THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATION – 2021

APPLIED CHEMISTRY – THIRD YEAR DEGREE

CH313- INSTRUMENTAL ANALYSIS I

TUESDAY 15TH JUNE, 2021 – 08:20 AM

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES:

1. You have 10 minutes to read the question paper. You MUST NOT begin writing in the answer book during this time.
2. ANSWER ALL THREE QUESTIONS.
3. All answers MUST be written on the answer book provided.
4. Calculators are permitted in the examination room. Lecture notes, notebooks and text books and are NOT allowed.
5. ALL MOBILE PHONES MUST BE SWITCHED OFF AND PUT AWAY OFF THE EXAM TABLE.
6. Show all workings and calculations in the answer book.
7. Write your name and number clearly on the front page. **DO IT NOW**.

MARKING SCHEME: [50 MARKS]

1. (a) In the laboratory synthesis of ortho- and para- nitro-aniline;

(i) Why was aniline acetylated before nitration? [2 marks]

(ii) Why were the ortho and para-nitroaniline the major products? [1 mark]

(iii) Why was activated carbon added before filtration? [1 mark]

(iv) Why was nitration done in ice cold condition? [1 mark]

(v) Why was nitrated acetanilide hydrolyzed? [1 mark]

(b) Briefly describe the extraction processes of light solvent extraction technique. [3 marks]

(c) Before attempting a preparative chromatographic analysis, why is it important to do prior thin layer chromatography (tlc) analysis. [3 marks]

(d) (i) Explain why iodine is not a suitable detector for thick layer chromatography. [1 mark]

(ii) Explain the two advantages of chromatotron over column chromatography. [2 marks]

(Total = 15 Marks)

2. (a) What would be the chromatographic method of choice for the following:

(i) Production of de-ionized water.

(ii) Separation of industrial synthetic polymers. [2 marks]

(b) (i) In doing tlc and paper chromatography, why is it important to keep the developing tank air-tight? [2 marks]

(ii) Explain the two advantages paper chromatography have over tlc. [2 marks]

(c) Contrast the solute/stationary phase interaction between gel permeation chromatography and thin layer chromatography. [4 marks]

(d) (i) Why is it important to keep a GC column temperature at or below recommended temperature limit? [2 marks]

(ii) How is the GC retention time affected when the carrier gas rate is increased and the column temperature is kept constant. [2 marks]

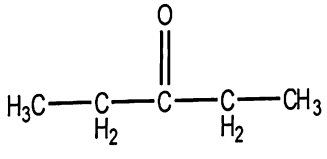
(iii) Comment on the efficiency of a HPLC column measured in terms of particle size, plate height and plate number. [4 marks]

(Total = 18 Marks)

3. (a) If you are given IR spectra of ethyl amine and acetamide, how you would differentiate them? [2 marks]

(b) List and briefly explain the FIVE main stages of mass spectrometry. [5 marks]

(c) From the structure given below, use:



(i) Give the number of different chemical environments for the magnetic nuclei of ^{1}H and ^{13}C. [2 marks]

(ii) Sketch diagram to Predict the chemical shift of the chemically equivalent ^{1}H, their splitting pattern and the number of ^{1}H that would give the respective signals. [5 marks]

(iii) Sketch diagram to predict the ^{13}C chemical shifts. [3 marks]

(Total = 17 Marks)