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University Examinations 2022/2023

FIRST YEAR, FIRST SEMESTER, SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE
DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY

FIRST YEAR, FIRST SEMESTER, SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE
DEGREE OF BACHELOR OF SCIENCE IN BIOLOGICAL SCIENCES

FIRST YEAR, FIRST SEMESTER, SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE
DEGREE OF BACHELOR OF SCIENCE IN EDUCATION

SCH 3100: PRINCIPLES OF INORGANIC CHEMISTRY

DATE: AUGUST 2023

TIME: 2 HOURS

INSTRUCTIONS: *answer question one and any other two questions*

QUESTION ONE (30 MARKS)

- a) Matter may be classified by its chemical constitution as an element, compound or mixture.
With one example each, explain these three terms (3 marks)
- b) Give the name and atomic symbol of the element with each Z value and classify it as a metal, metalloid, or nonmetal (4 marks)
- i) $Z = 33$
- ii) $Z = 35$
- c) Explain the following terms as used in the atomic structure
- i) Atomic number (2 marks)
- ii) Atomic mass unit (2 marks)

- d) During excessive physical activity, lactic acid ($m = 90.08 \text{ g/mol}$) forms in muscle tissue and is responsible for muscle soreness. Elemental analysis shows that this compound contains 40.0 mass %C, 6.71 mass %H, and 53.3 mass %O
- i) Determine the empirical formula of lactic acid (4 marks)
- ii) Determine the molecular formula (2 marks)
- e) What are the possible l and m_l values for $n = 4$? (3 marks)
- f) Chlorine consists of the following isotopes:

Isotope	Isotopic Mass (amu)	Fractional Abundance
Chlorine – 35	34.96885	0.75771
Chlorine – 37	36.96590	0.24229

- What is the atomic mass of chlorine? (4 marks)
- g) What is the de Broglie wavelength (in meters) of all ball with mass of 120g and a speed of 44, 7 m/s (3 marks)
- h) Give the possible combinations of the quantum numbers for a 4p orbital (3 marks)

QUESTION TWO (20 MARKS)

- a) Explain the following terms
- (i) Limiting reactant (2 marks)
- (ii) Molecular formula (2 marks)
- (iii) Aqueous solution (2 marks)
- b) Explain the terms theoretical, actual and percent reaction yields (3 marks)
- c) How many protons, neutrons and electrons does an atom have? (4 marks)
- d) Give the number of atoms of the specific element in a formula unit of the following compounds and calculate the molecular (formula) mass for that element in the formula:
- (i) Oxygen in aluminum sulfate, $\text{Al}_2(\text{SO}_4)_3$ (3 marks)
- (ii) Hydrogen in ammonium hydrogen phosphate, $(\text{NH}_4)_2\text{HPO}_4$ (4 marks)

QUESTION THREE (20 MARKS)

- a) Nitrogen dioxide is a component of urban smog that forms from gases in car exhaust. How many molecules are in 8.92g of nitrogen dioxide? (5 marks)

- b) Explain the difference between a strong base and a weak base (4 marks)
- c) Write balanced molecular, total ionic and net ionic equations and identify the spectator ions in the reaction: silver nitrate (AgNO_3) and sodium perchlorate (Na_2CrO_4) (5 marks)
- d) Give the expected ground-state electron configurations for the following elements;
- (i) Bromine ($Z = 35$) (3 marks)
- (ii) Potassium ($Z = 19$) (3 marks)

QUESTION FOUR (20 MARKS)

- a) How does the Pauli exclusion principle limit the possible electron configurations of an atom? (4 marks)
- b) In a 2s orbital there are 2 possible combinations of the four quantum numbers as shown in the table below. The same way in a 4p orbital, there are 6 possible combinations of the four quantum numbers. Using the same four quantum as in the table give them (6 marks)

n	l	ml	ms
2	0	0	+1/2
2	0	0	-1/2

- c) Which of the following statements is (are) true and which one is (are) false? Explain
- (i) The product of wavelength and frequency of light is a constant (2 marks)
- (ii) As the energy of electromagnetic radiation increases, its frequency decreases (2 marks)
- d) Physical theory at the time Rutherford proposed his nuclear model of the atom was not able to explain how this model could give a stable atom
- (i) Explain the nature of this difficulty (2 marks)
- (ii) Explain the main features of Bohr's theory. Do these features solve the difficulty alluded to in question (i)? (4 marks)