Exercise walk-through

Fission, Fusion, and Nuclear Decay ▪ 15.7

eXercise

You must be able to

- distinguish nuclear **fission** 裂变 (splitting) from **fusion** 聚变 (joining)
- relate the energy released to a change in **mass** 质量, $E = mc^2$
- describe **radioactive decay** 放射性衰变 as a random process with a **half-life** 半衰期

Method — Fission and fusion

- **Fission** — a heavy nucleus splits into lighter ones.
- **Fusion** — light nuclei join into a heavier one (as in the Sun).

Both release energy from a loss of mass.

Method — Mass-energy

$E = mc^2$: a tiny mass change gives a huge energy, because c^2 is enormous.

Method — Decay and half-life

Radioactive decay is **random** — you cannot predict when a given nucleus decays. The **half-life** is the time for half the nuclei to decay.

Practice 2.1 ▪ 2 marks

State the difference between nuclear fission and fusion.

Solution 2.1

Method: Fission and fusion

Worked steps

fission is the splitting of a heavy nucleus; fusion is the joining of light nuclei B1 B1.

Practice 2.2 ▪ 1 mark

State what the half-life of a radioactive substance means.

Solution 2.2

Method: Decay and half-life

Worked steps

the time taken for half of the radioactive nuclei to decay B1.

Practice 2.3 ▪ 2 marks

A mass of 2.0×10^{-3} kg is converted entirely to energy ($c = 3.0 \times 10^{8}$). Find the energy released.

Solution 2.3

Worked steps

$E = mc^2 = (2.0 \times 10^{-3})(3.0 \times 10^{8})^2 = 1.8 \times 10^{14}$ J **M1** **A1**.

Exam-style 3.1 ▪ 1 mark

Joining two light nuclei into a heavier one is called

A fission

B fusion

C decay

D ionization

Solution 3.1

Method: Fission and fusion

A fission

B fusion ✓

C decay

D ionization

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

The energy released in a nuclear reaction comes from a change in

A charge

B mass

C volume

D temperature

Solution 3.2

Method: Mass-energy

A charge

B mass ✓

C volume

D temperature

Worked steps

B.

Exam-style 3.3 ▪ 2 marks

A radioactive sample has a half-life of 8 days, starting with 80 g.
(a) Find the mass remaining after 16 days.
(b) Explain why radioactive decay is described as random.

Solution 3.3

Method: Decay and half-life

Worked steps

(a) after two half-lives: $80 \to 40 \to 20$ g **M1** **A1**. (b) you cannot predict which nucleus will decay or when — only the probability **B1**.