Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY
(DAC 10M)

ACH 2310: INSTRUMENTAL METHODS OF ANALYSIS III

SPECIAL/SUPPLEMENTARY: EXAMINATIONS

SERIES: February 2013

TIME: 2 HOURS

INSTRUCTIONS:

You should have the following for this paper

- *Answer booklet*

This paper consists of ***FIVE*** questions.
Answer Question **ONE (compulsory)** and any other **TWO** questions

Question ONE

a) Briefly discuss each of the following
   (i) Chromatography
   (ii) Separation science
   (iii) Elute
   (iv) Mobile phase
   (v) Chromatogram

(2marks each, 10marks)

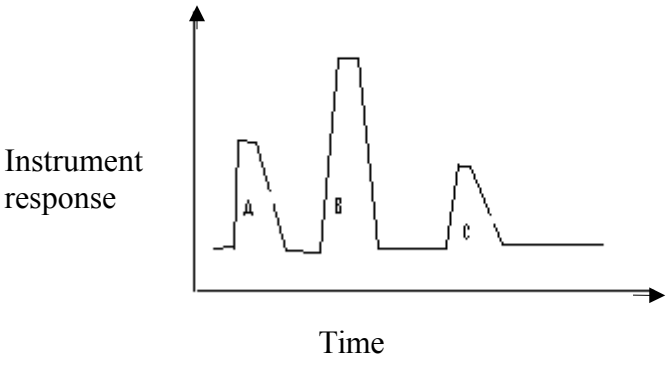
b) Highlight FOUR main qualities of a good GC detector. **(4marks)**

c) The capacity factor, K1 is defined as

$$K1 = \frac{tR - tmob}{tmob}$$

   (i) Explain the meaning of tR and tmob **(2marks)**
   (ii) If the retention time for a chromatographic peak, tR, is 65s and tmolo is 30s, Calculate the capacity factor, K1. **(3marks)**

d) A GC separation of three alkanes, butane, propane and pentane gave the following:



   i) Identify the alkanes A,B and C **(3marks)**
   ii) Explain how you would determine the concentration of each alkane A,B and C. **(2marks)**

e) Describe the working principle of a thermal conductivity detector. **(6marks)**

Question TWO

a) The van Deemter equation is given as $H = A + \frac{B}{\mu} + Cu$

   i) Explain the meaning of each term **(5marks)**
   ii) Explain how A, B and C in the above equation contribute to band or peak broadening. Explain separately for:
      a) A **(3marks)**
      b) B **(3marks)**
      c) C **(3marks)**
   iii) How can one describe the efficiency of a given chromatographic column from the above equation. **(2marks)**

iv) Outline TWO ways of increasing the efficiency of a chromatographic column **(4marks)**

Question THREE

a) The following is a schematic diagram of a typical GC (Gas chromatography)

i) Name the parts labeled
A _____ **(1mark)**
B _____ **(1mark)**
C _____ **(1mark)**
D _____ **(1mark)**
E _____ **(1mark)**

ii) A GC utilizes a carrier gas as the mobile phase, give three characteristics for the mobile phase gas **(3marks)**

iii) What is the suitable temperature for the part labeled C? **(2marks)**

b) Explain the working principles of the following GC detectors:
i) Flame ionization detector **(5marks)**
ii) Electron – capture detector **(5marks)**

Question FOUR

a) The number of theoretical plates from a chromatogram is given by:

$$N = 16\left(\frac{tR}{w}\right)^2$$

i) Explain the meaning of tR and w in the above equation **(2marks)**

ii) A chromatographic peak is found to have a retention time of 525. The base width of the peak is equivalent to 3.25 by intersection of the sides of the weak with the base-line. If the column 500cm long, calculate HETP. **(6marks)**

b) The following is a paper chromatogram for three (samples x, y and z)

i) Name the parts labeled A and B **(2marks)**

ii) By the use of Rf values, identify the common component in the three samples. **(2marks)**
iii) Describe the working principles of paper chromatography **(7marks)**

Question FIVE

a) Describe each of the following
   i) Retention time **(2marks)**
   ii) Distribution constant in chromatographic separations **(2marks)**
   iii) Elution chromatography **(2marks)**
   iv) Peak resolution **(2marks)**
   v) Stationary phase **(2marks)**
b) Describe the working principles of the following detectors in HPLC
   i) UV-Visible detector **(5marks)**
   ii) Fluorescence detector. **(5marks)**