AP PHYSICS 2 • EXERCISE SHEET

15.7 Fission, Fusion, and Nuclear Decay

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS mass 质量 • fission 裂变 • fusion 聚变 • half-life 半衰期 • radioactive decay 放射性衰变

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]

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

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

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

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

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]

Solutions

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

3.1 B.

3.2 B.

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