



# Technical University of Mombasa

Faculty of Applied and Health Sciences

**DEPARTMENT OF PURE AND APPLIED SCIENCES**  
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF  
TECHNOLOGY IN APPLIED CHEMISTRY  
**BTAC**

## **ACH 4310: SPECIAL ANALYTICAL TECHNIQUES**

SPECIAL/SUPPLEMENTARY EXAMINATION

MARCH 2014 SERIES

2 HOURS

Instructions to candidates:

This paper consist of **FIVE** questions

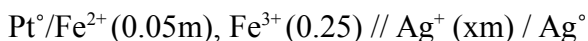
Answer question **ONE** (compulsory) and any other **TWO** questions

### Question ONE

- a) Define the following terms:-
- (i) Half-life (2marks)
  - (ii) Radio Tracer (2marks)
  - (iii) Biosensor (2marks)
- b) Using an example explain the meaning of electrode of the first kind. (4marks)
- c) State FOUR applications of radiochemical methods of analysis (4marks)
- d) Compared to other electrodes give any FOUR advantages of ion-selective electrodes

**(4marks)**

e) Determine the concentration of  $\text{Ag}^+$ , given that



$$E_{\text{cell}} = -0.106\text{V}$$

$$E^\circ \text{Fe}^{3+}/\text{Fe}^{2+} = 0.771\text{V}$$

$$E^\circ \text{Ag}^+/\text{Ag}^\circ = 0.799\text{V}$$

**(12marks)**

### Question TWO

- Electron spectroscopy can be used for chemical analysis. List down the different components of an electron spectrometer. **(4marks)**
- Explain the working principle of Auger electron spectrometry **(4marks)**
- List THREE advantages and THREE disadvantages of dropping mercury electrode.

**(12marks)**

### Question THREE

- State the difference between thermogravimetry and differential gravimetry. **(5marks)**
- An XPS electron was found to have a kinetic energy of 1052.6eV when ejected with an  $\text{Al}^{\text{K}}$  source ( $CA = 0.8393\text{nm}$ ) and measured in a spectrometer with a work function of 27.8eV. The electron is believed to be a N(1S) electron in  $\text{NaNO}_3$ . Given that :-  
 $h = 6.626 \times 10^{-34}\text{Js}$ ,  
 $C = 3.00 \times 10^8\text{m/s}$   
 $1\text{nm} = 10^{-9}\text{m}$ 
  - What was the binding energy of the electron? **(5marks)**
  - What would be the kinetic energy of the electron if a Mg K ( $CA = 0.98900\text{nm}$ ) source were used **(5marks)**
- Given FIVE applications of thermal analysis **(5marks)**

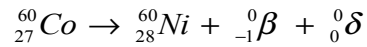
### Question FOUR

a) Describe how isotope dilution analysis is carried out **(10marks)**

b) Give some of the advantages of isotope dilution over neutron activation analysis

**(4marks)**

c) The 'Cobalt treatments' used in medicine to arrest certain types of concern rely on the ability of gamma rays to destroy cancerous tissues. Cobalt – 60 decays with the emission of beta particles and gamma rays, with a half-life of 5.27 yrs.



d) How much of a 3.42g sample of cobalt-60 remains after 30.0 years. **(6marks)**

### Question FIVE

a) Define the term pH **(2marks)**

b) State FOUR characteristics of a reference electrode. **(4marks)**

c) Discuss how qualitative and quantitative analysis is carried out in polarography.

**(8marks)**

d) Define the following terms :-

(i) Thermal analysis **(2marks)**

(ii) Voltammetry **(2marks)**

(iii) Limiting current **(2marks)**