Atomic structure and isotopes

AQA 7404 and 7405 · AS and A level

Answer on your own paper. Show your working where needed.

1. Count the particles

Copper has atomic number 29. Give the number of protons, neutrons and electrons in one copper-65 ion, Cu^{2+}.

2. Two magnesium atoms

Compare the numbers of protons, neutrons and electrons in neutral magnesium-24 and magnesium-26 atoms. Magnesium has atomic number 12. Use your comparison to define isotopes.

3. Check a lithium calculation

Lithium-6 and lithium-7 make up 7.40% and 92.60% of a sample. A student averages the mass numbers and reports $A_r = 6.50$. Explain the error and calculate A_r to three significant figures.

4. A bromine mass spectrum

Peaks from singly charged bromine ions occur at m/z 79 and 81. Their relative intensities are 50 and 48. Calculate the weighted mean A_r to two decimal places.

5. Find both abundances

A chlorine sample contains isotopes with relative masses 35 and 37 only. Its relative atomic mass is 35.48. Calculate the percentage abundance of each isotope.

6. A missing percentage

Neon-20 makes up 90.5% of a sample and neon-21 makes up 0.3%. Neon-22 makes up the rest. Using mass numbers, find the abundance of neon-22 and the relative atomic mass to two decimal places.

7. A zinc sample

A prepared zinc sample has isotopic masses 64, 66 and 68 only. Its relative atomic mass is 66.00, and 40.0% of its atoms have mass 64. Calculate the other two percentages.

8. Nickel in a sample

A 0.250 mol sample contains nickel atoms with relative isotopic masses 58 and 60 only. $A_r = 58.62$. Calculate the number of nickel-60 atoms. Use the Avogadro constant, 6.022×10^{23} mol^{-1}.

9. Extra challenge · Two peaks and a mean

In a time-of-flight spectrometer, two singly charged isotopes follow the same path with the same kinetic energy. The ion of relative isotopic mass 63.0 takes 30.00 µs. The other takes 30.47 µs.

Find the other isotopic mass to the nearest whole number. The corresponding peak intensities are 70 and 30, respectively. Calculate A_r to two decimal places, using the rounded isotopic mass.

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