



UNIVERSITY OF GHANA
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DEPARTMENT OF BIOMEDICAL ENGINEERING
END OF SECOND SEMESTER EXAMINATIONS: 2013/2014
LEVEL 300: BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING
BMEN 304: Solution and Colloid Chemistry (3 Credits)

Total Marks: 100

Time allocation: 3 Hours

Answer all questions

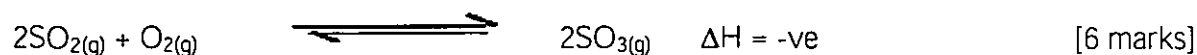
Question 1 [25 Marks]

- a. List the factors that influence solution formation. [4 marks]
- b. State why solubility of gases in water increases with increasing mass? [4 marks]
- c. Calculate the amount of water (in grams) that must be added to 5.00 g of urea in the preparation of a 16.2 percent by mass of a solution. [5 marks]
- d. Differentiate between 1 molar solution and 1 molal solution. [4 marks]
- e. A commonly purchased disinfectant is a 30% (by mass) solution of H_2O_2 in water. Assuming the density of the solution is 1.0g/cm^3 , calculate the
 - i. Molarity [3 marks]
 - ii. Molality [3 marks]
 - iii. mole fraction of H_2O_2 [2 marks]

[H =1, O = 16]

Question 2 [25 Marks]

- a. Using thermodynamic principles, deduce the most suitable conditions for an economic yield of SO_3



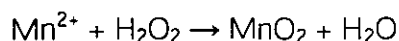
- b. What is a Conjugate acid – base pair? [3 marks]
- c. Explain why aqueous solutions of NH_3 and CH_3COOH are weak electrolytes but a mixture of the two forms a strong electrolyte. [6 marks]
- d. What is the relationship between the value of pK_a and the strength of a weak acid? [4 marks]
- e. The pH of a 0.10M solution of formic acid (HCOOH) is 2.39. What is the K_a of the acid? [6 marks]

Question 3 [25 Marks]

- a. State the Raoult's Law. [3 marks]
- b. In terms of intermolecular forces, what gives rise to positive and negative deviations from **Raoult's law**? Indicate the deviations with appropriate phase diagrams. [6 marks]
- c. If a solution shows a positive deviation from **Raoult's law**, would you expect it to have a higher or lower boiling point than if it was ideal? Why? [4 marks]
- d. The presence of a non volatile solute in solution reduces the tendency of the solvent molecule from escaping. Explain. [4 marks]
- e. Calculate the vapour pressure of a solution made by dissolving 218g of glucose (mm = 180.2g/mol) in 460ml of water at 30°C . What is the vapour pressure lowering? [v.p of water at 30°C = 31.82 mmHg; density of water = 1.0 g/ml]. [8 marks]

Question 4 [25 marks]

- a. Explain why the following reaction is a REDOX reaction [2 marks]



- b. The following reaction occurs in an alkali medium



- (α) List the species that is reduced and the one that is oxidised. [2 marks]
 - (β) State the initial and final oxidation numbers of the species you have listed. [2 marks]
 - (γ) Separate the reaction into two half-reactions and balance each of them. [8 marks]
 - (δ) Write the overall balanced equation. [2 marks]
- c. How is vapour pressure lowering related to a rise in boiling point of a solution? [2 marks]
- d. Using intermolecular forces differentiate between an ideal solution and non-ideal solution. [2 marks]
- e. (i) Differentiate between a galvanic cell and an electrolytic cell.
(ii) Draw a well labelled cell diagram represented by the equation $A/A^{3+} // B^{2+} / B$ and indicates the direction of flow of electrons. [5 marks]