AQA · GCSE · PHYSICS • EXERCISE SHEET

4.7 Nuclear fission and fusion

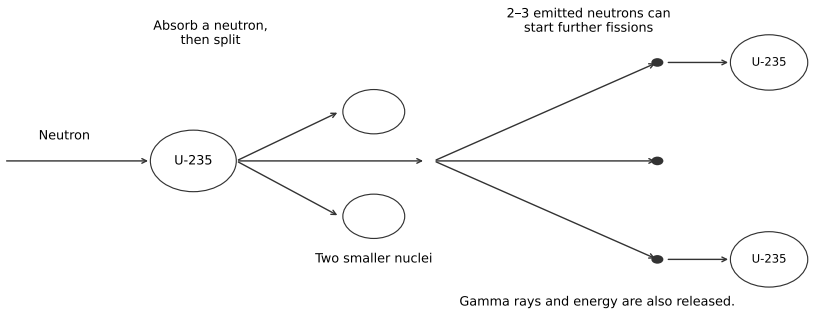
Name: _____ Class: _____ Date: _____ **Total: 21 marks**

KEY WORDS fission • fusion

Objective

Describe nuclear fission including the chain reaction, and nuclear fusion, and interpret the credited diagrams. Physics only. Original questions for spec statements 4.4.4.1–4.4.4.2.

1 Key knowledge and worked examples



Each released neutron can split another nucleus: a chain reaction.

Fission – the splitting of a **large, unstable** nucleus (uranium-235, plutonium-239):

1. spontaneous fission is rare – the nucleus usually **absorbs a neutron** first;
2. it splits into **two smaller nuclei, roughly equal in size**;
3. it releases **two or three neutrons** plus **gamma rays**; **energy is released**;
4. all the products (fragments, neutrons) carry **kinetic energy**;
5. the released neutrons may split further nuclei – a **chain reaction**.

Context	Chain reaction
nuclear reactor	**controlled** – control rods absorb neutrons to set the energy release rate
nuclear weapon	**uncontrolled** – it grows rapidly, releasing energy in an explosion

You must draw or interpret the chain diagram: neutron in → fragments + 2–3 neutrons out → each new neutron aimed at another large nucleus.

Fusion – **two light nuclei join** to form a heavier nucleus:

- some of the mass is **converted into the energy of radiation**;
- does not produce fission fragments, but a fusion system must not be assumed to create no radioactive material;
- needs extreme temperature and pressure to force nuclei together – why working fusion power is hard.

2 Practice

2.1 State the two fuel nuclei named by the spec for fission. [1]

2.2 List the products of one fission event (other than energy). [3]

2.3 State what fusion is and what happens to some of the mass. [2]

3 Exam-style questions

3.1 A uranium-235 nucleus absorbs a neutron and undergoes fission.

(a) Describe the products of this event. [3]

(b) Explain how a chain reaction can follow. [2]

(c) Explain how a reactor keeps the chain reaction controlled. [2]

3.2 Nuclear power stations do not generate electricity every day of the year; one station generated for 92% of a year (365 days). Calculate the number of generating days. [2]

3.3 Compare fission and fusion: their fuel nuclei, how energy is released, and radioactive material produced. [6]