KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2014/2015 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

CHEM 222: PHYSICAL CHEMISTRY III

DAY: WEDNESDAY **DATE: 12/08/2015**

TIME: 2:00 – 4:00PM **STREAM: Y2S2**

INSTRUCTIONS

Time allowed is 2 hours
Answer the question in section A and any other TWO questions in section B.

Constants

R=8.31447 kg m^2 s^{-2} K^{-1} mol^{-1}= 0.08206 L-atm/mol-K

SECTION A: TOTAL MARKS FOR THIS SECTION IS 30 MARKS
QUESTION ONE [30MARKS]

a. Define the following terms.
   i. Conjugate base [2marks]
   ii. Lewis acid [2marks]
   iii. pH [2marks]
   iv. Salt hydrolysis [2marks]

b. Differentiate between intensive and extensive properties of substances. [4marks]
c. State any four assumptions of kinetic theory of ideal gases [8marks]
d. State the characteristics of an ideal gas [4marks]
e. A balloon contains 14.0 L of air at a pressure of 760 torr. What is the volume if a balloon is taken to the bottom of a 10 ft pool where the pressure is 981 torr? [3marks]
f. Using the ideal-gas law calculate the volume occupied by 0.54 mol of N_2 at 15°C and 0.976 atm. [3marks]

SECTION TWO: TOTAL MARKS FOR THIS SECTION IS 40 MARKS.
ATTEMPT ANY TWO QUESTIONS FROM THIS SECTION.

QUESTION TWO [20MARKS]

a. State any two properties of an ideal gas [4marks]
a. The average human male consumes 200 mL of O_2 per hour at 25°C and 1.0 atm for each kilogram of body weight. How many moles of O_2 are consumed by a 70-kg male for 1 hour. [3marks]
b. Show that,
   i. At low pressure, $nRT \neq [P + \frac{an^2}{V^2}][V - nb]$ but $nRT = PV$ [3marks]

   ii. At high pressure, $nRT = P[V - nb]$ [3marks]

c. Compute the pH of the following solutions
   i. 0.02M H_2SO_4 [4marks]
   ii. 0.1M NaOH [3marks]

QUESTION THREE [20MARKS]

a. What is a buffer? Explain how a buffer system works [6marks]
b. Calculate the solubility of MX_2 in 0.12 M $M(NO_3)_2$.Given that
   $MX_2 \rightarrow M^{2+} + 2X^{1-}$ [$Ksp = 2.04x10^{-14}$] [4marks]

c. What are colligative properties? Give at least one example. [4marks]
d. A solution is composed of 1.40 mol cyclohexane ($P°_{cy}$ = 97.6 torr) and 2.50 mol acetone ($P°_{ac}$ = 229.5 torr). What is P_{total}, the total vapor pressure, above this solution? [4marks]
e. State the law of mass action of reacting particles [2marks]

QUESTION FOUR [20MARKS]

a. Differentiate between strong and weak electrolytes. [4marks]
b. Define the following terms [8marks]
   i. Gels
   ii. Sols
   iii. Emulsions
   iv. Colloids

c. Define the following terms
   i. Critical point [2marks]
   ii. Triple point [2marks]

d. Illustrate the phase diagram of water [4marks]

QUESTION FIVE [20MARKS]

a. Calculate the rms speed of an oxygen gas molecule, O_2, at 31.0 °C [4marks]
b. State any three actions that would disturb equilibrium? [6marks]
c. What are the equilibrium concentrations of Al^{3+} and OH^- when solid $Al(OH)_3$ is added to water at 25°C?. [5marks]

d. The K_{sp} for silver carbonate is 8.4×10^{-12}. The concentration of carbonate ions in a saturated solution is 1.28×10^{-4} M. What is the concentration of silver ions? [5marks]