MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY

DSL 214: CHEMICAL ANALYTICAL TECHNIQUES II

DATE: SCHOOLBASED **TIME:**

INSTRUCTIONS:

- Answer all questions in section A and any other two questions from questions in section B in the answer booklet provided.
- ALL working MUST be clearly shown where possible.

SECTION A

QUESTION ONE (30 MARKS) –COMPULSORY

a) Distinguish between the following chromatographic terms

i. Planar Chromatography and column chromatography (2 marks)

ii. Mobile phase and stationary phase (2 marks)

b) Describe the advantages and disadvantages of ion exchange separations (6 marks)

c) The distribution ratio of quinine between chloroform and water is 7.2. Calculate the moles of quinine extracted from the aqueous phase after 50 mL of 0.15 M aqueous quinine solution is extracted with

i. One 30 mL (once) (3 marks)

ii. Two 15 mL portions (batch extraction) (3 marks)

d) Distinguish between the terms reverse phase and normal phase separation in chromatography and illustrate your answer. (4 marks)

e) Mention two disadvantages of batch extraction. (2 marks)

f) By use of a flow chart describe the fractional distillation of liquid air. (4 marks)

g) Explain the applications of each of the following apparatus (4 marks)

(i) Gooch crucible (ii) Buchner funnel

SECTION B

QUESTION TWO (20 MARKS)

a) Describe four factors that affect ion exchange separations (8 marks)

b) After removing the membranes from an eggshell, the shell is dried and its mass recorded as 5.613 g. The eggshell is transferred to a 250-mL beaker and dissolved in 25 mL of 6 M HCl. After filtering, the solution containing the dissolved eggshell is diluted to 250 mL in a volumetric flask. A 10.00-mL aliquot is placed in a 125-mL Erlenmeyer flask and buffered to a pH of 10. Titrating with 0.04988 M EDTA requires 44.11 mL to reach the end point.

i. What name is given to this type of titration? Give a reason. (2 marks)

ii. Why was the eggshell dissolved in acid? Illustrate with a balanced chemical equation. (2 marks)

iii. Explain how the end point in this reaction is determined (2 marks)

iv. Determine the amount of calcium in the eggshell as % w/w $CaCO_3$. (4 marks)
(Formula weight of $CaCO_3$ = 100.0869)

v. State two major applications of this type of titration. (2 marks)

QUESTION THREE (20 MARKS)

a) Describe the principles and applications of each of the following forms of distillation (12 marks)

(i) Steam Distillation (ii) Vacuum distillation (iii) Reflux Distillation

b) Explain two precautions that must be undertaken when working with solvents. (4 marks)

c) Distinguish between the following separation terms

i. Vapour pressure and relative volatility (2 marks)

ii. Adsorption chromatography and partition chromatography (2 marks)

QUESTION FOUR (20 MARKS)

a) The color in red cabbage comes from a class of pigment molecules called Anthocyanins. Anthocyanins contain red, yellow, green and blue pigments. Describe the complete procedure involved in separation of pure red, yellow, green and blue pigments from red cabbage using paper chromatography. (8 marks)

b) Compare and contrast gravity and vacuum filtration methods. (4 marks)

c) A chromatographic analysis for Dieldrin gives a peak with a retention time of 8.68 min and a baseline width of 0.29 min.

i. How many theoretical plates are involved in this separation? (2 marks)

ii. If the column used in is 2.0 meters long, what is the height of a theoretical plate? (2 marks)

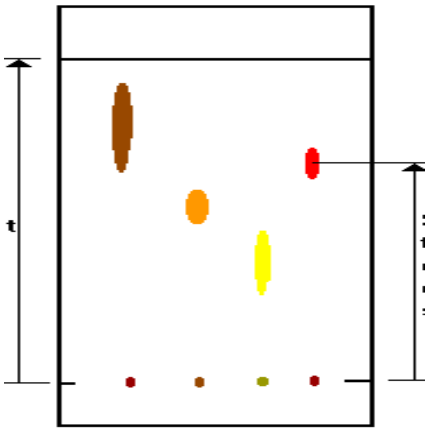
d) Describe four factors to be considered when making a choice of a separation method. (4 marks)

QUESTION FIVE (20 MARKS)

a) Describe the principles and applications of thin layer chromatography (12 marks)

b) Explain the functional features of Soxhlet extraction (4 marks)

c) The chromatogram below was used in the analysis of some artificial food dyes.



i. Explain the meaning of the term retardation factor and illustrate your answer with a suitable expression. (2 marks)

ii. By use of a ruler compare the R_f values of the first and fourth dye in the chromatogram. (2 marks)