



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF APPLIED CHEMISTRY

CHROMATOGRAPHIC SEPARATIONS

SCH 4292

Second Semester Examination Paper

May 2017

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Dr. A. Maringa

INSTRUCTIONS

- Answer ALL questions in section A and any three (3) questions in section B
- Each question in section A carries 10 marks and each question in section B carries 20 marks

MARK ALLOCATION

QUESTION	MARKS
SECTION A: 1.	10
2.	10
3.	10
4.	10
SECTION B: 5	20
6	20
7	20
8	20
TOTAL POSSIBLE MARKS	100

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SECTION A

1. a) Define the following terms:
 - (i) Supercritical fluid. [4 marks]
 - (ii) Critical temperature. [6 marks]
- b) What properties of a supercritical fluid are important in chromatography? [6 marks]
2. a) A peak with a retention time of 407 s has a width at half-height of 7.6 s. A neighbouring peak is eluted 17 s later with $w_{1/2} = 9.4$ s. Find the resolution for these two components. [5 marks]
- b) Why might HPLC be coupled to a mass spectrometer and how can this be achieved. [5 marks]
3. Describe the difference between:
 - a) Gel-filtration and gel-permeation chromatography. [5 marks]
 - b) Single-column and suppressor-column ion chromatography. [5 marks]
4. a) Why should you always use pencil to mark the starting line within paper chromatography? [3 marks]
- b) What phenomenon gives rise to band broadening within chromatography and why does band broadening increase with longer columns? [7 marks]

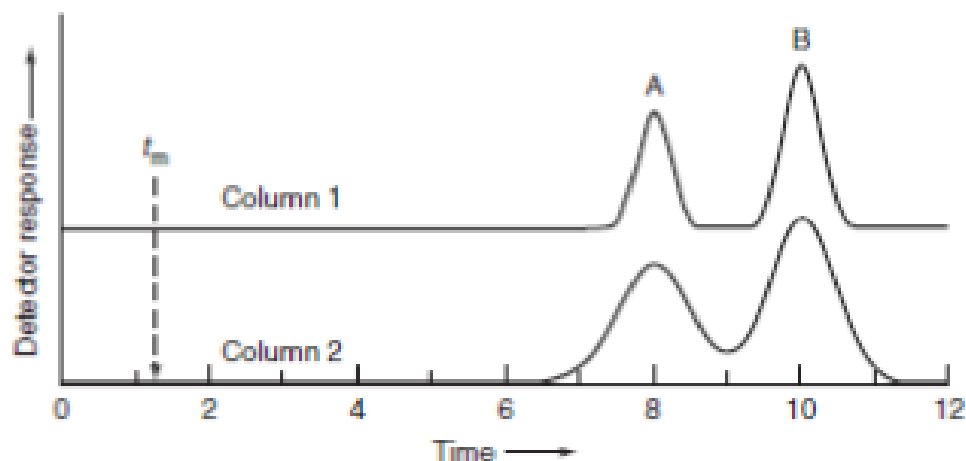
SECTION B

5. Many commercial food dyes contain three or more edible pigments such as Tartrazine, Sunset Yellow FCS, Indigo Carmine, or Amaranth. These components can be separated and identified by paper chromatography if one uses a mobile phase consisting of a 1: 100 ammonia/water mixture. Describe in detail how you will separate and identify the dyes. [20 marks]
6. a) Discuss the relative advantages of using paper and thin layer chromatography. [10 marks]
- b) With the aid of a schematic diagram, describe the principle behind gas chromatography. [10 marks]
7. a) A chromatographic procedure separates 4.0 mg of unknown mixture on a column with a length of 40 cm and a diameter of 0.85 cm.
- i) What size column size would you use to separate 100 mg of the same mixture? [4 marks]
- ii) If the flow is 0.22 mL/min on a small column, what volume flow rate should be used on a large column? [4 marks]
- iii) If the mobile phase occupies 35% of the column volume, calculate the linear flow rate for the small column and the large column. [4 marks]
- b) A Solvent passes through a column in 3.0 min but a solute requires 9.0 min.
- (i) Calculate the retention factor, k . [4 marks]
- (ii) What fraction of time is the solute in the mobile phase while in the column? [4 marks]

8. a) The retention volume of a solute is 76.2 mL for a column with $V_m = 16.6$ mL and $V_s = 12.7$ mL. Calculate the retention factor and the partition coefficient for this solute.

[5 marks]

- b) Chromatograms of compounds A and B were obtained at the same flow rate with two columns of equal length.



- (i) Which column has more theoretical plates? [2 Marks]
- (ii) Which column has a larger plate height? [2 Marks]
- (iii) Which column gives higher resolution? [2 Marks]
- (iv) Which column gives a greater relative retention? [2 Marks]
- (v) Which compound has a higher retention factor? [2 Marks]
- (vi) Which compound has a greater partition coefficient? [2 Marks]
- (vii) What is the numerical value of the unadjusted relative retention? [3 Marks]

End of question paper!!!!

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