PEARSON EDEXCEL · INTERNATIONAL GCSE · PHYSICS • EXERCISE SHEET

7.1 Radioactivity and half-life

Name: _____ Class: _____ Date: _____ **Total: 16 marks**

Objective

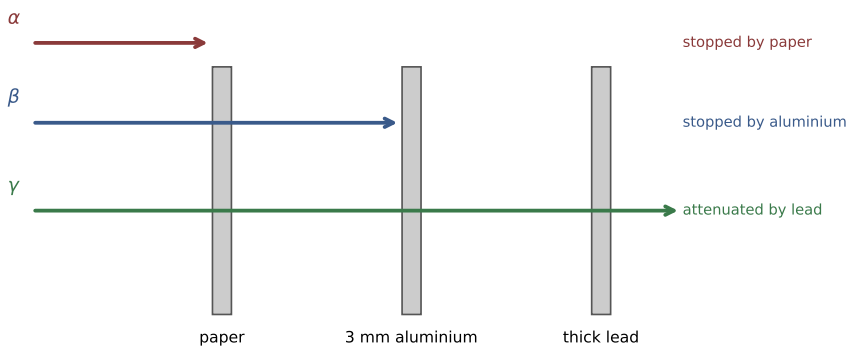
Cover radioactivity (7.2–7.16): nuclear notation, the three radiations with penetration and ionisation, balancing equations, detection, background radiation, half-life and uses, contamination vs irradiation and hazards. Original IGCSE-level practice.

1 Key knowledge and worked examples

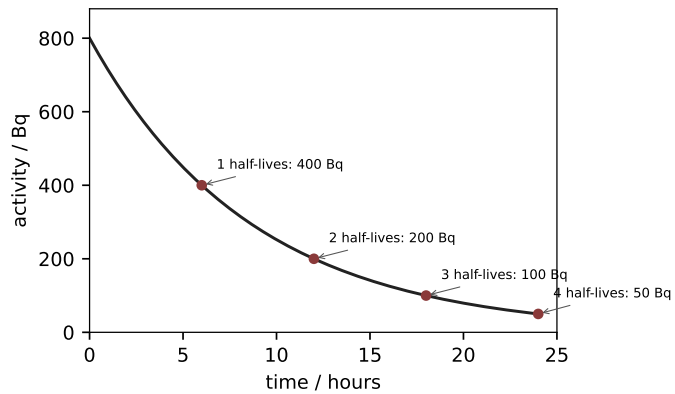
■ Notation and balance

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

Worked check. ${}^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + {}^{0}_{-1}e$ (beta); ${}^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$ (alpha).



■ Halving again and again



3200 Bq, half-life 5 h, after 15 h: 3200 → 1600 → 800 → 400 Bq.

2 Practice

2.1 In ${}^{31}_{15}P$, 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]

2.4 Give two sources of background radiation. [2]

2.5 Define half-life. [1]

3 Exam-style questions

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

Solutions

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

2.2 Alpha.

2.3 Gamma.

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

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

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

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 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.