



UNIVERSITY OF RUHUNA – FACULTY OF ALLIED HEALTH SCIENCES

DEPARTMENT OF PHARMACY

FOURTH B.PHARM PART I EXAMINATION – JUNE 2018

PH 4123 PHARMACEUTICAL ANALYSIS (SEQ)

TIME: TWO HOURS

INSTRUCTIONS

- There are four (04) questions in parts A, B, C, D, & E of SEQ paper.
- Answer each part in a separate booklet.
- Do not use any correction fluid.
- Marks will be deducted for illegible hand writing.

PART A

01. Answer all parts

1.1

1.1.1. Define the term spin-spin coupling pertaining to ^1H NMR spectroscopy.

(10 marks)

1.1.2. Explain briefly the two expected ^1H NMR spectra for an AX_2 spin system and AMX spin system. (**Hint:** AX_2 spin system has same J value whereas AMX spin system has two different J values).

(10 marks)

1.1.3. Give the number of peaks and their multiplicities that you would expect in the ^1H NMR spectra of the following molecules.

1.1.3.1. methylpropionate

1.1.3.2. 4-chlorophenol

(10 marks)

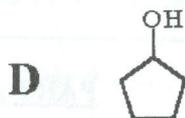
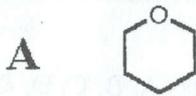
1.1.4. The compound **X** with the molecular formula of $\text{C}_4\text{H}_7\text{O}_2\text{Cl}$ gives the following signals in its ^1H NMR spectrum. $\delta 1$: 1.30 (t, 3H), $\delta 2$: 4.05 (s, 2H) and $\delta 3$: 4.20 (q, 2H).

Also, it shows a $\text{C}=\text{O}$ absorption band in its IR spectrum. Giving reasons propose a plausible structure for compound **X**.

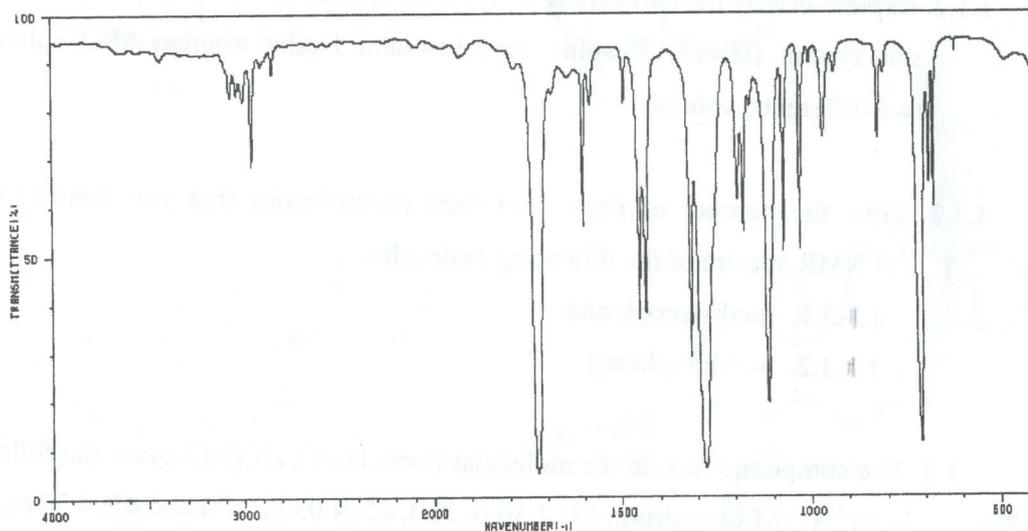
(20 marks)

PART B

1.2. Match the five $C_5H_{10}O$ isomers below (A-E) with the key infrared absorption bands listed:
(Note: the fingerprint bands and alkane C-H stretches are not reported.) (20 marks)

1.2.1. 3400 cm^{-1} 1.2.2. $3400, 1660\text{ cm}^{-1}$ 1.2.3. 1715 cm^{-1} 1.2.4. $1660, 1100\text{ cm}^{-1}$ 1.2.5. 1100 cm^{-1} 

1.3. The molecule with molecular formula $C_8H_8O_2$ gives following IR spectrum. Propose a reasonable structure for the molecule. Assign indicated wavenumbers (in the table) to the appropriate bonds. (30 marks)



Frequency (cm^{-1})	Assignment ν
3065-3033	
2999, 2952, 2905	
1724	
1601, 1493	
1452	
1278, 1111	
710	

PART C**02. Answer all parts**

2.1. A standard operating procedure states that a column must have efficiency > 30 000 theoretical plates/m. Which of the following 20 cm columns meet the specification?

