

# 15.7 Fission, Fusion, and Nuclear Decay

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

## Objective

Build the skills to answer exam questions on **fission, fusion, and nuclear decay**.

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

## 1 Worked examples

Study these first. Each one shows the method for a question type used later.

### ■ 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.

### ■ Mass-energy

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

### ■ 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.

## 2 Practice

2.1 State the difference between nuclear fission and fusion.

[2]

**2.2** State what the half-life of a radioactive substance means. [1]

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**2.3** A mass of  $2.0 \times 10^{-3}$  kg is converted entirely to energy ( $c = 3.0 \times 10^8$ ). Find the energy released. [2]

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### 3 Exam-style questions

**3.1** Joining two light nuclei into a heavier one is called [1]

- **A** fission
- **B** fusion
- **C** decay
- **D** ionization

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**3.2** The energy released in a nuclear reaction comes from a change in [1]

- **A** charge
- **B** mass
- **C** volume
- **D** temperature

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**3.3** A radioactive sample has a half-life of 8 days, starting with 80 g.

(a) Find the mass remaining after 16 days. [2]

(b) Explain why radioactive decay is described as random. [1]

### 4 Go further

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- work through the **15.7 Fission, Fusion, and Nuclear Decay** lesson on the **Learn** page;
  - read the **Modern Physics** section of the AP Physics 2 handout on the **Know** page.

## Solutions

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

**2.2** the time taken for half of the radioactive nuclei to decay.

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

**3.1 B.**

**3.2 B.**

**3.3** (a) after two half-lives:  $80 \rightarrow 40 \rightarrow 20 \text{ g}$ . (b) you cannot predict which nucleus will decay or when —only the probability.