



NATIONAL OPEN UNIVERSITY OF NIGERIA
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ABUJA.

FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCES

APRIL/MAY, 2019 EXAMINATIONS

COURSE CODE: CHM 391

COURSE TITLE: PRACTICAL CHEMISTRY V – INORGANIC AND
ANALYTICAL

CREDIT UNIT: TWO (2)

TIME: 2 HOURS

INSTRUCTION: Answer question one and any other three questions.

QUESTION ONE

1ai) Using the data provided below, determine the wavelength of maximum absorption (λ_{max}) of the organic compound.

Absorbance(s) of the organic compound	Wavelengths of absorption of the organic compound (nm)
0.100	360
0.110	380
0.120	400
0.125	420
0.130	440
0.160	460
0.165	480
0.400	500
0.60	520
1.00	540
1.10	560
0.80	580
0.40	600

0.10	620
0.11	640
0.12	660

6 marks

1aii) If after the determination of the unknown wavelength of maximum absorption (λ_{max}) of the organic sample in (1ai) above, the determined wavelength was used to obtain the concentration of the organic compound which was found to be $0.0008 \text{ mol dm}^{-3}$ at an absorbance of 1.23, use Beer's law to calculate molar absorptivity ϵ for the organic compound, given the cell width (path length l) to be 1 cm.

$3\frac{1}{2}$ marks

1b) Mention the uses of the following:

- | | | |
|------|--------------------------------|------|
| I. | Gravimetric analysis | 1 mk |
| II. | Potentiometric titration | 1 mk |
| III. | UV- Visible spectroscopy | 1mk |
| IV. | Colorimetry | 1 mk |
| V. | Infrared spectroscopy | 1 mk |
| VI. | Atomic absorption spectroscopy | 1 mk |

1c) How would you set the absorbance of UV-Visible spectrophotometer to zero (0)?

$1\frac{1}{2}$ marks

1d) What is digestion of a precipitate and why is it necessary

3 marks

1fi) Outline the sources of hardness in water.

2 marks

1fii) Of what significance is the determination of hardness in water.

2 marks

1fiii) Mention one method for the determination of hardness in water.

1 mark

QUESTION TWO

2a) In an analysis to determine the chloride present in a given sample weighing 1.52g by precipitation gravimetric method, aqueous solution of the sample was acidified with dilute acid and a slight excess of silver nitrate solution was added, whereupon the chloride present in the sample was precipitated as silver chloride. If the weight of the silver chloride precipitate obtained is 0.126 g, calculate the percentage of chloride in the sample. Gravimetric factor = $\text{Cl/AgCl} = 0.24737$

9 marks

2b) Explain briefly the principle of infrared Spectroscopy.

6 marks

QUESTION THREE

3a) In order to determine the concentration by atomic absorption spectroscopy (AAS) of vanadium in a vegetable sample obtained from a farm polluted with crude oil spill, standard solutions of vanadium was prepared and their absorbance was read at 525 nm. If the following data were obtained;

Standard	Concentration (mol/L)	Absorbance
1	0.00008	0.124
2	0.00016	0.239
3	0.00040	0.614
4	0.00080	1.160

Determine the concentration of vanadium in the vegetable sample whose absorbance is 0.56.

11 marks

3b) Enumerate the procedure of determination of concentration of an analyte by colorimetry.

4 marks

QUESTION FOUR

4a) Use a schematic diagram to show the procedure for;

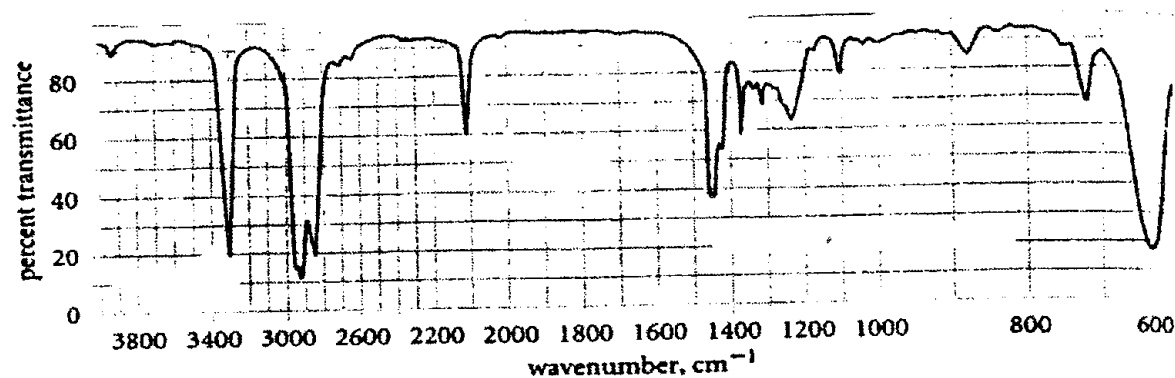
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|-----|--|---------|
| i. | Separation of metal cation in a sample. | 5 marks |
| ii. | Identification of metal cation in a sample | 5 marks |

4b) Differentiate between qualitative analytical groups and groups of the periodic table.

5 marks

QUESTION FIVE

5ai) Use the table of characteristic infrared absorption bands of organic functional groups provided to identify the functional groups present in an organic molecule whose IR spectrum appear below.



CHARACTERISTIC INFRARED ABSORPTION BANDS OF FUNCTIONAL GROUPS

Class of compounds	Absorption cm^{-1}	Intensity	Assignment
Alkanes and Akyls	2850 – 3000	s	C – H stretch
	1450 – 1470	s	C- H bend
	1370 – 1390	m	CH_2 , C – H bend
	1365 +1395	m	$-\text{CH}(\text{CH}_3)_3$ bend
	Two bands 715 - 725	w	$-(\text{CH}_2)_n$ bend
Alkenes	3020-3140	w-m	$=\text{C-H}$ Stretch
	1640-1670	vw-m	$\text{C}=\text{C}$ Stretch
	910+990	m+s	$=\text{C-H}$ bend
	Two bands 885-895	s	$=\text{C-H}$ bend
	665-730	m-s, broad	$=\text{C-H}$ bend
	960-980	s	$=\text{C-H}$ bend
	790-840	s	$=\text{C-H}$ bend
Alkynes	3265-3335	s	$=\text{C-H}$ Stretch
	2100-2140	m	$\text{C}=\text{C}$ Stretch
	610-700	s	$=\text{C-H}$ bend
	2190-2260	vw-w	$\text{C}=\text{C}$ Stretch
Ethers	1085-1150	s	C-O-C Stretch
	1020-1075 and 1200-1275 (Two bands)	m	$=\text{C-O-C}$ sym and asym stretch
Aldehydes	2700-2725	m	$\text{H-C}=\text{O}$ Stretch
	1720-1740	s	$\text{C}=\text{O}$ Stretch
	1685-1710	s	$\text{C}=\text{O}$ Stretch
	1100	m	C-C-C bending

Carboxylic acids	2500-3500 1710-1715 1680-1710	s bend s, broad s, broad	O-H Stretch C=O Stretch C=O Stretch
Alcohols	3300 – 3400 1125 - 1205	s, broad m - s	O – H stretch C –O stretch

Intensity abbreviations: vw = very weak, w = weak, m = medium, s = strong, vs = very strong

7 marks

5aii) Deduce from the identified functional groups what class of organic compound it is whose IR spectrum appear in 5ai above.

2 marks

5b) Enumerate the significant of acidity in water.

6 marks