Topic 12: Atomic Theory

12.1 The Mass Spectrometer

12.1.1 State the principles of a mass spectrometer and outline the main stages in its operation.

A simple diagram of a single beam mass spectrometer is required. The following stages of operation should be considered : vaporization, ionization, acceleration, deflection and detection.

12.1.2 Describe how the mass spectrometer may be used to determine relative isotopic, atomic and molecular masses using the ^{12}C scale.

Students should be able to calculate the relative atomic mass from the abundance of the isotopes (see 2.1.6). Interpretation of fragmentation patterns is not required.

12.2 Electron Configuration of Atoms

12.2.1 State and explain how evidence from first and successive ionization energies accounts for the existence of the main energy levels and sub-levels.

Interpretation of graphs of first ionization and successive ionization energies versus atomic number provides evidence for the existence of the main energy levels and sub-levels.

12.2.2 State how orbitals are labelled.

Limit this to $n < 5$.

12.2.3 State the relative energies of s, p, d and f orbitals.

12.2.4 State the number of orbitals at each energy level.

12.2.5 Draw the shape of an s orbital and the shapes of the p_x, p_y and p_z orbitals.

12.2.6 State the Aufbau principle.

Reference should be made to Hund's rule.

12.2.7 Apply the Aufbau principle to electron configurations.

Apply the Aufbau principle for an atom up to $Z = 54$, eg for $Z = 23$ the electronic configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$ or [Ar] $4s^2 3d^3$ or [Ar] $3d^3 4s^2$. Exceptions to this rule are not expected.

12.2.8 Relate the electron configuration of an atom to its position in the periodic table.

Students should be able to label the s, p, d and f blocks of the periodic table.