1.2 Atomic structure and the periodic table

Name: _____ Class: _____ Date: _____ **Total: 15 marks**

KEY WORDS isotope • relative atomic mass • successive ionisation energies • mass spectrometer

Objective

Practise Topic 2: isotopes and relative atomic mass, electronic configurations, ionisation-energy trends and their anomalies, and reading mass spectra including diatomic patterns.

1 Key knowledge and worked examples

Relative atomic mass

$$A_r = \frac{\sum(\text{isotope mass} \times \text{abundance})}{100}$$

Worked example: finding a missing abundance

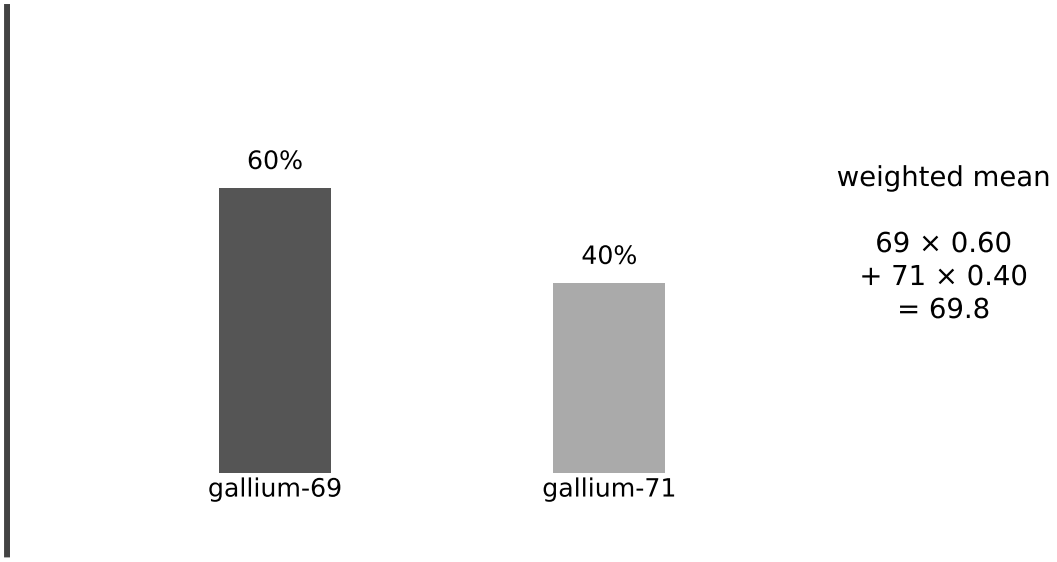
Gallium: masses 69 and 71, mean 69.8. Let x = % of 71: $(69(100-x)+71x)/100 = 69.8$. Simplifying gives $69.0 + 0.02x = 69.8$, so $x = (69.8 - 69.0)/0.02 = 40$. So 60% is 69 and 40% is 71.

Successive ionisation energies

Small rises within a shell; a big jump marks a NEW shell being opened. An element with jumps after the 2nd and 10th ionisation energies is in Group 2 of Period 3 (Mg).

Chlorine in the mass spectrometer

Peaks at 35 and 37 (3:1) for atoms; for Cl_2 molecules the combinations are 70, 72, 74 with heights 9:6:1 – because P(70) = 3/4 × 3/4 etc..



2 Practice

2.1 State what is meant by an isotope. [2]

2.2 Boron has A_r 10.8 from isotopes 10B and 11B. Calculate the percentage abundance of each. [2]

2.3 Give the electronic configuration of a Cr^{3+} ion. (Cr: [Ar] $3d^5 4s^1$) [1]

3 Exam-style questions

3.1 The first seven ionisation energies of an element are 578, 1817, 2745, 11577, 14842, 18379, 23326 kJ mol^{-1}. Deduce its group from the jump. State whether the jump alone establishes its period, and explain why. [3]

3.2 Explain why the first ionisation energy of sulfur is lower than that of phosphorus, even though sulfur has the greater nuclear charge. [3]

3.3 Bromine has isotopes 79Br and 81Br in approximately equal abundance. Predict the m/z values and relative heights of the peaks in the mass spectrum of Br_2 molecules, showing how you obtain the ratio. [4]