NATIONAL OPEN UNIVERSITY OF NIGERIA
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FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCE
OCTOBER/NOVEMBER, 2019 SECOND SEMESTER EXAMINATION

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

1a. State various types of possible transitions in organic molecules. 2 marks

1b. In an experiment to determine the concentration of a metal in an environmental sample, it was required to prepare a calibration curve of the UV-Visible absorbance of different concentrations of its coloured complex. Different volumes of 0.005 mol/dm^3 stock solution of the complex were diluted to 50 cm^3 mark in a volumetric flask.

i. Copy and complete the following table: 5 marks

	Volume (cm^3) of stock solution of metal complex diluted	Concentration (mol/dm^3) of metal complex	Absorbance
1	5.0	0.0005	0.022
2	10.0		0.045
3	15.0		0.063
4	20.0		0.085
5	25.0		0.107
6	30.0		0.122

(ii) Use your completed table in (a) to plot the calibration curve of the absorbance versus concentration of metal complex. 5 marks

(iii) If the absorbance of the metal in the environmental sample is 0.060 determine the concentration of the metal.

2 marks

1ci. Mention two requirements for Colorimetry determination 2 marks

1cii. State the relationship between the amounts of visible radiation absorbed by a coloured compound and the concentration of the analyte in the solution.

1 mark

1ciii. What happens when a molecule absorbs radiation at the infrared region? 1 mark

1di. Complete the table below: 3 marks

Type of transition	Region of radiation absorption
	Far infrared/microwave
Vibration	
Electronic	

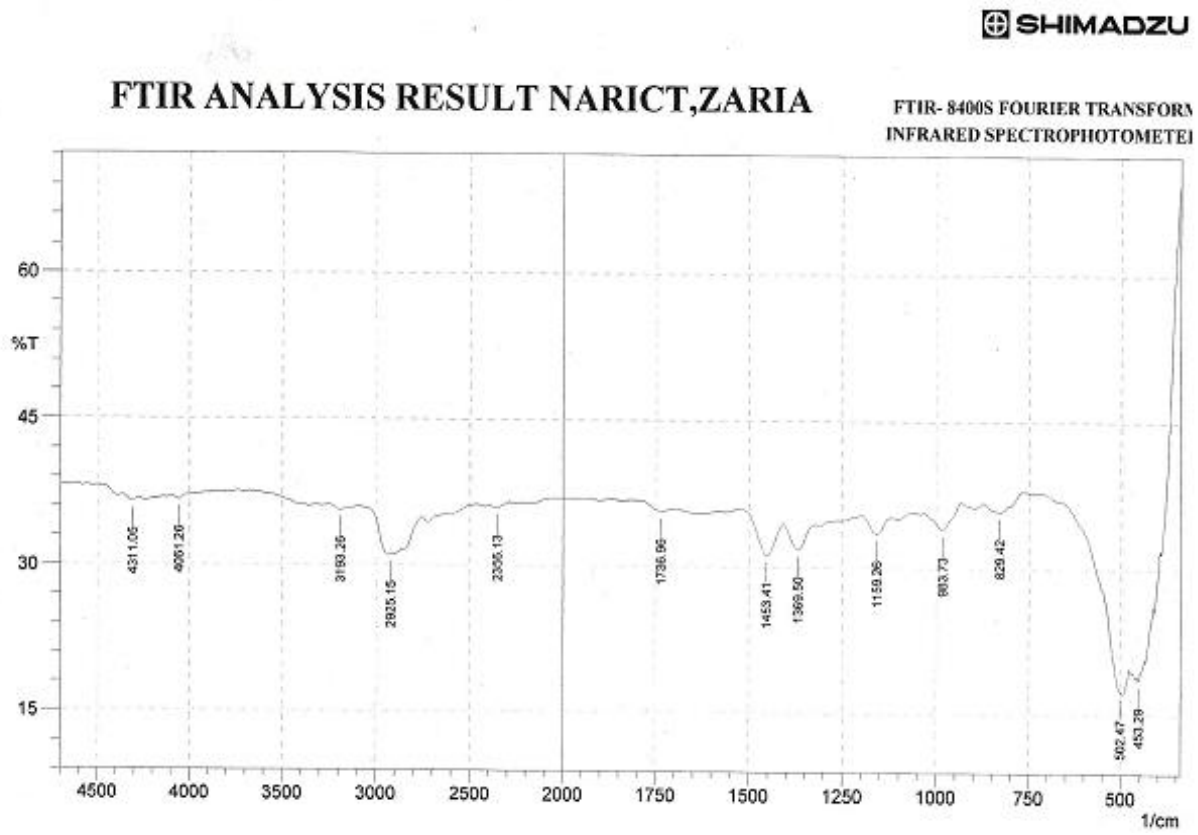
1dii. What are the two major types of fundamental vibrations in an organic molecule? 1 mark

