



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)

- Define a secondary standard as used in volumetric analysis (2 marks)
- Explain why colloids stay suspended in a solution (3 marks)
- Not all chemical reactions are used as a basis for titration. Name and discuss three properties of chemical reactions used in Titrimetry. (3 marks)
- Describe one method that can be used to test the presence of Cu^{2+} ions in a solution (3 marks)
- Calculate the hydroxonium ion concentration in a solution with a pH of 12.014 (3 marks)
- Define end point as used in Titrimetry and state two characteristics of end point. (3 marks)

- g) A $5.0 \times 10^{-4} \text{ M}$ 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)

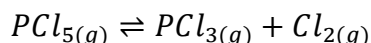


- i. Identify the compound,
 - ii. give its molecular formula
 - iii. classify the compound
- j) State and give a mathematical expression for the first law of thermodynamics (2 marks)

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) Discuss how addition of electrolytes settles out colloids in a solution (3 marks)
- c) Show that $\text{pH} + \text{pOH} = 14$ 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



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 $78^\circ C$ 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 moth uses 2-methyl-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,
 $CO_g + H_2O_g \rightleftharpoons CO_{2(g)} + H_{2(g)}$
The concentration in a mixture is $CO_{(g)}$, 0.0600 mol/L; $H_2O_{(g)}$, 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 formula (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) Discuss five characteristics of a good sample as used in analysis (5 marks)

QUESTION FIVE (20 MARKS)

- a) Discuss giving suitable reasons whether the following compounds/molecules will form hydrogen bonds? (8 marks)
- i. HF
 - ii. C₂H₄
 - iii. HBr
 - iv. NH⁴⁺
- 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 formula and write its molecular formula (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)