

QUESTION PAPER

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

SECOND SEMESTER EXAMINATION

CH323 – ADVANCED INSTRUMENTAL ANALYSIS

MONDAY 25TH 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.**
3. All answers **MUST** be written on the answer book 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 book.
7. **DRAW the STRUCTURES** clear and visible.
8. **DO NOT** over write.
9. Write your name and number clearly on the front page. **DO IT NOW.**

MARKING SCHEME: Total 50 marks

1. (a) Explain, how X-ray absorption technique is useful in the detection of broken bones in the human body?
- (b) The mass absorption coefficient for Ni, measured with the CuK_α line is $49.2 \text{ cm}^2/\text{g}$. Calculate the thickness of a nickel foil that was found to transmit 48.1% of the incident power of a beam of CuK_α radiation. Assume that the density of Ni is 8.9 g/cm^3 .

(TOTAL: 10 Marks)

2. (a) What is the function of a collimator in an X-ray technique?
- (b) What is the short wavelength limit of continuum produced by an X-ray tube having a silver target and operated at 55 kV?
- (c) Draw a schematic diagram of an X-ray tube, label the major parts.
- (d) Explain the working principle of a pneumatic nebulizer.
- (e) Name TWO disadvantages of Geiger-Muller Tube counter.

(TOTAL: 10 Marks)

3. (a) Briefly mention TWO reasons why Graphite Furnace Atomic Absorption Spectrometry (GFAAS) may be preferable over Flame Atomic Absorption Spectrometry.
- (b) Mention TWO reasons why matrix modification in Graphite Furnace Atomic Absorption Spectrometry is useful.

(TOTAL: 8 Marks)

4. (a) Name TWO key components required to perform a Zeeman background correction in GFAAS?
(4 marks)
- (b) How is background correction performed in GFAAS instruments based on the Direct Current (DC) Zeeman correction technique?
(4 marks)
- (c) What are the disadvantages of the DC Zeeman Background Correction technique?
(4 marks)

(TOTAL: 12 Marks)

5. (a) Mention FOUR types of interferences encountered in Flame Atomic Absorption Spectrometry.

(4 marks)

(b) For each interference in 5 (a) above), mention ONE way a Chemist can overcome the interference.

(6 marks)

(TOTAL: 10 MARKS)

-----THE END – MERRY CHRISTMAS TO YOU-----

DATA SHEET

Conversion Table and Physical constants

Planck constant,

$$h \text{ (in J s)} = 6.63 \times 10^{-34} \text{ J s}$$

$$h \text{ (in eV s)} = 4.13 \times 10^{-15} \text{ eV s}$$

Speed of light (*in vacuo*), $c = 3 \times 10^8 \text{ m/s}$

$$1 \text{ J} = 6.24 \times 10^{18} \text{ eV}$$

$$1 \text{ \AA} = 10^{-10} \text{ m}$$

$$1 \text{ nm} = 10^{-9} \text{ m}$$