THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

(A Centre of Excellence)

Faculty of Applied and Health Sciences

DEPARTMENT OF **PURE AND APPLIED SCIENCES**

DIPLOMA IN ANALYTICAL CHEMISTRY
(DAC 10M)

ACH 2308: PHYSICAL CHEMISTRY II

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
*This paper consists of **4 PRINTED** pages*

Question ONE

a) Briefly discuss each of the following
   (i) Chemical kinetics
   (ii) Instantaneous rate
   (iii) Rate Law
   (iv) Activation energy
   (v) Elementary reactions

(10marks)

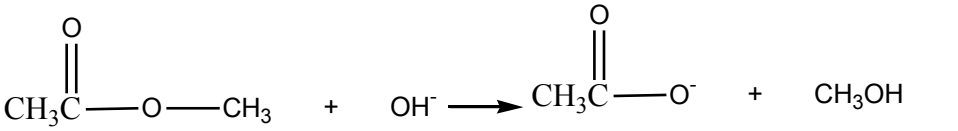
b) Discuss the influence of each of the following on the rate of a chemical reaction
   i) Temperature **(3marks)**
   ii) Concentration of reactants **(3marks)**

c) The reaction $aA + bB \rightarrow cC + dD$ has rate law at 25˚C given as:
   rate = $K[A]^2[B]$
   (i) Define the order of the reaction with respect to A and B and the overall reaction order

(3marks)

   (ii) Explain the effect of the following on reaction rate:
      a) Concentration of A is doubled **(2marks)**
      b) Concentration of B is doubled **(2marks)**

d) At 25˚C, these data were collected for the following reaction.



methyl acetate | hydroxide ion | acetate ion | methanol

Experiment	initial concentration (mol/l) $[CH_3COOCH_3]$	$[OH^-]$	initial Rate (mol/ls)
1	0.040	0.040	0.00022
2	0.040	0.080	0.00045
3	0.080	0.080	0.00090

From the data above, determine the:

a) Rate law **(4marks)**
b) Reaction rate when
   $[CH^3COOHCH^3]$ = 0.071M and
   $[OH^-]$ = 0.054M.

(1mark)

Question TWO

a) For each of the rate laws below, state the reaction order with respect to the hypothetical substances A and B and give the overall order.
   i) Rate = $K[A][B]^2$ **(3marks)**
   ii) Rate = $K[A][B]$ **(3marks)**

iii) Rate = K[A] **(2marks)**

b) The hypothetical reaction

$2A + 2B \longrightarrow C + 3D$ was studied at 25˚C by measuring the initial rate of appearance of C. These data were obtained.

[A](M)	**[B](M)**	**Initial Rate (MU)**
6.0×10^{-3}	1.0×10^{-3}	0.012
6.0×10^{-3}	2.0×10^{-3}	0.024
2.0×10^{-3}	1.5×10^{-3}	0.0020
4.0×10^{-3}	1.5×10^{-3}	0.0080

i) What is the rate law for this reaction **(5marks)**

ii) Determine the rate constant **(3marks)**

iii) If at a given instant A is disappearing at a rate of 0.034mls, what is the rate of appearance of C? **(4marks)**

Question THREE

a) Describe how each of the following can be used in studying reaction rates.

i) Conductometric analysis **(3marks)**

ii) Photometric analysis **(3marks)**

b) Identify and explain two methods that can be used to investigate reaction rate for the reaction:

$Br_{(aq)} + HCOOH_{(aq)} \longrightarrow 2Br^-_{(aq)} + 2H^+_{(aq)} + CO_{2(aq)}$ **(6marks)**

c) The reaction below was investigated at 855K.

$C_5H_8 \longrightarrow C_5H_6 + H_2$

(g) (g) (g)

At this temperature, the following data was obtained:

Time	$[C_5H_8](M)$
1	0.0200
20	0.0189
50	0.0173
100	0.0149
200	0.0112
300	0.0084
400	0.0063
500	0.0047
700	0.0027
1000	0.0011

If the reaction is first order, obtain the rate constant. **(8marks)**

Question FOUR

a) Describe each of the following
   (i) Half-life **(3marks)**
   (ii) Homogeneous catalyst **(3marks)**
   (iii) Heterogeneous catalyst **(3marks)**

b) The first – order rate constant is $1.87 \times 10^{-3} min^{-1}$ at 37˚C for reaction of ciplastin . The reaction is
   Cisplatin $+ H_2O \longrightarrow$ cisplatin $OH_2^+ + Cl^-$
   Suppose that the initial concentration of cisplatin is 4.73×10^{-4}M. What will the concentration be exactly 24 hours later **(4marks)**

c) The compound SO_2Cl_2 decomposes in a in a first-order reaction
   $SO_2Cl_2 \longrightarrow SO_2 + Cl_2$
   (g) (g) (g)
   That has a rate constant of $1.47 \times 10^{-4}\ S^{-1}$ at 600K. If you begin with 1.6×10^{-3} mol of pure SO_2Cl_2 in a 2.0L flask, at what time will the amount of SO_2Cl_2 be 1.2×10^{-4}mol. **(5marks)**

Question FIVE

a) Briefly discuss enzyme catalysis in relation to:
   i) Substance concentration **(3marks)**
   ii) Cofactor **(3marks)**
   iii) Temperature **(3marks)**
   iv) Inhibitors **(3marks)**

b) When enzymes are present at very low concentration, their effect on reaction rate can be described by first-order kinetics. By what factor does the rate of an enzyme –catalyzed reaction change when the enzyme concentration is changed from 1.5×10^{-7}M to 4.5×10^{-6}M? **(8marks)**