

Unstable nuclei, decay and half-life

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test answers (mark scheme)

Model answers show the working that earns method marks. Allow follow-through if a wrong value from an earlier part is used correctly in a later part, and accept equivalent wording in the explanations.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-8, GCSE P4

Question 1 Stopping radiation (2 marks)

Alpha is stopped by paper. Gamma needs thick lead (or concrete) to reduce it.

Marking: 1 mark for each correct radiation.

Question 2 Alpha decay equation (3 marks)

Mass number $234 - 4 = \mathbf{230}$; atomic number $92 - 2 = \mathbf{90}$; the nucleus is **thorium-230**.

Marking: 1 mark for each of the mass number, the atomic number and the name.

Question 3 Half-life calculation (3 marks)

Number of half-lives = $36 \div 12 = 3$. Activity: $2400 \rightarrow 1200 \rightarrow 600 \rightarrow \mathbf{300 \text{ Bq}}$.

Marking: 1 mark for 3 half-lives, 1 mark for halving three times, 1 mark for the answer with unit.

Question 4 Reading the decay graph (3 marks)

- The activity falls from 640 kBq to 320 kBq in **5 minutes**.
- 15 minutes is 3 half-lives: $640 \rightarrow 320 \rightarrow 160 \rightarrow \mathbf{80 \text{ kBq}}$.
- $640 \rightarrow 320 \rightarrow 160 \rightarrow 80 \rightarrow 40 \rightarrow 20$ is 5 half-lives: $5 \times 5 = \mathbf{25 \text{ minutes}}$.

Marking: 1 mark for each part.

Question 5 Irradiation and contamination (3 marks)

Irradiation is exposure to radiation from a source outside the body. Contamination is when radioactive atoms get on or inside the body. To avoid contamination, wear gloves, do not eat or drink near sources, and wash hands after handling.

Marking: 1 mark for irradiation, 1 mark for contamination, 1 mark for a precaution.

Question 6 Fission and fusion (2 marks)

Fission is used in nuclear power stations. Fusion takes place in the Sun.

Marking: 1 mark for each.

Question 7 Choosing a tracer (2 marks)

The 6-hour isotope loses its activity quickly, so the patient receives a low total dose and the radiation soon becomes negligible. A 6-year isotope would stay radioactive in the patient for a long time and give a larger dose.

Marking: 1 mark for the lower dose or faster decay, 1 mark for the longer exposure with the 6-year isotope.

Question 8 Beta particles (2 marks)

A beta particle is a fast-moving electron. It is produced when a neutron in the nucleus changes into a proton, and the electron is emitted.

Marking: 1 mark for an electron, 1 mark for a neutron changing into a proton.