



OFFICE OF THE DEPUTY VICE CHANCELLOR
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER REGULAR

EXAMINATION

FOR THE DEGREE OF BACHELOR OF
EDUCATION SCIENCE

COURSE CODE: CHE 210

COURSE TITLE: ATOMIC STRUCTURE AND
BONDING

DATE: 19/12/2022

TIME: 2-5 P.M.

INSTRUCTION TO CANDIDATES

- SEE INSIDE

THIS PAPER CONSISTS OF 4 PRINTED PAGES

PLEASE TURN OVER

REGULAR – MAIN EXAM

CHE 210: ATOMIC STRUCTURE AND BONDING

STREAM: BED (Science)

DURATION: 3 Hours

INSTRUCTIONS TO CANDIDATES

Answer *ALL* questions.

Question One (12 Marks)

- a. State the four quantum numbers necessary to completely describe an electron in an atom (4) (4 Marks)
- b. Write down two possible sets of quantum numbers that describe an electron in a 2 s atomic orbital (2) (2 Marks)
- c. Give the Lewis dot structure of each of the following compounds:
- (i) Ammonia (4) (1 1/2)
 - (ii) Carbon monoxide (4) (1 1/2)
 - (iii) Hydrogen peroxide (4) (1 1/2)
 - (iv) Water (4) (1 1/2)

Question Two (13 Marks)

- a. Derive the de Broglie's equation and use it to explain the 'dual nature of matter' concept (4) (4 Marks)
- b. Sketch the shapes of s and p orbitals. (4) (4 Marks)
- c. With the help of a diagram, highlight the observations and the deductions of Rutherford and his colleagues when they studied the deflection of alpha particles targeted at a gold foil (5) (5 Marks)

Question Three (13 Marks)

- a. Define the term resonance (2) (2 Marks)
- b. Show resonance in the following molecules
- i. Nitrate ion (3) (2.5 Marks)
 - ii. Nitrite ion (3) (2.5 Marks)

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- c. Using examples, explain the meaning of the following terms,
- i. Dipole-dipole forces (2)
 - ii. Hydrogen bonding (2)
 - iii. London dispersion forces (2)

Question Four (14 Marks)

- a. Give the electron configuration for atoms with the following atomic numbers and with reason(s) state their group and period numbers
- i. $Z = 24$ (3)
 - ii. $Z = 29$ (3)
- b. With the help of a diagram explain how bonding occurs in metals (2)
- c. With the help of Lewis structures, demonstrate how coordinate bond occurs in the following molecules:
- i. Ammonium ion (2 M)
 - ii. Hydroxonium ion (2 M)
 - iii. Carbon monoxide molecule (2 M)

Question Five (9 Marks)

- a. Define the term expanded octet (1)
- b. With the aid of Lewis structures, demonstrate bonding in the following molecules
- i. Sulphur hexafluoride (2 M)
 - ii. Phosphorus pentachloride (2 M)
 - iii. Triiodide ion (2 M)
- c. State the main postulate of the Valence Shell Electron Pair Repulsion (VSEPR) theory (2 mar)

$\frac{2M}{3} \times \frac{3}{4}$

Question Six (11 Marks)

a. On the basis of the VSEPR theory, explain the shapes of the following molecules and clearly state the bond angles between the bonding atoms:

- (i) Beryllium dichloride (2) (2 Marks)
- (ii) Beryllium trifluoride (2) (2 Marks)
- (iii) Water (2) (2 Marks)
- (iv) Ammonia (1) (2 Marks)

b. Explain the relationship between the number of lone pairs of electrons in a molecule and bond angles of the molecule in question 3 (3 Marks)
