KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2019/2020

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF PHARMACY (BPharm Level IV)

PPC 420: PHARMACEUTICAL CHEMISTRY IV

DATE: Monday, 29th March 2021 **TIME: 8.00 a.m. - 11.00 a.m.**

INSTRUCTIONS:

- **The paper consists of three sections A, B and C**
- **Answer all questions**
- **Answer sections A, B and C in separate booklets**

SECTION A: SPECTROSCOPY I

1. State five (5) ways in which a non-polymorphic pharmaceutical substance may be prepared to obtain an IR spectrum from a Fourier Transform Infrared Spectrophotometer (FTIR) (5 marks).
2. Calculate the percentage of Ultraviolet (UV) incident radiation absorbed by a drug that gives an absorbance of 0.500 (3 marks).
3. In the analysis of a sample of acyclovir cream 5% w/w by UV spectrophotometry, 0.1564 g of the cream was shaken with 50 mL of 0.5 M sulfuric acid in a separating funnel. To this mixture, 50 mL of ethyl acetate was added, shaken vigorously and allowed to separate. The aqueous layer (A) was then collected in a conical flask. The organic layer was washed with 15 mL × 2 portions of 0.5 M sulfuric acid and the washings (B) combined with the aqueous layer (A). The combined aqueous extracts (A+B) were made to 100 mL with 0.5 M sulfuric acid and filtered. To 10 mL of the filtrate, water was added to produce a 50 mL solution. The UV absorbance of the resulting solution at 255 nm was recorded as 0.863 in a 1 cm cuvette.

   (a) Taking the **A (1%, 1 cm)** value for acyclovir at 255 nm to be 562, Calculate the content (% w/w) of acyclovir in the sample. (4 marks)

(b) Calculate the acyclovir content as a percentage of the stated amount. Round off your answer to 4 significant figures (4 marks)

4. The following signals were obtained from an infrared spectrum of phenoxymethyl penicillin potassium whose chemical structure is shown figure 1. Assign each of the signals to the most likely chemical bond stretch or bend: 3360 cm^{-1}; 3000 cm^{-1}; 1765 cm^{-1} 1744 cm^{-1}; 1690 cm^{-1} (5 marks)

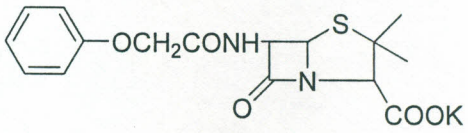


Figure 1

5. State Beer's Law and explain four applications of Ultraviolet/Visible spectrophotometry in pharmaceutical analysis (5 marks)
6. Regarding Infrared (IR) spectrophotometry
   (a) Explain its working principle (3 marks)
   (b) Convert 2500 nm and 50000 nm wavelengths to wavenumbers (cm^{-1}) (2 marks)
7. Describe three classes of interferences that may be encountered during atomic absorption spectrophotometry (6 marks)
8. Calculate the specific optical rotation [α] for timolol maleate 9.8% w/v in 1 M HCl; α = 0.59 [made using the sodium D line at 25°C in a 1 dm cell] and express it in the conventional form (3 marks).

SECTION B: SPECTROSCOPY II

1. (a) Using appropriate illustrations and text, explain one "hard" and one "soft" ionization method used in Mass-Spectrometry. (6 marks)
   (b) Determine the molecular formula of an ester with a molecular ion peak at m/z = 102. (3 marks)
   (c) Using mass fragmentation trees, illustrate the formation of the fragments shown in brackets arising from the following compounds: (4 marks)
   (i). Trans-2-heptene (m/z = 55)

(ii). 1- Pentanol (m/z = 31)

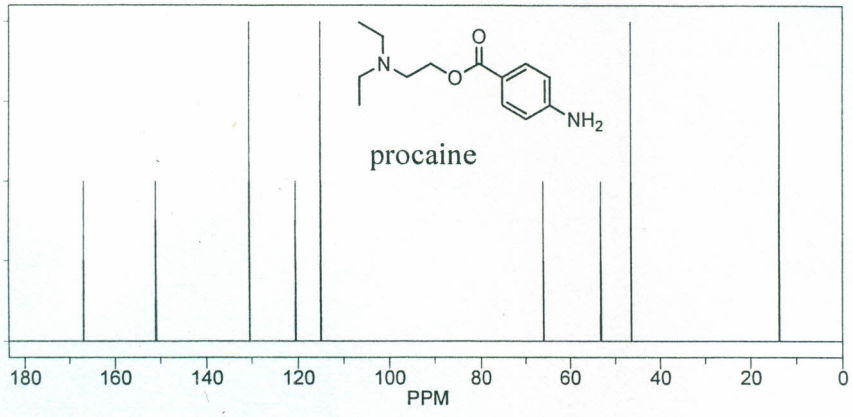
(iii).$CH_3CH_2CH_2NHCH_2CH_2CH_2CH_3$ (m/z = 72)

