MACHAKOS UNIVERSITY

University Examinations 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF AGRICULTURAL EDUCATION AND EXTENSION

KST 104: FUNDAMENTALS OF CHEMISTRY

DATE: 15/6/2021 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

- Question **ONE** is **COMPULSORY** (**SECTION A**) (30 marks).
- Answer **ANY** other **TWO** questions (**SECTION B**) (each 20 marks).

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

a) Define a secondary standard as used in volumetric analysis (2 marks)

b) Explain why colloids stay suspended in a solution (3 marks)

c) Not all chemical reactions are used as a basis for titration. Name and discuss three properties of chemical reactions used in Titrimetry. (3 marks)

d) Describe one method that can be used to test the presence of Cu^{2+} ions in a solution (3 marks)

e) Calculate the hydroxonium ion concentration in a solution with a pH of 12.014 (3 marks)

f) Define end point as used in Titrimetry and state two characteristics of end point. (3 marks)

g) A $5.0 \times 10^{-4}\ M$ solution of analyte is placed in a sample cell path length of 1.0 cm. when measured at a wavelength of 490 nm, the solution's absorbance is 0. 338. What is the analyte's molar absorptivity at this wavelength (4 marks)

h) A water sample was collected from a river near a farm after heavy rain. Describe a simple home-based procedure of making the water portable. (4 marks)

i) Insects communicate through chemical messengers called pheromones. One of the principal components of this pheromone is shown below. (3 marks)

i. Identify the compound,
ii. give its molecular formula
iii. classify the compound

j) State and give a mathematical expression for the first law of thermodynamics (2 marks)

SECTION B: ANSWER ANY OTHER TWO QUESTIONS

QUESTION TWO (20 MARKS)

a) Using suitable equations, explain how cation exchange resins remove hardness in water (4 marks)

b) Discus how addition of electrolytes settles out colloids in a solution (3 marks)

c) Show that pH+pOH=14 in all dilute aqueous solutions (3 marks)

d) Water becomes less dense as a solid. Discuss the significance of this property (4 marks)

e) Consider the following equilibrium process

$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

State and explain the direction of shift of equilibrium when

i. More chlorine gas is added to reaction mixture (2 marks)
ii. Pressure of the gas is increased (2 marks)
iii. Catalyst is added to the reaction mixture (2 marks)

QUESTION THREE (20 MARKS)

a) Water is a powerful solvent. Discuss (5 marks)

b) Ethanol (C_2H_5OH) boils at 78°C while diethyl ether (CH_3-O-CH_3) boils at -23.6 despite the fact that they have the same molecular weight. Explain (3 marks)

c) Female month uses 2-methy-branched alkane having a molecular weight of 254 to attract its mate. Identify the structural and molecular formula of this compound. (4 marks)

d) For the following reaction at a certain high temperature,

$CO_g + H_2O_g \leftrightharpoons CO_{2(g)} + H_{2(g)}$

The concentration in a mixture is $CO_{(g)}$, 0.0600 mol/L; $H_20_{(g)}$, 0.120 mol/L; $CO_{2(g)}$, 0.150 mol/L; and H_2(g), 0.300 mol/L. Calculate the value of the equilibrium constant at this temperature (4 marks)

e) Using a suitable drawing show SP^2 hybridization in carbon (4 marks)

QUESTION FOUR (20 MARKS)

a) Classify the following as open, closed or isolated systems as applied in chemical thermodynamics? (4 marks)

I) A tightly stoppered bottle of soda

II) The earth

III) Vacuum flask

IV) Living things

b) Isoamyl acetate is the common name given to substance responsible for the characteristic odour of bananas. Given that the compound is an ester in which the carbonyl group bears a methyl substituent and a 3-methyl butyl group attached to one of its oxygen. Draw the structural formula for Isoamyl acetate and write its molecular formular (4 marks)

c) 20 ml of 0.05 M acidified $KMnO_4$ solution oxidized 25 ml of Fe^{2+} in 40 g/l of impure iron (II) sulphate to Fe^{3+}_{aq}. Calculate the percentage impurities in the iron II sulphate (7 marks)

d) Discus five characteristics of a good sample as used in analysis (5 marks)

QUESTION FIVE (20 MARKS)

a) Discus giving suitable reasons whether the following compounds/molecules will form hydrogen bonds? (8 marks)

i. HF

ii. C_2H_4

iii. HBr

iv. NH^{4+}

b) Phytane is a common name of a naturally occurring alkane produced by algae spirogyra. Its IUPAC name is 2,6,10,14-tetramethyl hexadecane. Draw its structural formular and write its molecular formular (3 marks)

c) Carbon forms many compounds compared to other elements. Discuss two unique ways that carbon differs with other elements (4 marks)

d) Calculate the pH of a solution of 6.9×10^{-2} M of NaOH (5 marks)