7.2 Fission and fusion

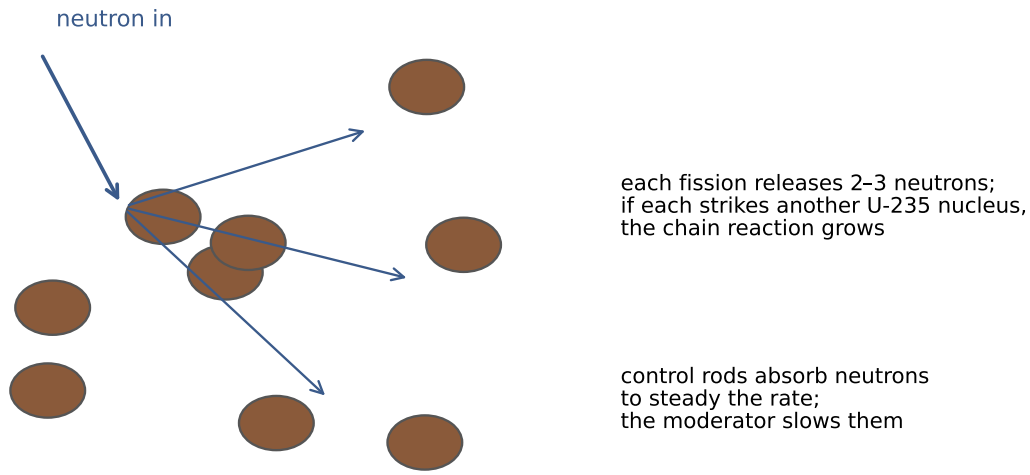
Name: _____ Class: _____ Date: _____ **Total: 16 marks**

Objective

Cover fission and fusion (7.17–7.26): energy from nuclear reactions, U-235 fission, chain reactions with moderator, control rods and shielding, and fusion in stars. Original IGCSE-level practice.

1 Key knowledge and worked examples

■ The chain, managed



One U-235 + n → two daughter nuclei + 2–3 neutrons + kinetic energy. Moderator slows neutrons; control rods absorb them; shielding protects.

■ Fusion: joining nuclei

Small nuclei fuse to a larger one with a loss of mass and release of energy – the Sun's power. Proton repulsion demands extreme temperature and pressure.

2 Practice

2.1 State what bombards U-235 to cause fission. [1]

2.2 Name the three products of a U-235 fission besides energy. [3]

2.3 State the role of the control rods. [1]

2.4 State the role of the moderator. [1]

2.5 What provides the Sun's energy? [1]

3 Exam-style questions

3.1 Describe how a chain reaction builds in a mass of U-235, and how control rods keep it steady. [3]

3.2 Explain the difference between nuclear fission and nuclear fusion, naming where each is used. [3]

3.3 Explain why fusion reactors need much higher temperatures than fission reactors produce. [3]

Solutions

2.1 A (slow) neutron.

2.2 Two radioactive daughter nuclei and 2–3 neutrons.

2.3 Absorb neutrons to control the fission rate.

2.4 Slow the neutrons so they split U-235 efficiently.

2.5 Nuclear fusion of hydrogen (into helium).

3.1 A fission releases 2–3 neutrons; each can strike another U-235 nucleus, causing further fissions whose neutrons continue the growing chain; control rods lowered into the reactor absorb neutrons, holding one fission per neutron – a steady rate.

3.2 Fission splits a large nucleus (U-235) into smaller nuclei, releasing energy – used in nuclear power stations; fusion joins small nuclei into a larger one, releasing energy – powering the Sun (and experimental reactors).

3.3 Both nuclei to be fused are positively charged; like charges repel electrostatically, so the nuclei must collide at enormous speed to approach closely enough to fuse; enormous speeds require extremely high temperatures and pressures.