UGANDA MARTYRS UNIVERSITY

NKOZI CAMPUS

UNIVERSITY EXAMINATION

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

SEMESTER I, 2022 / 2023

BACHELOR OF SCIENCE WITH EDUCATION

BASIC PHYSICAL CHEMISTRY

DATE: December 13, 2022
TIME: 9:30am – 12:30pm
DURATION: 3HRS

Instructions:

(ii) This Examination consists of Two sections, A and B
(iii) Attempt all questions in section A and any three questions in section B.
(iv) Remember to write your Examination Clearance number on the answer booklet and attendance list
(v) All answers must be written in the answer booklets provided.
(vi) Show all necessary working and use relevant examples

Section A

Attempt all Questions from this section

Question One

(a)(i) State Kohrlrausch's law of ionic conductivity at infinite dilution   (2 marks)

(ii) Calculate the molar conductivity of methanoic acid at infinite dilution

$(\lambda 0 \ (HCOONa) = 9.5 \times 10^{-2} Sm^2 mol^{-1}, \lambda 0(NaCl) = 1.26 \times 10^{-1} Sm^2 mol^{-1}, \lambda 0(HCl) = 4.26 \times 10^{-1}$
$Sm^2 mol^{-1})$ (2marks)

(b) Ionic conductivities of Ag^+ and Cl^- at infinite dilution are 6.2×10^{-2} and $7.6 \times 10^{-2} Sm^2 mol^{-1}$ respectively at 298K. The electrolytic conductivity of silver chloride at 298K is $1.22 \times 10^{-4} Sm^{-1}$. Calculate the solubility, in $moldm^{-3}$, of silver chloride at 298K.   (5marks)

(c) Name one practical application of ionic conductivity apart from the determination of solubility of electrolytes.   (1mark)

Question Two

(a) (i) List any two assumptions in the collision theory.   (2marks)

(ii) Show that the rate constant obtained from collision theory is similar to Arrhenius equation.   (4marks)

(iii). Explain why some collisions having the required activation energy may not result in a reaction.   (2marks)

(b) State any two limitations of collision theory.   (2marks)

Question three

(a). Give three important characteristics of gases   (3marks)

(b). Explain why the density of ice is lower than that of water.   (2marks)

(c). One litre flask containing vapours of methyl alcohol (Mol. mass = 32) at a pressure of 1 atm and 25°C was evacuated till the final pressure was 10^{-3} mm. How many molecules of methyl alcohol were left in the flask? (5 marks)

Section B

Attempt any three questions from this section

Question Four

a (i) State Graham's Law. (2 marks)

(ii) Oxygen diffuses through a small hole 0.935 times faster than gas X. Calculate the relative molecular mass of X (4 marks)

(b).Summarize the basic principles of the kinetic theory of mater. (4 marks)

(c) State what is meant by the term an ideal gas. (01 mark)

(d) Explain how liquefaction of a gas can be affected by

(i) Pressure (2 ½ marks)

(ii) Temperature (2 ½ marks)

(e) The curve below shows deviation of some gases from ideal behaviours.
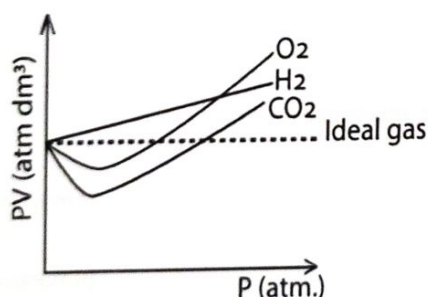
(i) State why hydrogen shows a small deviation from ideal behavior compared to other gases (1 ½ marks)

(ii) Compared to deviations of oxygen and carbon dioxide from ideal behavior. (2 ½ marks)

Question Five

a) State Kohlrausch's Law [2marks]

b) Explain three applications of Kohlrausch's Law [6 marks]

c) The equivalent conductance of sodium chloride, hydrochloric acid and sodium acetate at infinite dilution are 126.45, 426.16 and 91.0 ohm^{-1} cm^2 $equiv^{-1}$, respectively at 25 °C. Calculate the equivalent conductance of acetic acid at infinite dilution. [6 marks]

d) Explain three factors that affect conductance of an electrolyte [6 marks]

Question Six

a) Describe the different types of electrolytes [4 marks]

b) Differentiate between specific conductance and molar conductance [3 marks]

c) A 0.05 N solution of a salt occupying a volume between two platinum electrodes separated by a distance of 1.72 cm and having an area of 4.5 cm^2 has a resistance of 250 ohm. Calculate the equivalent conductance of the solution. [6 marks]

d) The specific conductivity of 0.02 M KCl solution at 25 °C is 2.768 x 10–3 ohm–1 cm–1 . The resistance of this solution at 25 °C when measured with a particular cell was 250.2 ohms. The resistance of 0.01 M CuSO4 solution at 25 °C measured with the same cell was 8331 ohms. Calculate the molar conductivity of the copper sulphate solution. [7 marks]

Question Seven

(a) Derive expressions for each of the following order reactions;

(i) First-order reaction. (5marks)

(ii) Pseudo order reaction. (4marks)

(b) For a reaction in which A and B react to form C, the following data were obtained from three experiments;

Expt.	[A] / mol^{-1}	[B] /mol^{-1}	Initial rates / mol^{-1}S^{-1}
1	0.3	0.15	7.0 x 10^{-4}
2	0.6	0.3	2.8 x 10^{-3}
3	0.3	0.3	1.4 x 10^{-3}

(i) What is the rate equation for the reaction?   (4 marks)

(ii) What is the numerical value and units of the rate constant K?   (7 marks)