

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF BACHELOR OF SCIENCE IN
ENVIRONMENTAL SCIENCE, ENGINEERING PHYSICS, MINING PHYSICS,
NATURAL RESOURCES, AGRICULTURE, HORTICULTURE, AGRICULTURE
ECONOMICS, AGRICULTURAL EDUCATION & EXTENSION, ANIMAL SCIENCE,
FOOD SCIENCE AND TECHNOLOGY AND WILDLIFE ENTERPRISE
MANAGEMENT

CHEM 102: GENERAL INORGANIC AND PHYSICAL CHEMISTRY

STREAMS: "AS ABOVE"

TIME:2 HOURS

DAY/DATE: TUESDAY 17/12/2024

11.30 A.M. –1.30 P.M.

Instructions

- Do not write anything on the question paper
- Answer question ONE and any other two questions
- Value of $R=62.4 \text{ L.mmHg.K}^{-1}\text{mol}^{-1}$

Question one [30 marks]

- Write the electronic configuration of N, S²⁻, Ti, Cr and Fe in FeO given that the atomic numbers of nitrogen, sulphur, titanium, chromium and iron are 7, 16, 22, 24 and 26 respectively. [5 marks]
- Determine the relative atomic mass of silicon which has three stable isotopes Si-28 (92.2 %), Si-29 (4.7 %) and Si-30 (3.1 %). [3 marks]
- Calculate the percentage by mass of phosphorous in the following fertilizers (Ca=40, H=1, N=14, P=31 and O=16).
 - Monocalcium phosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2$ [2 marks]

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- ii) Ammonium phosphate [2 marks]
- d) Express the following gas laws mathematically and graphically. [6 marks]
- (i) Boyle's
 - (ii) Gay-Lussac's
 - (iii) Avogadro's
- e) Calculate the pH of a solution whose concentration of hydroxide ions is 0.0018 M and mention whether the solution is basic, acidic or neutral. [3 marks]
- f) Write half reactions and overall reaction for electrolysis of molten sodium chloride. [3 marks]
- g) Draw a well labelled sketch of standard hydrogen electrode. [3 marks]
- h) Give three ways of detecting spots on the sheet after completion of chromatographic process. [3 marks]

Question two [20 marks]

- a) Discuss the trends of the following properties of elements in the periodic table;
- (i) Atomic size [4 marks]
 - (ii) Ionic size. [4 marks]
 - (iii) Ionization energy. [4 marks]
- b) Draw electron dot structures showing how chemical bonds of the following compounds are formed and state the type of bond/s present in each compound (atomic numbers of C, N, O, Mg & Cl are 6, 7, 8, 12 & 17 respectively).
- (i) Magnesium chloride. [3 marks]
 - (ii) Nitrogen gas. [2 marks]
 - (iii) Carbon (II) oxide. [3 marks]

Question three [20 marks]

- a) A sample with a mass of 1.0876 g containing carbon, hydrogen and oxygen only was burned in oxygen completely. 2.078 g of carbon dioxide and 1,2738 of water were obtained. If this compound has a molar mass of 138.204, determine its molecular formula (C=12.01, H=1.008, O=16). [8 marks]

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- b) You are provided with analytical grade magnesium nitrate crystals to prepare 1000 ppm Mg stock solution and thereafter make 200 ml working solution of 40 ppm. How do you achieve this? [6 marks]
- c) Calculate the electromotive force of cell of silver and tin given that;
 $\text{Ag}^+ + \text{e} \rightarrow \text{Ag (s)} \quad \epsilon^\circ = +0.80 \text{ V}$ and
 $\text{Sn}^{2+} + 2\text{e} \rightarrow \text{Sn (s)} \quad \epsilon^\circ = -0.14 \text{ V}$. [3 marks]
- d) What are the standard states for, solution and pure substances that are used to determine heats of reactions? [3 marks]

Question four [20 marks]

- a) Enumerate four assumptions of kinetic molecular theory of ideal gases and explain the causes of deviations by real gases. [6 marks]
- b) A volume of 108 ml of butane at 715 mmHg and 25° C was put in a cylinder. What was the mass of this gas ($C = 12.01$, $H = 1.008$, $R=62.4 \text{ L.mmHg.K}^{-1}\text{mol}^{-1}$)? [4 marks]
- c) How do the following affect position of equilibrium?
(i) Increase in temperature [3 marks]
(ii) Catalyst [2 marks]
- d) (i) When 0.1 M solution was prepared, it was found that the concentration of hydronium ion was 0.00134 M. Find the acid dissociation constant of this acid. [3 marks]
- (ii) A saturated solution of strontium fluoride [SrF_2] was found to have strontium ion concentration of 0.00087 M and fluoride ion concentration of 0.0017 M. determine the value of solubility product constant of this salt. [2 marks]
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