7.2 Fission and fusion

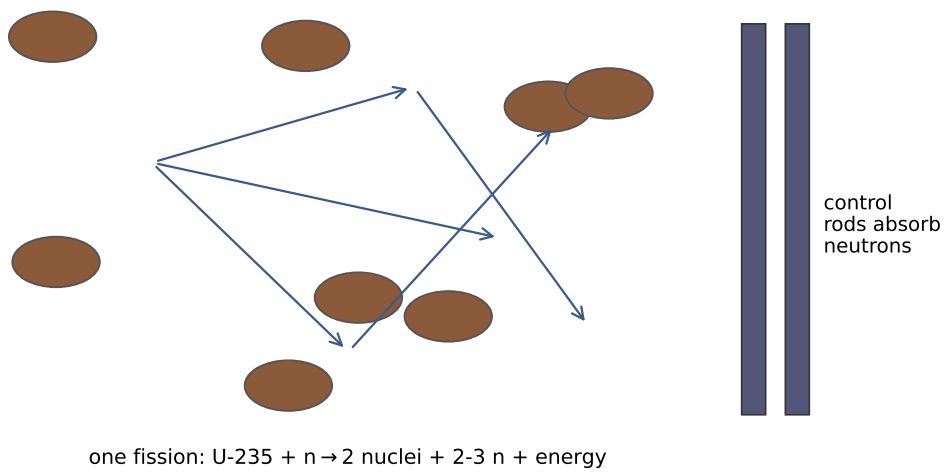
Name: _____ Class: _____ Date: _____ **Total: 16 marks**

Objective

Cover fission and fusion (3.7.3–3.7.4): induced fission of U-235/Pu-239, chain reactions with control rods, waste and disposal, and (P) fusion in stars with the temperature requirement. Original OxfordAQA practice.

1 Key knowledge and worked examples

■ Split, chain, contain



U-235 + n → two smaller nuclei + 2–3 neutrons + energy; control rods hold the chain steady; waste stays radioactive for its half-life.

■ (P) Fusion in the stars

Light nuclei join; mass converts to energy; proton repulsion demands extreme temperature and pressure.

2 Practice

2.1 Which nuclide must absorb a neutron before fission can occur? [1]

2.2 Name the three products of fission besides energy. [3]

2.3 What do control rods do? [1]

2.4 Why is fission waste dangerous for a long time? [1]

2.5 (P) What powers the stars? [1]

3 Exam-style questions

3.1 Describe how a chain reaction builds and how a reactor keeps it steady. [3]

3.2 Compare the energy released per kilogram in fission with a chemical reaction, and give one reason nuclear waste is a disposal problem. [3]

3.3 (P) Explain why fusion reactors are harder to build than fission reactors. [3]

Solutions

2.1 Uranium-235 (or plutonium-239).

2.2 Two smaller (daughter) nuclei and 2–3 neutrons.

2.3 Absorb neutrons so on average only one neutron per fission causes another fission.

2.4 Its radioactive isotopes have long half-lives, emitting ionising radiation for thousands of years.

2.5 (P) Nuclear fusion of light nuclei (hydrogen to helium).

3.1 Each fission releases 2–3 neutrons; these strike further U-235 nuclei causing more fissions – the chain grows; control rods lowered into the core absorb excess neutrons, holding the rate steady.

3.2 Fission releases far more energy per kilogram than any chemical reaction; the waste stays radioactive for very long half-lives, so it must be shielded and stored securely for millennia.

3.3 (P) Both fusing nuclei are positively charged and repel; they must collide at enormous speed to approach closely enough to fuse; that requires extreme temperatures and pressures, which are hard to contain.