(15 marks)

Column	Retention time of analyte (min)	$W_{1/2}$ (min)
X	7.4	0.2
Y	6.8	0.2
Z	8.3	0.7

2.2 In gas chromatography, the van Deemter equation relates the column efficiency to the mobile phase flow rate by the following equation.

$$H = A + \frac{B}{u} + Cu$$

2.2.1 Sketch a typical van Deemter plot with labeled axis that shows how H depends on

u.

(10 marks)

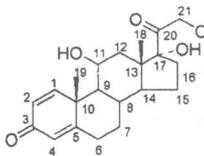
2.2.2 Briefly explain the terms A, B and C in the equation.

(15 marks)

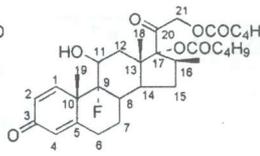
2.2.3 What is the similarity of van Deemter plot of liquid chromatography and that of gas chromatography?

(05 marks)

2.3 A sample containing following compounds were eluted from a reverse phase HPLC column using 75:25 methanol/water as the mobile phase.

**(I)**

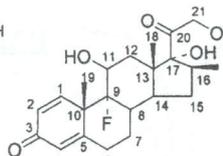
Prednisolone

**(II)**

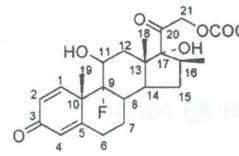
Betamethasone

17,21-

dipropionate

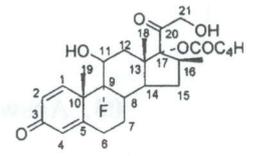
**(III)**

Betamethasone

**(IV)**

Betamethasone

21-valerate

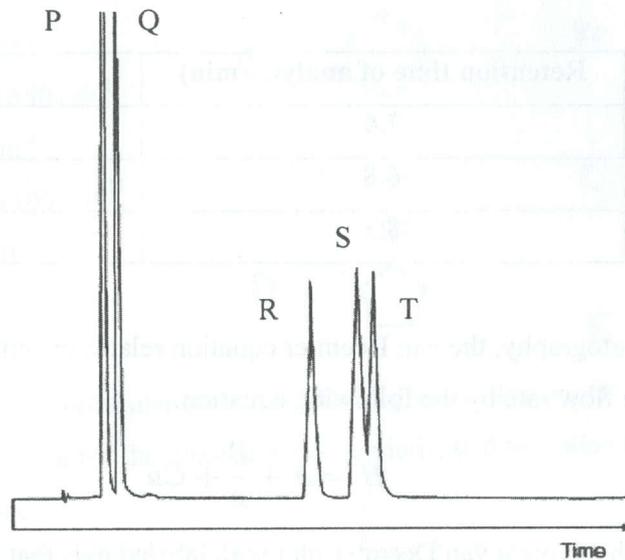
**(V)**

Betamethasone

17-valerate

Following HPLC chromatogram (UV detection at 240 nm) was obtained for the sample.
Giving reasons, assign the compounds (I)-(V) to the chromatographic peaks P-T.

(40 marks)



2.4 In an ion exchange chromatographic analysis, 15.0 g of cation exchanger were used. Suppose that 2.0 M NaCl solution was used to replace the entire H^+ bound to the resin and those H^+ was titrated with 0.25 M NaOH solution. If the volume of NaOH required was 32.50 mL, calculate the available capacity of the resin. (15 marks)

PART D

03. Answer all parts

3.1. Galvanic cells convert chemical energy to electrical energy. Describe the following galvanic cells.

3.1.1. $Zn(s)|ZnSO_4(aq, m_1, \text{mol kg}^{-1})||CuSO_4(aq, m_2, \text{mol kg}^{-1})|Cu(s)$ (15 marks)

3.1.2. $Pt(s), H_2(g)(p^{st})|HCl(aq, a_{\pm} = 1 \text{ mol dm}^{-3})|AgCl(s)|Ag(s)$ (15 marks)

3.1.3. Calculate the standard cell potential, E°_{cell} of the cell given in 3.1.1 at 298 K for the reaction involving and hence calculate the change in Gibbs free energy, ΔG° of the process. (15 marks)

