



Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY

(DAC 11M)

ACH 2306: INSTRUMENT METHODS OF ANALYSIS II

SPECIAL/SUPPLEMENTARY : EXAMINATIONS

SERIES: OCTOBER 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) Using suitable examples where possible discuss briefly each of the following:

- i) Vibrational modes in IR spectroscopy
- ii) Emission spectroscopy
- iii) Electromagnetic radiation
- iv) Desolvation in flame photometry
- v) Calibration curve.

(10marks)

b) Lead is extracted from a sample of blood and analyzed at a 283nm and gave an absorbance of 0.340 in an atomic absorption spectrometer. The following additional data was also obtained by the subsequent dilution of a standard solution of lead ions:

[Pb ²⁺] (ppm)	Absorbance
0.000	0.000
0.100	0.116
0.200	0.216
0.300	0.310
0.400	0.425
0.500	0.525

Draw a calibration curve and determine the lead content of blood in ppm.

(7marks)

c) Green light has a wavelength of 500nm. Determine the energy and frequency of this radiation. (C= 3.0 x 10⁸m/s, h=6.63 x 10⁻³⁴ s-s)

(5marks)

d) (i) A species has an infrared absorption at 200cm⁻¹, What is the wavelength of the light?

(2marks)

(ii) Draw the vibrational modes of the water (H₂O) molecule. Identify all the active vibrational modes.

(6marks)

Question TWO

a) Explain what the difference between:

(i) IR active and IR inactive molecule

(4marks)

(ii) Baseline and absorption band in IR spectrum.

(4marks)

b) Draw the various vibrational modes for the methylene (-CH₂-) group

(12marks)

Question THREE

a) Using of well-labelled schematic diagram, describe the working principle of:

i) Hollow-cathode lamp

(6marks)

ii) Atomic absorption spectrometer

(7marks)

b) A 0.623g sample containing a compound of sodium is dissolved in water and diluted to 100cm³ in a volumetric flask. It is analysed in an atomic absorption spectrometer using the 589nm sodium line and shows an absorbance of 0.30. The following additional data was also obtained:

<i>[Na] (mg/dm³)</i>	<i>Absorbance</i>
0.00	0.00
0.50	0.10
1.00	0.26
1.50	0.36
2.00	0.46
2.50	0.62

Draw a calibration curve in order to obtain the concentration in mg/dm³ and percentage of sodium in the sample. (Molar mass of sodium = 23g/mol) **(7marks)**

Question FOUR

- a) Define flame photometry **(3marks)**
 b) Discuss the fate of the sample in the burner flame during flame photometry. **(10marks)**
 c) The following data were obtained in the flame photometric determination of sodium by internal standard method. 10ppm of Lithium was added to the series of standard solutions of sodium and the sample. The ratios of intensity of emission at the wavelengths of sodium and Lithium are given below:

<i>Solution number</i>	<i>Concentration of Li(ppm)</i>	<i>Concentration of Na (ppm)</i>	<i>Intensity ratio of sodium to lithium</i>
0	10.0	0.0	0.0
1	10.0	2.0	15.8
2	10.0	4.0	31.4
3	10.0	6.0	45.4
4	10.0	8.0	58.1
5	10.0	10.0	70.2
Sample	10.0	Unknown	43.0

Draw a calibration curve and determine the concentration of sodium in the unknown sample

(7marks)

Question FIVE

- a) Using a well-labelled schematic diagram, discuss the various parts of a double-beam IR spectrometer. **(8marks)**
 b) State the main advantage of a double-beam IR instrument over a single-beam IR instrument.

(2marks)

- c) Suggest the number of IR active bands in the IR spectrum of each of the following gaseous molecules. Explain
 (i) HCl **(3marks)**

(ii) BeCl_2

(7marks)