MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED HEATH SCIENCES

DEPARTMENT OF PHYSICAL AND BIOLOGICALSCIENCES

UNIVERSITY ORDINARY EXAMINATION

2020/2021 ACADEMIC YEAR

SECOND YEAR **FIRS**T SEMESTER EXAMINATION FOR, BACHELOR OF SCIENCE IN ANALYTICAL AND INDUSTRIAL CHEMISTRY

UNIT CODE: 204

UNIT TITLE: CHEMICAL KINETICS

DURATION: 2 HOURS

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:
   i. Transference number (1 mark)
   ii. Relaxation effect (1 mark)
   iii. Elementary steps (1 mark)
   iv. Limiting molar conductance (1 mark)

b) The proportionally constant k between rate of reaction and concentration is known as rate constant .State four (4) factors that determine the rate constant k (2 marks)

c) Distinguish between the following terms
   i. Specific conductance and equivalent conductance (2marks)
   ii. Standard and non-standard cell (2marks)
   iii. Strong and weak electrolyte (2marks)

d) Give overall order and units for K for the following rate expression.

i $Rate=K[NaOH]^{1/2}[Br]^{2}[CH_3CH_2OH]$ 1 Mark

ii $Rate=K[NH_3]^{3/2}[Li]^{3/2}[C_6H_6]^{2}$ 1 Mark

e) State four (4) types of electrodes (2marks)

f) If at 25 ^{0}C the molar conductivity of Be^{2+} and Ga^{3+} are 5.01 $mSm^{2}mol^{-1}$ and 7.35 $mSm^{2}mol^{-1}$ Calculate the ionic mobilities for.
   i) Be^{2+} ion (2marks)
   ii) Ga^{3+} ion (2marks)

g) State and briefly explain two (2) methods used to measure/determine ionic transference number (6marks)

h) Write and explain the characteristics of the half-life ($t_{1/2}$) expression for the following reaction order kinetics.
   i. First order reaction (2marks)
   ii. 2nd order reaction with only one reactant (2marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) Explain how temperature and concentration affect equivalent conductance of.
   i. Weak electrolytes (4marks)
   ii. Strong electrolytes (4marks)

b) Equivalent conductance of 0.001028 $molL^{-1}$ acetic acid solution is 48.15 $\Omega^{-}cm^{2}$and at infinite dilution its conductivity is 390.6$\Omega^{-}cm^{2}$. Determine the degree of dissociation (4marks)

c) The decomposition of N_2O_5 dissolved in carbon tetrachloride is a first order reaction. The chemical reaction is as follows.

$$2N_2O_{5(g)} \longrightarrow 4NO_{2(g)} + O_{2(g)}$$

At 45^0 the reaction was begun with initials concentration of 1.00M. After 3 hours the N_2O_5 concentration decreased to 1.21 X 10^{-3}M. calculate the half-life of N_2O_5expressed in minutes

at 45^0 C (5marks)

d) Explain the reason why ironic motilities of Hydronium and Hydroxyl ions are extremely high and cannot be measured using available methods (2marks)

QUESTION THREE (20 MARKS)

a) Ammonium cynate reacts to form urea according to equation

$$NH_4CNO_{(aq)} \longrightarrow NH_2CONH_2\ (aq)$$

The initial rate of the reaction is measured at 65^0 C for three different initial concentration of ammonia cynate

Experiment No.	NH_4CNO	Initial Rate ($molL^{-1}S^{-1}$)
I	0.100	$3.60X10^{-2}$
II	0.201	$1.44X10^{-1}$
III	0.400	$5.75X10^{-1}$

i. Determine the order of reaction with respect to ammonia cynate and write the Rate law (6marks)

ii. Calculate rate constant and units of K (5marks)

iii. Calculate the initial reaction rate if the concentration of NH_4CNO is 0.0500 $molL^{-1}$ (4 Marks).

b) Specific conductivity of saturated AgCl solution at 25^0C is $3.41x10^{-6}$ $\Omega^{-1}cm^{-1}$, while the specific conductance of water that was used as the solvent is $1.6x10^{-6}\Omega^{-1}cm^{-1}$.

Calculate the solubility of AgCl in water at 25^0C in $molL^{-1}$, given that equivalent conductance of infinite diluted AgCl is 138.2 $molL^{-1}\Omega^{-1}$ (4marks)

c) State and explain the terms in Nernst equation (1 mark)

QUESTION FOUR (20 MARKS)

a) While using suitable graphs, explain the typical end-point of conductometric titrations of

i. Strong acid-strong base titration (4marks)

ii. Weak acid-weak base titration (4marks)

iii. Weak acid-Strong base titration (4marks)

b) The rate constant of reaction

$$NO_{2(g)} + O_{3(g)} \longrightarrow NO_{3(g)} + O_{3(g)}$$

At 50^0 c is found to be $2.10x10^5$ $(molL)^{-1}S^{-1}$. The reaction occurs 1.90 times faster at 70^0 C

i. Calculate the activation energy (4marks)

ii. Calculate the rate constant of the reaction at 100^0 C (4marks)