



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 12S/ BTAC 13S EVE

ACH 4205: METHODS OF CHEMICAL SEPARATION

SEMESTER EXAMINATION

DECEMBER 2013 SERIES

2 HOURS

Instructions to candidates:

This paper consists of **FIVE** questions

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

QUESTION ONE

- a) Explain the following terms used in separation methods
- | | |
|---------------------------------------|----------|
| (i) Module | (2marks) |
| (ii) Rententate | (2marks) |
| (iii) Molecular weight cut off (MWCO) | (2marks) |
| (iv) Osmotic pressure | (2marks) |
- b) Movement of solutes across the membrane is by mass transport. List FOUR driving forces for mass transport. (4marks)
- c) Using examples, state and explain two broad classes of separations. (6marks)
- d) State TWO disadvantages of cellulose acetate which makes it to be a less common material compared to synthetic materials like polyamide in membrane technology. (2marks)
- e) The chromatograph below shows a phenomenon that occurs in chromatographic

separations. Give an explanation for such occurrence.

(4marks)

- f) In a separation process a mixture of sodium chloride, protein and sucrose in waste water is to be separated from one another . With reasons, devise a combination of membrane processes to accomplish the same. **(6marks)**

QUESTION TWO

a) Describe the fundamental difference between;

- (i) Ion-exchange and size-exclusion chromatography **(2marks)**
- (ii) Reverse and normal phase chromatography **(2marks)**

b) What is the order in which the following compounds would be eluted from an HPLC column containing a reversed –phase packing

- (i) Benzene, diethyl ether, n-hexane **(2marks)**
- (ii) Acetone, dichloroethane, acetamide **(2marks)**

c) Define the following terms and describe how they affect column separation:

- (i) Retention factor **(4marks)**
- (ii) Selectivity factor **(4marks)**

(iii) Theoretical plate **(4marks)**

QUESTION THREE

- a) Explain the term fouling as used in membrane technology **(2marks)**
- b) Discuss factors that cause membrane fouling **(9marks)**
- c) Outline the general steps involved in cleaning of separation membrane **(6marks)**
- d) List any **THREE** materials used in production of membranes in reverse osmosis. **(3marks)**

QUESTION FOUR

- a) Describe separation mechanism in supercritical fluid chromatography and state any two application of this technique. **(6marks)**
- b) A chromatogram of a two-component mixture on a 25cm packed LC column is shown in the figure below. The flow rate was 0.40ml/min
 - (i) Find the times that components A and B spend in the stationary phase **(2marks)**
 - (ii) Find the retention times for A and B **(2marks)**
 - (iii) Determine the retention factors for the two components **(6marks)**
 - (iv) Find the resolution of the two peaks **(4marks)**

QUESTION FIVE

- a) What are some of the factors that an industry should consider when choosing the type of membranes system to install? **(5marks)**
- b) Below are some of the common separation techniques. Explain how separation occurs in each and give an industrial application for each technique.
- (i) Dialysis **(3marks)**
 - (ii) Ultrafiltration **(3marks)**
 - (iii) Gas chromatography **(3marks)**
 - (iv) Electrophoresis **(3marks)**
 - (v) Reverse osmosis **(3marks)**