(iv).2-pentanone (m/z = 43)

2. (a) Define the term chemical shift as used in NMR (1 mark)

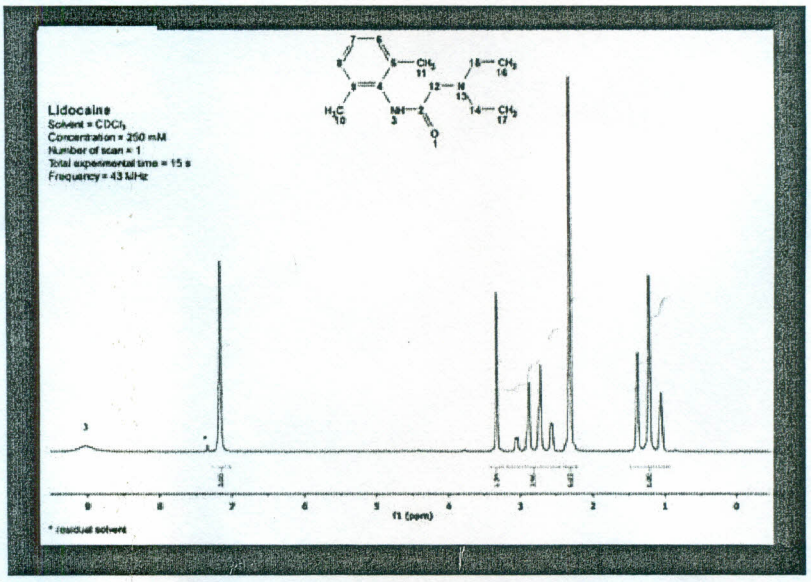
(b) Discuss three factors affecting chemical shift in both C-13 and ^1H NMR. (3 marks)

(c) Assign the signals in the C-13 spectrum of procaine shown below (6 marks)

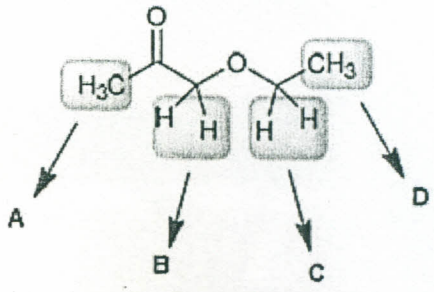


(d) Explain two applications of NMR spectroscopy in pharmaceutical industry (4 marks)

3. (a) Assign the signals in the ^1H NMR spectrum of lidocaine shown below (6 marks)



(b) Determine the multiplicity expected in the ^1H NMR spectrum of each signal in the following compound: (4 marks)



(c) Using examples, explain the three types of equivalence protons in ^{1}H NMR. (3 marks)

SECTION C: ELECTROCHEMICAL METHODS

1. Using five examples, discuss the theory behind ion selective electrodes (ISE) (10 Marks).
2. During analysis by differential potentiometry, a 0.05 M standard solution of silver nitrate was placed in one container and 50.0 mL of the sample solution was placed in another container. The two containers were electrically connected with a potassium nitrate salt bridge. Identical silver-wire indicator electrodes were inserted into the solutions and connected to a voltmeter. Addition of 5.24 mL of 0.100 M silver nitrate to the sample solution was required to make the emf between the two solutions zero. Use this information to answer the following:
   (a) Describe 2 functions and 3 ideal properties of a salt bridge (5 marks)
   (b) Calculate the concentration of silver ions in the original sample solution (5 Marks)
3. Discuss the care and advantages of a dropping mercury electrode (DME) as used in polarography (10 marks)
4. With suitable examples, discuss the four commonly encountered curves in amperometric titrations (10 marks).