THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE
(A constituent of JKUAT)
Faculty of Applied and Health Sciences
DEPARTMENT OF PURE AND APPLIED SCIENCES
UNIVERSITY EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN FOOD TECHNOLOGY & QUALITY
ASSURANCE

ACH 4102: PHYSICAL CHEMISTRY

SPECIAL/SUPPLEMENTARY EXAMINATION

FEBRUARY 2013 SERIES
2 HOURS
Instructions to candidates:

This paper consist of **FIVE** questions
Answer question **ONE** (compulsory) and any other **TWO** questions

Question ONE

a) (i) Define the term "Isobar"   **(1mark)**

   (ii) State Gay-Lussac's Law   **(1mark)**

   (iii) Sketch the general Gay-Lussac's law isobar (V –T curve) for an ideal gas, and explain the salient features of the plot.   **(5marks)**

   (iv) The volume of 2.30g of ethylene gas is 360ml at $15°C$. and 1 atm pressure. Determine the temperature at which the volume will be 480ml at the same pressure   **(6marks)**

b) (i)   State the "Law of mass action".   **(1mark)**

   (ii) A mixture of 0.45 mole of hydrogen gas and 0.40 mole of iodine vapour was heated at $450°C$ until equilibrium was attained, at which point the concentration of hydrogen iodide was 0.35mole. Calculate the equilibrium constant for the reaction.   **(8marks)**

c) (i)   Define the term "heat of solution".   **(1mark)**

   (ii) The molar heat of hydration of solid anhydrous $CuSO_4$ to form solid pentahydrate is 78.90KJ, and the heat of vaporization of water is 44.03 KJ mol^{-1} at $25°C$.

Calculate the heat of hydration of 1 mole of CuSO4 by 5 moles of water vapour at the same temperature.   **(7marks)**

Question TWO

a) (i)   State the "equation of state" for an ideal gas.   **(1mark)**

   (ii)   5.00g of helium gas occupies a volume of 300ml at 12˚C and 1.5 atm pressure. Determine the pressure at which the volume will be 375ml when the temperature is raised to 42˚C.   **(6marks)**

b) (i) Explain the meaning of the term "dynamic chemical equilibrium"   **(2marks)**

   (ii) A general expression derived for a reversible reaction can be represented as

$$K_c \rightleftharpoons \frac{[C][D]}{[A][B]}$$

   Explain the meaning of the terms in the above expression.   **(5marks)**

c) (i)   State Boyle's law.   **(1mark)**

   (ii)   A given mass of an ideal gas accupies a volume of 240ml at a pressure of 1.25atm. determine the change in volume of the gas if the pressure is changed to 0.75atm at the same temperature.   **(5marks)**

Question THREE

a) (i)   State the kinetic theory of gases.   **(1mark)**

   (ii)   Using the kinetic theory, explain how an increase in temperature and decrease in volume, respectively, affect the pressure of a gas.   **(4marks)**

   (iii)   State TWO main assumptions of the kinetic theory on which the derivation of ideal gas laws were based.   **(2marks)**

   (iv)   Give TWO reasons why real gases do not obey ideal gas laws, based on the assumptions in (iii) above.   **(2marks)**

b) (i) Define the term "heat of formation".   **(1mark)**

   (ii) For the reaction

$$Al_2Cl_6(s) + 6Na(s) = 2Al(s) + 6NaCl(s) \quad \Delta H = -1072KJ.$$

   The heat of formation of Na Cl(s) is -410 KJ.Mol^{-1}. Calculate the heat of formation of solid Al_2Cl_6.   **(6marks)**

c) Define the following terms

   (i)   Thermodynamics   **(1mark)**

(ii)   Thermochemistry   **(1mark)**

   (iii)   Exothermic reaction   **(1mark)**

   (iv)   Endothermic reaction   **(1mark)**

Question FOUR

  a) (i)   State Hess's Law.   **(1mark)**

   (ii)   Using Hess's law, calculate the standard enthalpy of hydrogenation of ethylene to ethane at 25°C. The standard heats of combustion of ethylene, hydrogen and ethane are -1411, -285 and -1557KJ.mole^{-1}, respectively.   **(8marks)**

  b) Plot the general curve for the variation of enthalpy of solution (y-axis) with quantity of solute (x-axis) in a given solvent at constant temperature. Explain the shape of the curve.   **(5marks)**

  c) (i)   Define term "reversible reaction"   **(1mark)**

   (ii)   For the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_2$ at 500°C, $K_p = 1.44 \times 10^{-5}$ atm, assuming ideal gas behavior. Calculate the corresponding value of Kc in moles per litre

             $\{K_p = K_c(RT)^{\Delta n}$; R= 0.082 lit-atom.deg^{-1}mole^{-1} **(5marks)**

Question FIVE

  a) (i) Define the term "isotherm".   **(1mark)**

   (ii)   Sketch the general Boyles law isotherm (P-V curve) for an ideal gas, explaining the salient features of the curve.   **(5marks)**

  b) (i)   Define the term "partial pressure" as applied to gas mixtures.   **(1mark)**

   (ii)   State Dalton's law of partial pressures   **(1mark)**

   (iii)   A mixture consists of 0.495g of gas A of molecular weight 66.0, and 0.182g of gas B of molecular weight 45.5. The total pressure is 76.20cmHg. Calculate the partial pressures of the two gases.   **(7marks)**

  c) The van der Waals equation of state for real gases is expressed as

     $$\left(P + \frac{a}{V^2} \right)(V - b) = nRT$$

     Explain the meaning of the terms in parentheses on the basis of the kinetic theory of gases.   **(4marks)**