Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY
(DAC 10J)

ACH 2318 : INSTRUMENTAL METHODS OF ANALYSIS

SPECIAL/SUPPLEMENTARY: EXAMINATIONS

SERIES: FEBRUARY 2013

TIME: 2 HOURS

INSTRUCTIONS:

You should have the following for this paper

- *Answer booklet*

This paper consists of ***FIVE*** questions.
Answer Question **ONE (compulsory)** and any other **TWO** questions
*This paper consists of **4 PRINTED** pages*

Question ONE

a) (i) State and explain THREE factors which affect the efficiency of a chromatographic column **(3marks)**

(ii) Give FOUR factors influencing vibrational frequencies in IR spectroscopy. **(2marks)**

(iii) Explain briefly the nature of TWO different types of flames used I n AAS. **(3marks)**

b) (i) Give THREE advantages why using narrower a wavelength band is preferred in spectroscopic analysis. **(3marks)**

(ii) Define the following terms as used in UV – visible spectrophotometry. **(4marks)**

I. Auxochrome
II. Chromophore
III. Hypochromic effect
IV. Bathochromic effect

(iii) How many fundamental vibrational frequencies would you expect to observe in the infrared absorption spectrum of CO_2. Justify your answer. **(5marks)**

c) (i) Give the difference between normal phase and reversed phase chromatographic techniques. **(4marks)**

(ii) Explain THREE reasons why temperature control is important in HPLC and LC analysis.

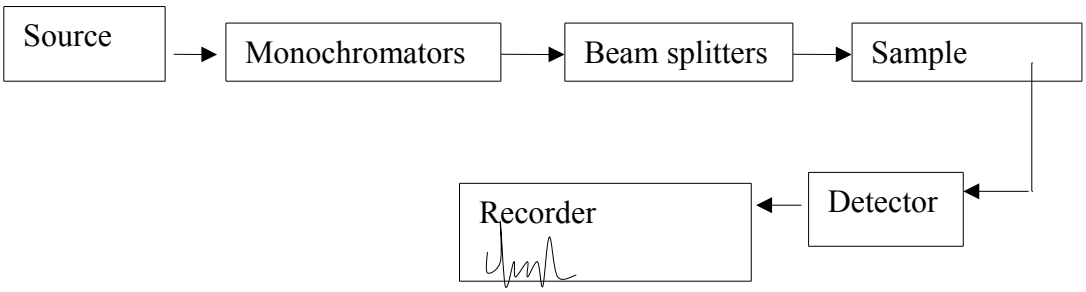
(3marks)

(iii) State THREE functions performed by power supply system in UV spectrophotometers.

(3marks)

Question TWO

a) (i) Describe briefly the working principles of a double beam spectrophotometer (Use a block diagram). **(5marks)**



(ii) State THREE advantages of a double beam spectrophotometer over a single beam spectrophotometer.

(3marks)

(iii) Define the following terms **(4marks)**

(I) Releasing agent
(II) Protecting agent

(III) Dead time
(IV) Attenuation

b) (i) Calculate the approximate frequency of the C-H stretching vibration from the following data.

K = $500Nm^{-1}$ = $5.0 \times 10^5 gS^{-1}$ (since $1N = 10^3 gm^{-1}$)
Mc = Mass of carbon atom = $2.0 \times 10^{-24}g$
MH = Mass of Hydrogen atom = $1.6 \times 10^{-24}g$
C = $3.0 \times 10^8 ms^{-1}$

(3marks)

Question THREE

a) (i) Define :
I. Monochromator
II. Noise

(2marks)

(ii) State FOUR methods used to prepare solid samples for IR analysis **(2marks)**

b) (i) State THREE causes of deviation from Beer-Lambert Law **(3marks)**
(ii) Identify THREE types of chemical reactions occurring in the flame in FES **(3marks)**
(iii) List FOUR types of Nebulization **(2marks)**

c) A stock solution was made by dissolving 0.900g of Potassium permanganate ($KMnO_4$) in water and diluting to $250cm^3$. Calculate the concentration of the solution in ppm with respect to manganese (RFM of $KMnO_4$ = 158.036) **(3marks)**

Question FOUR

a) (i) Describe the working principles of a phototube detector **(5marks)**
(ii) Name TWO types of filters and TWO types of monochromators. **(2marks)**
(iii) Give THREE requirements of a radiation sources. **(3marks)**

b) Describe determination of the formula of complexes by Job's method **(5marks)**

Question FIVE

a) (i) A solution containing TWO substances P and Q has an absorbance in 1cm curette of 0.36 at 350Aanumeters and 0.225 at 400nm. The molar absorption coefficients of P and Q at this wavelength are given below **(5marks)**

Compound	**Wavelength(ﻧ)**	**Wavelength (λ)**
	At 350nm	At 400nm
P	1500	3000
Q	7000	6500

Calculate the concentrations of P and Q

(ii) Identify all symbols in the expression **(2marks)**

$$\mu = \frac{M_1 M_2}{M_1 + M_2}$$

(iii) Frequency of vibration is given by the equation

$$\upsilon = \frac{1}{2\pi c}\sqrt{\frac{K}{\mu}}$$

Identify the symbols **v**,**c** and **k** and state one physical significance of **f**. **(2marks)**

(b) (i) A column with height 100cm gave the following experimental results.

Trial(no.)	**Flow rate cms^{-1}**	**tRSec**	**W(sec)**
1	1.0	300	80
2	2.5	100	24
3	5.0	50	10

Calculate the number of theoretical plates N and the Height equivalent of a theoretical plate (HETP) **(3marks)**

(ii) State the physical significance of number theoretical plates (N) and the height equivalent of a theoretical plate H. in HPLC.

(2marks)

(iii) Give One application of IR in the industry **(1mark)**