atm mole}^{-1}\text{K}^{-1}$$

$$0^\circ \text{C} = 273.15\text{K}$$

$$\text{R.A.M. (H} = 1.008, \text{C} = 12.011, \text{O} = 15.9994)$$

INSTRUCTIONS:

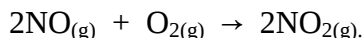
Answer **ALL** questions.

- Q.1
- Write to distinguish between *mole*, *molarity* and *molality* (6 marks)
 - Explain the term *colligate property* (3 marks)
 - A sac of semi-permeable membrane filled with a 0.03M solution is dipped into pure water at 25°C. Determine the osmotic pressure that develops inside the sac. (3 marks)
 - At a certain temperature, the reaction:
$$\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}$$
has an equilibrium constant, $K_c = 5.8 \times 10^{-2}$. Calculate the equilibrium concentrations of PCl_5 , PCl_3 and Cl_2 , if only PCl_5 is present initially at a concentration of 0.160M. (8 marks)
- Q.2
- Give the Bronsted-Lowry definition of an acid. (2 marks)
 - Arrange the following species into conjugate acid-base pairs:
$$\text{OH}^-, \text{H}_2\text{SO}_4, \text{SO}_4^{2-}, \text{O}^{2-}, \text{HSO}_4^-$$
(6 marks)
 - The dissociation constant, K_a , for weak ethanoic acid HAc, is 1.85×10^{-5} at 25°C. Determine the pH of an aqueous solution of HAc with $[\text{HAc}] = 0.35\text{M}$. (4 marks)

- Q.3 a) Given that $K_c = 1.03 \times 10^{-3}$ for the reaction:
- $$\text{H}_2\text{S}_{(g)} \rightleftharpoons \text{H}_{2(g)} + \frac{1}{2} \text{S}_{(g)}, \text{ at } 750^\circ\text{C}, \text{ determine } K_p \text{ for the reaction at the same temperature.} \quad (4 \text{ marks})$$
- b) The solubility product of magnesium hydroxide, $\text{Mg}(\text{OH})_2$ in water is $8.9 \times 10^{-12} \text{ mol}^3 \text{ litre}^{-3}$, at 25°C . Determine the number of mole of Mg^{2+} present in 500 cm^3 of solution at 25°C . (6 marks)
- c) With reasons, explain the effect of changes in pressure on the position of equilibrium of the reaction:



- Q.4 a) State Raoult's law. (3 marks)
- b) Ethanol, $(\text{CH}_3\text{CH}_2\text{OH})$, and methanol, (CH_3OH) , form a solution than is ideal. The vapor pressures of pure ethanol and pure methanol at 25°C are 44.5 mmHg and 88.7 mmHg respectively. Determine the vapor pressure of a solution made by mixing 40g of ethanol and 20g of methanol. (8 marks)
- c) i) Explain the concept of half-life, as used in chemical kinetics (3 marks)
- ii) The following data were obtained for the reaction:



EXPT #	INITIAL [NO]	INITIAL [O ₂]	INITIAL RATE, Ms^{-1}
1	0.015	0.015	0.024
2	0.030	0.015	0.096
3	0.015	0.030	0.048
4	0.030	0.030	0.192
(α) Determine the rate law			(7 marks)
(β) Determine the rate constant.			(3 marks)

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