THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH 442 – APPLIED ANALYTICAL CHEMISTRY

TUESDAY 26TH OCTOBER 2021 – 12:50 PM

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES: -

1. You will have 10 minutes to read the question paper. You **MUST NOT** begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS IN EACH SECTION.**
3. All answers **MUST** be written on the **SEPARATE ANSWER BOOKS** provided.
4. Calculators are permitted in the examination room. Lecture notes, notebooks plain papers and textbooks are **NOT ALLOWED**.
5. Mobile phones are not allowed. **SWITCH OFF THE MOBILE PHONES.**
6. Show all workings and calculations in the answer books.
7. **DRAW the STRUCTURES** clear and visible.
8. **DO NOT** over write.
9. Write your name and student ID number clearly on the front page of the answer books. **DO IT NOW.**

MARKING SCHEME:

SECTION A: [30 MARKS]

SECTION B: [30 MARKS]

TOTAL 60 MARKS

SECTION A

ANSWER ALL QUESTIONS

1. (a) Give the rationale for implementing quality assurance in the analytical chemistry laboratory. [2 marks]

   (b) Name the international quality system applicable to a chemical testing laboratory and discuss the benefits of implementing it. [2 marks]

   (c) Draw a Shewhart Control Chart and briefly explain how it is implemented. [3 marks]

   (Total = 7 marks)

2. (a) Define method validation and give at least FOUR key performance characteristics that are established during the validation process. [3 marks]

   (b) Define precision and differentiate between repeatability and reproducibility precision. [2 marks]

   (c) Name the different types of blanks and describe what each type achieves in the quality control strategy of an analytical laboratory. [3 marks]

   (Total = 8 marks)

3. The results of a HPLC method validation exercise are given below.

   (i) Recovery test using 10 ppm spike gave a result of 7.5 ppm.

   (ii) The repeatability precision test gave the results presented below.

Injection #	Std conc. (ppm)	Peak Area	Mean Peak Area	% RSD
1	20	1061942		
2	20	1051362		
3	20	1072773	----------	-------
4	50	2579139		
5	50	2564200		
6	50	2624116	----------	-------
			Mean % RSD	-------

Refer to the DATA SHEET (Page 4) for formulas to help with your calculations.

(a) Calculate the recovery of the method. [2 marks]

(b) Calculate the repeatability precision of the method. [4 marks]

(c) Does the method pass the accuracy and precision tests if the accepted recovery = 100±10% and precision RSD = ≤ 1.0%? [2 marks]

(Total = 8 marks)

4. (a) What is the objective of laboratory proficiency (PT) testing? [2 marks]

(b) In a recent proficiency testing program, the National Food Testing and Monitoring Centre (NFTMC) obtained a histamine result of 35.7 ppm. If the PT accepted value of histamine was 31.3 ppm, calculate the accuracy or bias of NFTMC. [3 marks]

(d) If the accepted accuracy for this PT is 100 ± 15%, comment on NFTMC's performance (i.e., does it pass or fail this round of the PT testing?). [2 marks]

(Total = 7 marks)

Refer to the DATA SHEET (Page 4) for formulas to help with your calculations.

SECTION B

ANSWER ALL QUESTIONS

5. (a) Differentiate between eukaryotic and prokaryotic cells with reference to cell size, nuclear membrane, chromosome number chromosome shape, mitosis and chloroplast. [3 marks]

(b) Define resolving power and explain why oil immersion lens or 100x objective lens of a compound microscope has higher resolution compared to lower dry objective lenses. [3 marks]

(c) What are the functions of major and trace elements in a bacterial cell? [2 marks]

(d) Describe selective differential medium. Give an example of this type of medium, name the selective and differential agents it contains and their functions. [4 marks]

(e) Discuss the reasons why anaerobic microorganisms are not able to grow in the presence of oxygen. List two methods which can be used to grow anaerobic microorganisms. [3 marks]

(Total = 15 marks)

6. (a) Bacterial growth in a closed system goes through different phases during incubation. List and briefly explain these phases. [5 marks]

(b) How can control of growth of microorganisms be achieved? [1 mark]

(c) Explain the general mode of actions of antimicrobial agents. [5 marks]

(d) Explain the mode of actions of ANY ONE of the following. [4 marks]

(i) Chlorine and chlorine compounds.

(ii) UV radiation.

(iii) Ionizing radiation.

(Total = 15 marks)

DATA SHEET

1. $$\%\ Recovery = \frac{C_{measured}}{C_{added\ or\ accepted\ value}}\ x\ 100$$

Where: $C_{measured}$ = measured concentration of the spike or a test material.
$C_{added\ or\ accepted\ value}$ = actual concentration of the spike added or an accepted value of a test material.

2. $$RPD = \left[\frac{C_{higher} - C_{lower}}{\bar{X}}\right] x\ 100$$

Where: C_{higher} = concentration of the two measurements.
C_{lower} = concentration of the lower of the two measurements.
$\bar{X}$ = mean concentration of the two measurements.

3. $$Mean, \bar{X} = \frac{\sum X_i}{n}$$

Where: X_i = individual measurements.
n = number of measurements.

4. $$Standard\ deviation, s = \sqrt{\sum_i (X_i - \bar{X})^2/(n-1)}$$

5. $$RSD = \frac{s}{\bar{X}}\ x\ 100$$