KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCH 120: CHEMISTRY II

DATE: MONDAY 26TH MARCH 2012 **TIME: 2.00 P.M. – 4.00 P.M,**

INSTRUCTIONS
Answer ALL questions.
Each section must be answered in a separate answer booklet

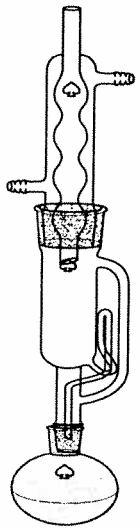
SECTION A:
INTRODUCTION TO CLASSICAL ANALYSIS AND SEPARATION TECHNIQUES

A. Essay question (10 Marks)

1. Discuss five (5) methods for separating **interferences** from a sample being analysed.

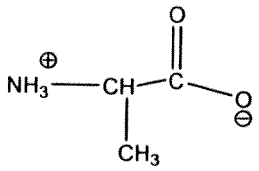
B. Short answer questions (3 Marks each)

1. Briefly describe instrumental and reagent errors encountered in chemical analysis.
2. Give three (3) conditions that a reaction must fulfill in titrimetric analysis.
3. What are the uses of the ***F-test*** in statistical analysis?
4. Define a Primary Standard as used in titrimetry?
5. Name and describe the purpose of the apparatus below

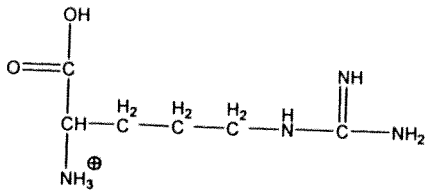


6. Write down three (3) types of stationary phases used in Thin Layer Chromatography.

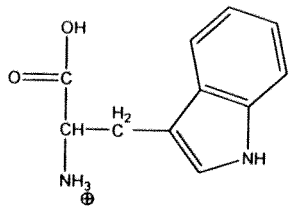
7. Give the most appropriate chromatographic technique for separating the compounds below. Indicate the order in which the compounds would separate.



Alanine



Arginine



Tryptophan

SECTION B : ATOMIC STRUCTURE AND CHEMICAL BONDING

1. Briefly explain what you understand by the following terms as used in atomic theory.
   a. Dual nature of matter
   b. Hybridization. (4 marks)

2. Briefly explain two practical experiment that can be performed in a laboratory and give evidence that
   a. Electron occupy orbital that possess energy in discrete values.
   b. Existence of degenerate orbitals in atoms. (6 marks)

3. Below are two versions of the Schrodinger equation used in quantum mechanics. Use them to answer the equations below.

$$-\frac{\hbar^2}{2m}\nabla^2\psi(\mathbf{r})+V(\mathbf{r})\psi(\mathbf{r}) = E\,\psi(\mathbf{r})$$

$$\frac{-\hbar^2}{2\mu}\left[\frac{1}{r^2}\frac{\partial}{\partial r}r^2\frac{\partial}{\partial r}+\frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)+\frac{1}{r^2\sin^2\theta}\frac{\partial^2}{\partial\phi^2}+\tilde{v}(r)\right]\psi(r,\theta,\phi) = E\psi(r,\theta,\phi),$$

   a. Briefly explain what the following terms used in the equation represent.
      i. ∇^2
      ii. ψ
      iii. $V(\mathbf{r})$
   b. How are the two equations related above related. (6 marks)

4. Use molecular orbital theory to explain why O_2 is paramagnetic.

(4 marks)

5. Discuss the major differences and similarities between the Bohr and quantum model of atomic structure. (4marks)

6. Use Born-Haber cycles calculations to show why formation of the salt $CaBr_2$ is favoured over CaBr. Information you need (all in kJ/mol) to estimate the enthalpies of formation for the two salts:
   $Ca(s) \rightarrow Ca(g)$ $\Delta H°vap = 178$ $Br_2(l) \rightarrow Br_2(g)$ $\Delta H°vap = 31$
   $Br_2(g) \rightarrow 2\,Br(g)$ $\Delta H°d = 193$ $Br(g) + e^- \rightarrow Br^-(g)$ $\Delta H°ea = -331$
   $Ca(g) \rightarrow Ca^+(g)$ $\Delta H°ie = 590$ $Ca^+(g) \rightarrow Ca+2(g)$ $\Delta H°ie = 1145$

(8marks)

SECTION C : CHEMICAL THERMODYNAMICS (PHARMACY)

Q1. (a) What is
(i) an open system?
(ii) Closed system?
(iii) Isolated system? (3 marks)

(b) Isothermal process
(ii) Adiabatic process
(iii) Reversible process (3 marks)

(c) Give an expression for the first Law of thermodynamics (1marks)

(d) Two moles of oxygen at 27^0C expands isothermally from 3 atm to 1 atm. Assuming that oxygen behaves ideally, calculate work done (W), if the expansion is reversible (3 marks)

Q2. (a) For a process at 451 K and at constant pressure, ΔS surrounding is $-326jk^{-1}$ calculate the quantity of heat (in kJ) absorbed by the system. (3 marks)

(b) The boiling point of a substance is the temperature at which equilibrium is established between the liquid and the vapour.

$$CH_3CH_2OH_{(l)} \rightarrow CH_3CH_2OH\ (g)$$

Calculate the boiling point (in k) f ethanol

CH3CH2OH, if $\Delta H = 42.6$ 6kJ and $\Delta s = 122k^{-1}$ for this process (3marks)

(c) Calculate the change in free energy when 11.21 dm^3 of a perfect gas at O^0C and 760mmHg expands isothermally until its pressure is 190 mmHg (3marks)

(d) Calculate the work done when 50g of iron reacts with HCl in a closed vessel of fixed volume.

Q3. (a) The heat released or absorbed in chemical reactions can be monitored by measuring the temperature change that results. Such reactions are carried out in a 'calorimeter'. Give the expression, which relates the heat energy transferred to the calorimeter, q_{cal} to the observed change in temperature. (2 marks)

(b)(i) If 80KJ of heat are supplied to the calorimeter and the temperature changes by $+8.40^0C$, calculate the heat capacity of the calorimeter.

(2 marks)

(c) (ii) State Hess's Law (2 marks)

(ii) Given the following data

$2C_2H_{6(g)} + 7O_{2(g)} \rightarrow 4CO_{2(g)} + 6H_2OL$; $\Delta H = -3120KJ$

$C(s) + O_2(g) \rightarrow CO2(g)$; $\Delta H = -394KJ$

$2H_2(g) + O_{2(g)} \rightarrow 2H_2O_{(L)}$; $\Delta H = -572KJ$

Calculate ΔH for the following reaction

$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$ (2marks)

(c) What is the work done by a gas which expands in a cylinder from a volume of 3.00 litres to 5.00 litres against a pressure of 0.895 atm?

(2marks)