1e. State one major application of Atomic Absorption Spectroscopy. 1 mark

1f. Describe how inclusion can be removed from a precipitate. 2 marks

QUESTION TWO

2a. Below is an infrared spectrum of an unknown organic compound. Using the table of the characteristic infrared absorption bands of organic functional groups provided below, identify the functional groups present in this organic compounds.



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	$-CH(CH_3)_3$ bend
	Two bands		
	715 - 725	w	$-(CH_2)n$ bend
Alkenes	3020-3140	w-m	=C-H Stretch
	1640-1670	vw-m	C=C Stretch
	910+990	m+s	=C-H bend
	Two bands		
	885-895	s	=C-H bend
	665-730	m-s, broad	=C-H bend
	960-980	s	=C-H bend

	790-840	s	=C-H bend
Alkynes	3265-3335 2100-2140 610-700 2190-2260	s m s vw-w	=C-H Stretch C=C Stretch =C-H bend C=C Stretch
Ethers	1085-1150 1020-1075 and 1200-1275 (Two bands)	s m	C-O-C Stretch =C-O-C sym and asym stretch
Aldehydes	2700-2725 1720-1740 1685-1710	m s s	H-C=O Stretch C=O Stretch C=O Stretch
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

9 marks

2b. Explain briefly the principle of infrared Spectroscopy. 6 marks

QUESTION THREE

3a. A laboratory analysis was conducted to determine the amount of aspirin (2-acetylbenzoic acid) in a commercial aspirin product using UV-Visible Spectroscopic method. The commercial aspirin was complexed with sodium hydroxide and iron (iii) Solution to form the salicylate dianion (the intensity of the colour of the complex is directly related to the concentration of aspirin present) and the absorbance of this complex determined. Five series of solutions with different aspirin concentrations was prepared and labeled A-E and complexed. The absorbance of each solution was measured. Using the information below

(i) Construct a calibration curve 6 marks

(ii) Use the calibration curve to determine the amount of aspirin in the commercial aspirin product. 4 marks

Concentrations of standard solution (mg/ml)	Absorbances of standard solution	Standard solutions
0.05	0.2	A
0.10	0.4	B
0.15	0.6	C
0.20	0.8	D
0.25	1.0	E

The absorbance of the commercial aspirin product is 0.5

3bi. Describe briefly the types of molecules that can absorb UV-Visible radiation. 2 marks

3bii. What are the applications of UV-Visible spectroscopy 3 marks

QUESTION FOUR

4a. Write briefly on the principle of Atomic Absorption Spectroscopy. 6 marks

4b. The concentration of magnesium in tap water is to be determined by employing Atomic Absorption Spectroscopy (AAS) to measure the absorbance of magnesium in tap water. If a set of standard solutions of magnesium was prepared as given in the table below, and their absorbance obtained;

i. Prepare a calibration curve of the magnesium standard solutions and 6 marks

ii. determine from the calibration curve the concentration of magnesium in the tap water if the absorbance of the magnesium in the tap water is 0. 2

3 marks

Concentration of magnesium standard solutions (PPM)	Absorbance of magnesium standard solutions
2.50	0.2
4.500	0.3
6.500	0.5
8.500	0.7
10.500	0.9

QUESTION FIVE

5ai. Below is a table of values obtained for the determination of total alkalinity in a water sample, use this table to calculate the total alkalinity of a 100 ml water sample titrated with 0.02 M H_2SO_4.

NO of titration	Volume of sample (mL)	Initial burette reading	Final burette reading	Volume of Sulphuric (mL)
1	100	0.00	8.50	8.50
2	100	0.00	8.30	8.30
3	100	0.00	8.30	8.30

6 marks

5aii. Mention the indicators used to detect the presence of the following sources of alkalinity in water samples.

i. OH^-
ii. HCO^{3-}

2 marks

5aiii. Give two significance and application of alkalinity. 2 marks

5bi. Describe briefly the term Gravimetric Analysis. 3 marks

5bii. State the uses of gravimetric analysis. 2 marks