



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCES
DEPARTMENT OF PHYSICAL AND BIOLOGICAL SCIENCES

UNIVERSITY ORDINARY EXAMINATION

2018/2019 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATION
B.Ed. (SCIENCE)

ACH 204 – CHEMICAL KINETICS

DURATION: 2 HOURS

DATE: 25/04/2019

TIME: 9.00-11.00 AM

Instructions to candidates:

1. Answer **question One** and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

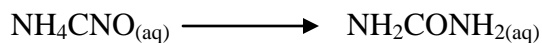
QUESTION ONE (30 MARKS)

- a) Define the following terms:
- Transference number (1 mark)
 - Relaxation effect (1 mark)
 - Molecularity (1 mark)
 - Molar conductance (1 mark)
 - Ionic mobility (1 mark)
- b) The proportionality constant (K) between rate of reaction and concentration is known as rate constant. State four factors that determine the rate constant (K). (4 marks)
- c) Distinguish between the following terms:
- Specific conductance and equivalent conductance (2 marks)
 - Electrochemical and galvanic cell (2 marks)
- d) Gas phase decomposition of acetaldehyde at elevated temperatures and low pressures follow the rate law
- $$\text{Rate} = K[\text{CH}_3\text{CHO}]^{3/2}$$
- Determine the units of rate constant (K). (4 marks)
- e) If at 25°C the molar conductivity of Li^+ , Mg^{2+} and Al^{3+} are $3.87\text{m}^2\text{mol}^{-1}$, $5.01\text{m}^2\text{mol}^{-1}$ and $7.35\text{m}^2\text{mol}^{-1}$ respectively. Calculate the ionic mobilities for:
- Li^+ ion (2 marks)
 - Mg^{2+} ion (2 marks)
 - Al^{3+} ion (2 marks)
- f) State three applications of electrolysis (3 marks)
- g) Equivalent conductance of 0.001028mol^{-1} acetic solution is $48.15\Omega^{-1}\text{cm}^2$ and infinite dilution its conductivity is $390.6\Omega^{-1}\text{cm}^2$. Determine the degree of dissociation. (4 marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a) Briefly explain how temperature and concentration affect equivalent conductance of:
- Weak electrolytes (4 marks)
 - Strong electrolytes (4 marks)
- b) Ammonium cyanate reacts to form urea according to equation



The initial rate of the reaction is measured at 65°C for three different initial concentration of ammonia cyanate.

Experiment NO.	NH_4CNO (MolL^{-1})	Initial rate ($\text{MolL}^{-1}\text{s}^{-1}$)
1.	0.100	3.60×10^{-2}
2.	0.201	1.44×10^{-1}
3.	0.400	5.75×10^{-1}

- Determine the order of the reaction with respect to cyanate and write the rate law (4 marks)
- Determine the rate constant (4 marks)
- Determine the units of the K (2 marks)
- Calculate the initial reaction rate if the concentration of NH_4CNO is 0.050MolL^{-1} (2 marks)

QUESTION THREE (20 MARKS)

- a) The following table shows the kinetic data for reaction between $\text{Na}_2\text{S}_2\text{O}_3$ and CH_3I at 298K. The concentration being expressed in MolL^{-1}

Time (minutes)	0	4.75	10	20	35	55
$\text{Na}_2\text{S}_2\text{O}_3$ (MolL^{-1})	35.35	30.5	27	23.2	20.3	18.6
CH_3I (MolL^{-1})	18.25	13.4	9.9	6.1	3.2	1.5

- Show that the reaction follows 2nd order kinetics (6 marks)
 - Show that the half-life ($t_{1/2}$) expression for a reaction with only one react following a 2nd order kinetics is given by $t_{1/2} = \frac{1}{k_2 C_0}$ (4 marks)
- b) Specific conductivity of saturated AgCl solution is $3.41 \times 10^{-6} \Omega^{-1} \text{cm}^{-1}$, while the specific conductance of water that was used as solvent is $1.6 \times 10^{-6} \Omega^{-1} \text{cm}^{-1}$. Calculate the solubility of AgCl in water at 25°C in MolL^{-1} given that equivalent conductance of infinite dilution of AgCl is $138.2 \text{MolL}^{-1} \Omega^{-1} \text{cm}^{-1}$. (4 marks)
- c) While using suitable graphs, explain the typical end-point of conductometric titrations of:
- Strong acid – strong base titration (3 marks)
 - Strong acid – weak base titration (3 marks)

QUESTION FOUR (20 MARKS)

- a) If the limiting molar conductivity of KCl , KNO_3 and AgNO_3 are $14.99 \text{m}^2 \text{mol}^{-1}$, $14.50 \text{m}^2 \text{mol}^{-1}$, and $13.34 \text{m}^2 \text{mol}^{-1}$ respectively at 25°C.
- Derive equations to show how to calculate the limiting molar conductivity for AgCl at 25°C. (4 marks)
 - Calculate the limiting molar conductivity for AgCl at 25°C. (4 marks)
- b) The rate constant of the reaction $\text{NO}_{2(g)} + \text{O}_{3(g)} \longrightarrow \text{NO}_{3(g)} + \text{O}_{2(g)}$ at 50°C is found to be $2.1 \times 10^5 (\text{MolL}^{-1})^{-1} \text{S}^{-1}$. The reaction occurs 1.90 times faster at 70°C.
- Determine the activation energy (4 marks)
 - Determine the rate constant of the reaction at 100°C (4 marks)
 - Determine the overall reaction order (4 marks)