EMBU UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)

FIRST SEMESTER EXAMINATIONS 2013/2014

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCH 103: BASIC PHYSICAL CHEMISTRY

DATE: NOVEMBER 29, 2013   TIME: 11.00 0- 1.00PM

INSTRUCTIONS:

Answer ALL the Questions.

Useful information

R = 0.08205 atm/K/mol

  = 8.314J/K/mol

1atm = 760 torr = 101.325kPa

QUESTION ONE:

a)   i)   Starting with the gas laws derive the ideal gas equation   (5 marks)

     ii)   State the Van der Waals Equation   (2 marks)

     iii)   Briefly explain how the correction factors, a and b are arrived at in the Van der Waals equation   (2 marks)

b)   Calculate the pressure exerted by 0.50 moles of nitrogen gas in a 1.00L container at 25.0°C using the Van der Waals Equation.   (5 marks)

($a = 1.39atmL^2/mol^2$; $b = 0.0391L/mol$)

QUESTION TWO:

a)   i)   Give two examples of colligative properties of solutions   (2 marks)

     ii)   Sketch the phase diagram to show how pressure affects   of a non volatile solute affects the colligative properties of water   (5 marks)

b)   i)   State the mathematical expression of the Raoult's law   (2 marks)

     ii)   A solution was prepared by adding 20.0g of urea to 125g of water at 25°C, a temperature at which pure water has a vapor pressure of 23.76 torr. The observed vapor pressure of the solution was found to be 22.67 torr. Calculate the molecular weight of urea?   (5 marks)

QUESTION THREE:

a)   i)   Derive the Henderson Hasselbalch equation   (3 marks)

     ii)   If the strength of an acid is defined using the equilibrium position of its dissociation constant

$$HA_{(aq)} + H_2O_{(l)} \longleftrightarrow H_3O^+_{(aq)} + A^-_{(aq)}$$

     Distinguish between a strong and weak acid?   (2 marks)

b)   i)   Define a buffer solution   (2 marks)

     ii)   How would you prepare 10mL of a 0.02M acetate buffer, pH 4.30, from stock solutions of 0.05M acetic acid (HAc) and 0.05M NaOH? pKa acetic acid = 4.76?

     (7 marks)

QUESTION FOUR:

a)   i)   Distinguish between the terms equilibrium constant and reaction quotient

     (4 marks)

     ii)   Consider the gaseous reaction below

$$H_2O_{(g)} + Cl_{2(g)} \longleftrightarrow 2HOCl_{(g)}$$

     Calculate the concentration of all the species at equilibrium when 1.0 mole of pure HOCl is placed in a 2.0L flask at 25°C? K = 0.090.   (5 marks)

b)	Explain how the system at equilibrium above would shift if;

    i.)	Chlorine gas is removed	(2 marks)

    ii.)	Water vapor is added	(2 marks)

    iii.)	Adding Helium gas to the reaction	(1 mark)

QUESTION FIVE:

a)	i)	Differentiate between intensive and extensive properties of matter	(4 marks)

    ii)	Derive a relationship between Cv and Cp for ideal gases	(5 marks)

b)	A student performs an experiment on an ideal gas by adding 42.0 J of heat to it. As a result the student finds that the volume of the gas changes from 50 cm^3 to 150 cm^3 while the pressure remains constant at 101.3 kPa.

If the quantity of the gas present is 0.007 moles, determine the molar specific heat capacity of the gas that the student would find at constant pressure.	(5 marks)

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