UNIVERSITY OF GHANA

BSC. ENGINEERING
SECOND SEMESTER EXAMINATION: 2015/2016
DEPARTMENT OF BIOMEDICAL ENGINEERING
BMEN 304: SOLUTION AND COLLOID CHEMISTRY (3 CREDITS)

INTSTRUCTIONS: ANSWER ALL QUESTIONS

TIME ALLOWED: TWO AND HALF HOURS (2 ½)

1. You are to prepare 500 ml of a 2.0M NaOH solution and use it for your analysis. Out of the stock solution prepared you are to prepare 50 ml dilute solutions with the following concentrations: 0.60M and 0.20M. Describe the process in details. **[10 marks]**

[Na = 23; O = 18; H = 1]

2. The solubility of gases in water increases with increasing mass. Explain. [4 marks]

3. Differentiate between **1 Molal** solution and **1 molar** solution [4 marks]

4. Compare and contrast **solution, colloid and suspension**. Give an example each.[6 marks]

5. Reactions with large equilibrium constants are fast. True or False?

Explain your answer. [4 marks]

6. How will the equilibrium position of a gas phase reaction be affected by changing the volume of the reaction vessel? [4 marks]

7. To analyse the alcohol content of a body fluid, the chemist needs 1.00 L of an aqueous 0.200M $K_2Cr_2O_7$ solution. How much solid $K_2Cr_2O_7$ must be weighed out to make this solution?

[K = 39.10, O = 16, Cr = 52] [5 marks]

8. The concentrated sulphuric acid used in the laboratory is 98% H_2SO_4 by mass. Calculate the molality and molarity of the acid solution.

[H=1, O=16, S=32, density of solution = 1.83gml^{-1}]. [10 marks]

9. A buffer solution is a solution that resists appreciable change in pH when a small amount of an acid or base is added to it. What components must be present in order to have a buffered solution? [4 marks]

10. Lactic acid ($HC_3H_5O_3$) is a waste product that accumulates in the muscle tissue during exertion leading to pain and feeling fatigue. In a 0.100M aqueous solution lactic acid is 3.7% dissociated. Calculate the value of Ka and give its units. [10 marks]

11. Solution A is a common purchased disinfectant which is 9% (by mass) solution of H_2O_2 in water. Assuming the density of the solution is 0.96 g/cm^3, calculate

i. the molarity ii. Molality iii. Mole fraction of H_2O_2 in the solution

[H = 1; O = 16] [6 marks]

12. Using thermodynamic principles, deduce the most suitable conditions for an economic yield of hydrogen iodide (HI).

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)} \quad \Delta = -ve$$ [6 marks]

13. Calculate the Ksp value for Calcium hydroxide ($Ca(OH)_2$) which has a solubility of 1.0×10^{-15} moldm^{-3} at 25°C. [4 marks]

14. Benzene and toluene form a nearly ideal solution. At 80 ^{0}C, the vapour pressure of pure benzene (MW = 78.1) is 753 torr and that of toluene (MW = 92.1) is 290 torr. Assume the solution contains 100 g of each substance. Calculate the partial pressure of each solution that would be in equilibrium with the solution at 80 ^{0}C. [5 marks]

15. Draw a labeled diagram of a galvanic cell which operates on the reaction

$$Fe^{2+} + H^+ + Cr_2O_7^{2-} \longrightarrow Fe^{3+} + Cr^{3+} H_2O$$

Show clearly the two electrode systems which make up the cell and write a balanced equation for the half cell reactions. Indicate the direction of flow of electrons. [10 marks]

16. State Lambert – Beer's law [2marks]

17. What is the relationship between the intensity of colour of a solution and its concentration? [2 marks]

18. What is the purpose of the "Blank" in spectrophotometry? [4 marks]