Hint: $\Delta G^\circ = -n F E^\circ_{\text{cell}}$

Note: $F = 96500 \text{ C mol}^{-1}$



3.2. Moisture content is one of the most commonly measured properties of pharmaceutical materials.

3.2.1. For which purposes water is added to drugs?

3.2.2. Briefly discuss:

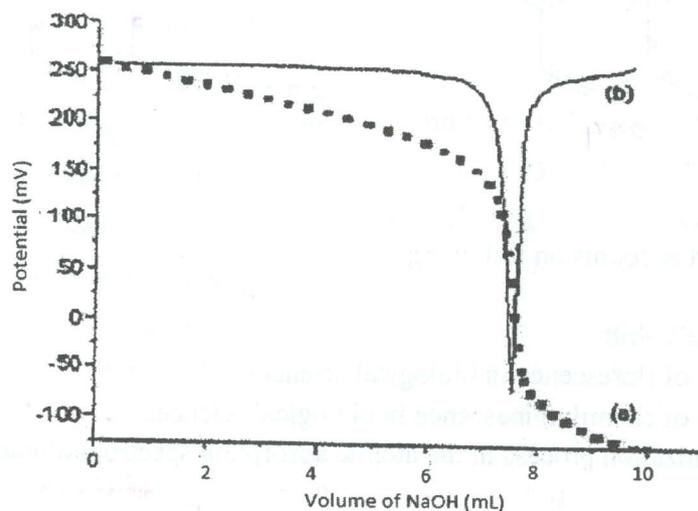
3.2.2.1. the importance of determination of water content

3.2.2.2. the microwave and electrochemical methods of water determination in drugs.

(30 marks)

3.3. Potentiometric titration with ion selective electrodes has been used for the analysis of captopril in pharmaceuticals formulations. The method is based in a potentiometric titration of captopril (carboxyl group) in aqueous solutions with sodium hydroxide solution using a combined glass electrode, coupled to an autotitrator. An aliquot of 15.00 mL of captopril solution was prepared by dissolving a tablet weighing 3.195 g that contains captopril. This solution was potentiometrically titrated with a standard solution of $0.0200 \text{ mol dm}^{-3}$ NaOH at 25°C .

Following figure shows the resulting titration curve with only one inflection point since captopril is a very weak acid in relation to its second hydrogen ($K_2 = 10^{-10}$) that its titration curve does not present a perceivable inflection for the second point of equivalence.



Potentiometric titration curves: (a) experimental titration curve, (b) first derivative curve

Using the above information and titration experiment data, calculate the content (m/m) % of captopril in the tablet. (25 marks)

PART E

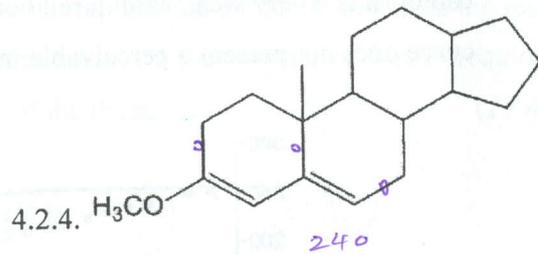
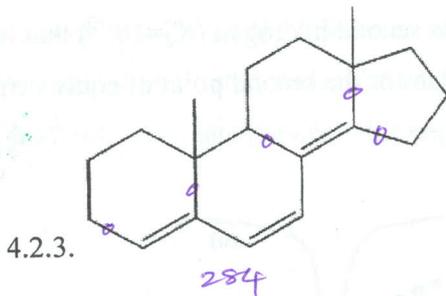
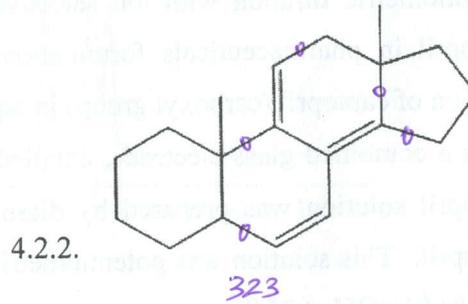
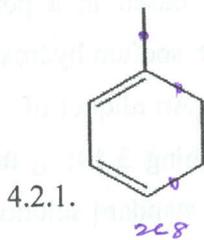
04. Answer all parts

4.1. Using the energy level diagrams, show all possible electronic transitions take place from ground state to excited state of the following molecules:



(20 marks)

4.2. Using Woodward-Fieser rules, calculate the λ_{max} for the following compounds.



(40 marks)

4.3. Write short accounts on following.

4.3.1. Stoke's shift

4.3.2. Uses of florescence in biological sciences

4.3.3. Uses of chemiluminescence in biological sciences

4.3.4. Atomization process in the atomic absorption spectrophotometry.

problem of conversion of absorbance into conc. (40 marks)

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