

Exercise walk-through

7.1

Radioactivity and half-life

Pearson Edexcel · International GCSE · Physics

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The method

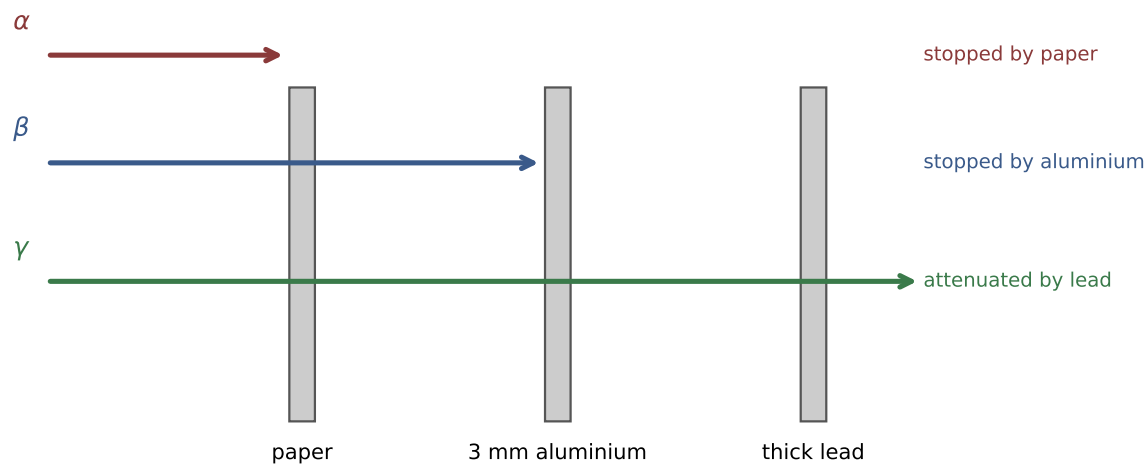
Method — Notation and balance

${}^A_ZX$: A = protons + neutrons, Z = protons. Alpha decay loses 4 and 2; beta-minus gains 1 proton, mass unchanged; gamma changes nothing.

Worked check. ${}^{239}_{93}\text{Np} \rightarrow {}^{239}_{94}\text{Pu} + {}^0_{-1}\text{e}$ (beta); ${}^{210}_{84}\text{Po} \rightarrow {}^{206}_{82}\text{Pb} + {}^4_2\text{He}$ (alpha).

Method — Notation and balance

A = protons + neutrons, Z = protons.



Alpha stopped by paper; beta by aluminium; gamma attenuated by lead.

Exercises 2.1·2.3

2.1 In ${}_{15}^{31}\text{P}$, how many protons and neutrons does the nucleus hold? [2]

2.2 Name the radiation stopped by a sheet of paper. [1]

2.3 Which radiation has the longest range in air? [1]

Exercises 2.1·2.3

2.1 In ${}_{15}^{31}\text{P}$, how many protons and neutrons does the nucleus hold? [2]

2.1 15 protons, $31 - 15 = 16$ neutrons.

2.2 Name the radiation stopped by a sheet of paper. [1]

2.2 Alpha.

2.3 Which radiation has the longest range in air? [1]

2.3 Gamma.

Exercises 2.4·3.1

2.4 Give two sources of background radiation. [2]

2.5 Define half-life. [1]

3.1 Balance the beta decay of ${}^{90}_{38}\text{Sr}$, writing the daughter nuclide in full notation. [3]

Exercises 2.4·3.1

2.4 Give two sources of background radiation. [2]

2.4 Any two: rocks, cosmic rays, radon gas, food, medical exposure, fallout.

2.5 Define half-life. [1]

2.5 The time for half the undecayed nuclei of an isotope to decay.

3.1 Balance the beta decay of ${}^{90}_{38}\text{Sr}$, writing the daughter nuclide in full notation. [3]

3.1 ${}^{90}_{38}\text{Sr} \rightarrow {}^{90}_{39}\text{Y} + {}^0_{-1}\text{e}.$

Exercises 3.2·3.3

3.2 A source reads 6400 Bq. After 20 days it reads 400 Bq. Determine the half-life. [3]

3.3 Explain why a medical tracer is chosen with a short half-life and gamma emission.[3]

Exercises 3.2·3.3

3.2 A source reads 6400 Bq. After 20 days it reads 400 Bq. Determine the half-life. [3]

3.2 $6400 \rightarrow 400$ is $6400/2^n = 400$, so $2^n = 16$ and $n = 4$ half-lives; half-life = $20/4 = 5$ days.

3.3 Explain why a medical tracer is chosen with a short half-life and gamma emission.[3]

3.3 Gamma passes out of the body to a detector, while doing the least ionising damage on the way; a short half-life means the activity – and the patient's dose – falls quickly after the scan.