

**ROBERT GABRIEL MUGABE SCHOOL OF
HERITAGE AND EDUCATION**

DEPARTMENT OF SCIENCE AND TECHNICAL EDUCATION

BED (SECONDARY) IN SERVICE HONOURS DEGREE

LEVEL I SEMESTER I

EXAMINATION QUESTION PAPER

MODULE CODE : CCHS 113
MODULE NARRATION : ATOMIC STRUCTURE
DATE : 2024
DURATION : 3 HOURS

INSTRUCTIONS TO CANDIDATES:

- 1. Answer any THREE questions.**
- 2. Each question carries 25 marks.**

Question 1

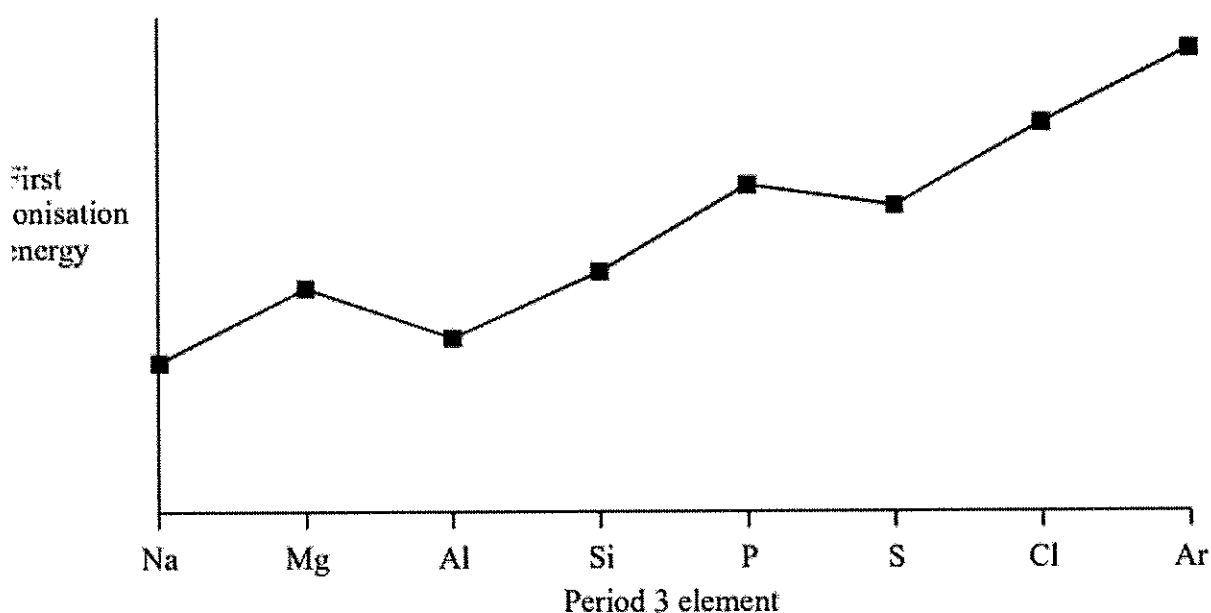
- a) State the Aufbau principle illustrating how the orbitals are arranged from lower energy level to higher energy level. [3]
- b) What is the minimum number of quantum numbers required to specify an orbital? Name them. [6]
- c) An atom of an element has two electrons in the outermost M-shell. State its
- Electronic configuration
 - Number of protons
 - Atomic number
 - Nature whether metal or non-metal
 - Valency
 - Name of the element. [6]
- d) Using s, p, d and f notations, describe the orbital with the following quantum numbers. On a table show the maximum electrons the orbitals can hold.
- (a) $n=1, l=0$;
- (b) $n = 3; l=1$;
- (c) $n = 4; l=2$;
- (d) $n=4; l=3$. [10]

Question 2

- a) What is meant by the term degeneracy? [2]
- b) with the aid of well labelled diagrams show the the degeneracy of the four s,p,d and f orbitals. [6]
- c) State and explain the three categories of magnetism in transition elements and compound. [10]
- d) With the aid of clearly labelled diagrams state the Pauli exclusion principle and Hund's rule. [7]

Question 3

- a) Applying Pauli exclusion principle and Hund's rule draw energy diagrams for the following elements O, S, Se and Te. [10]
- b) Name and describe the three properties of radiation particles emitted by radioactivity. [8]
- c) The diagram below shows the variation in first ionisation energy across Period 3



- i. What is the maximum number of electrons that can be accommodated in an s sub-level? [1]
- ii. What evidence from the diagram supports your answer to part (c(i))? [2]
- (iii) What evidence from the diagram supports the fact that the 3p sub-level is higher in energy than the 3s. [2]
- (iv) What evidence from the diagram supports the fact that no more than three unpaired electrons can be accommodated in the 3p sub-level? [2]

Question 4

a) Consider the following nuclear reactions. Copy and complete the equations.



b) Discuss the uses and benefits of radioactivity. [10]

c) Sodium-24 has a half life of 15 hours. If there are 800 g of Na-24 initially. How long will it take for 750 g of Na-24 to decay? Use this relation $t_{1/2} = \frac{0.693}{\lambda}$ where symbols have their usual meanings. [5]

Question 5'

a) Explain what is meant by the term "photoelectric effect". [2]

b) Define the following terms used in atomic structure;

i. mass defect. [2]

ii binding energy. [2]

- c) The mass defect Δm of a nucleus can be calculated using:

$$\Delta m = Zm_p + (A - Z)m_n - m_{\text{total}}$$

Define all terms in the equation. [5]

d) Einstein's photoelectric equation is given below. $\nabla E_{K \text{ max}} = hf - \phi$ where symbols have their usual meanings, Explain in detail what each term represent. [6]

e) The work function of Potassium metal is 2.3 eV.