Exam workout

atomic structure

1 Isotopes and nuclear equations

$$^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$$

(lead)

top: 210 − 4 = 206 — 206 + 4 = 210 ✓

bottom: 84 − 2 = 82 — 82 + 2 = 84 ✓

- Atomic number (protons) = **bottom number**. Neutrons = **top − bottom**. A neutral atom has as many electrons as protons: potassium-39 (atomic number 19) has 19 p, 20 n, 19 e.
- In a nuclear equation, **each row must balance**: polonium-210 (84) → lead-206 (82) + alpha (mass 4, charge 2), since 210 = 206 + 4 and 84 = 82 + 2.

2 Half-life from data

A sample's count-rate is taken every 2 days. What is the half-life?

	0	1200
+2	2	600 ÷ 2
+2	4	300 ÷ 2
+2	6	150 ÷ 2

half-life = 2 days

a time (days), not a count-rate

- Find the time for the count-rate to **halve**: 1200 → 600 → 300 → 150 counts per second, every 2 days, so the half-life is **2 days**.
- Half-life is **a time**, not a count-rate.

3 Safety answers

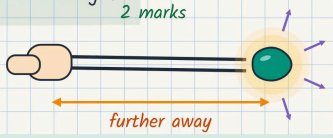
Model answer

The tongs keep the source further away from the teacher's hand. ✓

So the teacher receives less radiation, which lowers the risk of cell damage. ✓

2 marks

not ~~"no radiation"~~



- Long tongs keep the source **further away**, so the teacher receives **less radiation**, which **lowers the risk** of cell damage.
- Say **reduces**, never "prevents" or "no radiation".

4 Higher: net decline

Activity = 3200 Bq. Half-life = 8 hours.
What is the activity after 1 day?
What is the net decline?

½ × ½ × ½ = 1/8 left

3200 × 1/8 = 400 Bq

decline = 3200 − 400 = 2800 Bq

= 7/8 of the start

3200 Bq
8 h ÷ 2
1600 Bq
8 h ÷ 2
800 Bq
8 h ÷ 2
400 Bq

- Count the half-lives first: 1 day = 24 h, and 24 ÷ 8 = **3 half-lives**. After 3 half-lives, **1/8** is left: 3200 Bq × 1/8 = **400 Bq**.
- Net decline = 3200 − 400 = **2800 Bq**, which is **7/8** of the starting activity.

Exam tip

Use the examiner's words: "strongly ionising" (not only "alpha"), "counts per second" (not "counts"), and "the object does not become radioactive" for irradiation.

Check yourself

- 1 Why did the alpha scattering experiment show that most of an atom is empty space?

Answers: 1. Most alpha particles passed straight through the foil without being deflected.