BOWEN UNIVERSITY, IWO OSUN STATE
COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE
INDUSTRIAL CHEMISTRY PROGRAMME
2022/2023 B.SC DEGREE SECOND SEMESTER EXAMINATION

Course Code: CHM 326 Course Title: Applied Spectroscopy Credit: 2
Date: 23/06/2023 Time allowed: 2 hours

Instructions: (a) Answer Any four (4) questions.
(b) Answer each question on a fresh page.
EACH QUESTION CARRIES 25 MARKS.

Question 1

(a) Define the following terms in Mass Spectroscopy:

i. Metastable ion ii. Fragmentation iii. Mass spectrum **6 Marks**

(b) State the uses of IR spectroscopy **6 Marks**

(c). Discuss the principle of Ultraviolet Spectroscopy **8 Marks**

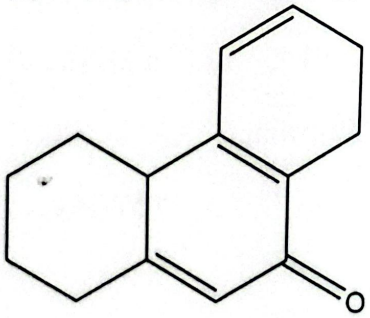
(d) Briefly explain the difference in the infrared absorption pattern of a) H_2 and b) CO_2 **5 Marks**

Question 2

(a) Briefly describe the infrared and microwave region of the electromagnetic radiation **6 Marks**

(b) List and explain the three (3) major components of a UV/Visible Spectrophotometer. **6 Marks**

(c). Using UV spectroscopy only, differentiate between the following pairs **8 Marks**



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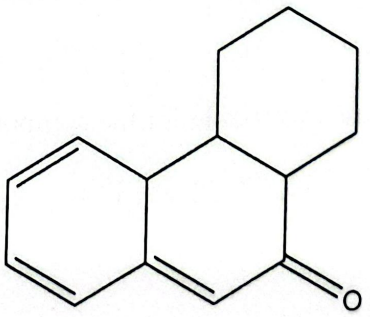
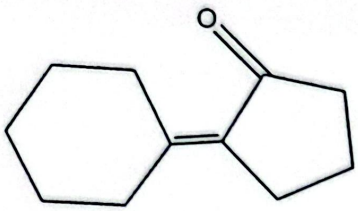


Cii



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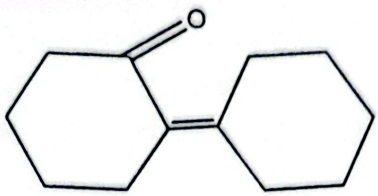


Ciii Civ

(d) Explain anisotropic effect as a term that influences the chemical shift of a compound

5 Marks

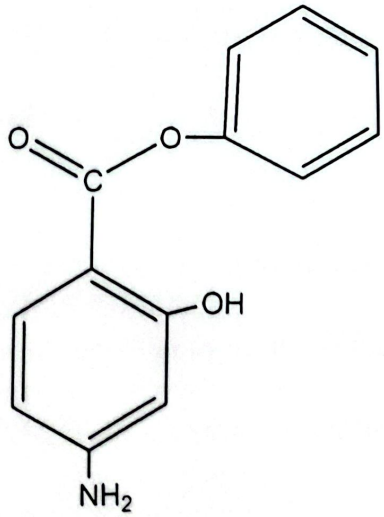
Question 3

(a) A compound burns with luminous sooty flame has Infrared absorption at 3600, 3000, 1640 cm^{-1} and reacts with B V_{max} at 1899 and 1760cm^{-1}. The products are C 1765 and 1640cm^{-1} and D 3250 – 2500cm^{-1} and 1700cm^{-1}

i. Write the functional groups of A, B C and D **8 Marks**

ii. Write the equation for the reaction. **2 Marks**

(b) Describe in detail the Infrared spectra characteristics of



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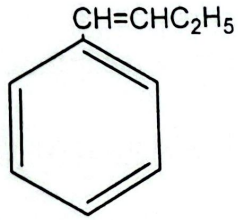

ii

8 Marks

(c) Predict structures justifiable for the compound $C_7H_{14}O$ with the following

m/e ratios: 29, 57, 72, 85, 114 **7 Marks**

Question 4

(a) Predict structures for the following:

i $C_5H_{10}O_2$ (3H T 1.1, 2H Q 2.1, 2H Q 4.1, 3H T 1.3)
ii $C_5H_8O_2$ (2H Q 4.1, 3H T 1.3, 2H D 6.2, 1H T 5.8)
iii. C_4H_8O (3H S 2.1, 2H Q 2.4, 3H T 1.2

6 Marks

(b) i Explain Beer-Lambert law as related to absorption spectroscopy **2 Marks**

ii Write short notes on the following:

Electron coupled spin-spin splitting **2 Marks**

Chemical Shift **2 Marks**

(c). Propose a structure for a ketone with the following m/e ratios

27 35%) 28 (10%) 29 (70%) 41 (22%) 57 (100%) 72 (20%) 85 (22%) 114 (100%) **8 Marks**

(d). Justify the statement "Only those vibrations that result in a rhythmical change in the dipole moment of the molecule are observed in the infrared region" **5 Marks**

Question 5

(a) When acetone is treated with a base, a higher boiling liquid bpt 130°C can be isolated from the reaction mixture. The spectrum properties of this liquid are

IR: $\tilde{\nu}$ 1620cm^{-1} 1695cm^{-1}

NMR: 1.9 (3H S) 2.1 (6H, S) 6.15 (1H S)

UV λ_{max} = 11,700

MS: $^{m}/_{z}$ 55 (100) 83 (90) 43 (78) 98 (49) 29 (46) 39 (43) 27 (42) 53 (13) 41 (18) 28 (18)

Deduce the structure of the liquid based on the above spectra properties! **10 Marks**

(b) Septan-3-one $CH_3CH_2COCH_2CH_2CH_2CH_3$ showed the following peaks in MS

$^{m}/_{e}$	27	28	29	41	57	72	85	114
R.A (%)	35	10	70	22	100	20	22	10

Justify all $^{m}/_{e}$. **4 Marks**

(c) From Spectra A, Justify and Identify all vibrational frequencies and their associated compounds **6 Marks**

Spectra A

(d) How does bond strength affect vibrational frequencies of a compound? **5 Marks**