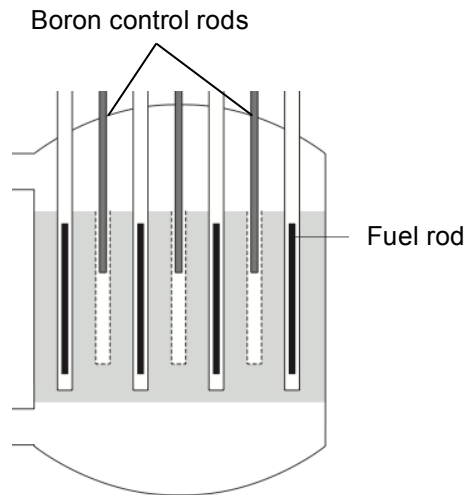


Fission and Fusion

- 1 The diagram shows the inside of a nuclear reactor. The nuclear reactor generates electricity.



The fuel rods are made of a radioactive element. The boron control rods are used to control the reaction inside the reactor. Boron atoms absorb neutrons safely.

- 1 (a) Name a suitable radioactive element that is used to make the fuel rods in a nuclear reactor.

Uranium 235 or plutonium 239 [1 mark]

The two fuels are mentioned in the specification so a good idea to remember them.

(1 mark)

- 1 (a) (i) The boron control rods can be raised or lowered in order to control the reaction. Raising them would increase the amount of energy released in the reactor.

Explain why.

Less neutrons are absorbed (by boron / control rods) [1 mark]

There are more neutrons [1 mark]

Chain reaction gets faster / increases [1 mark]

Use of boron not mentioned specifically in the spec, but it's a good idea to be aware of how they work.

(2 marks)

- 1 (a) (ii) Energy is released from nuclear fuels. This energy is released in the form of heat energy.

Describe how this heat energy is used to generate electricity.

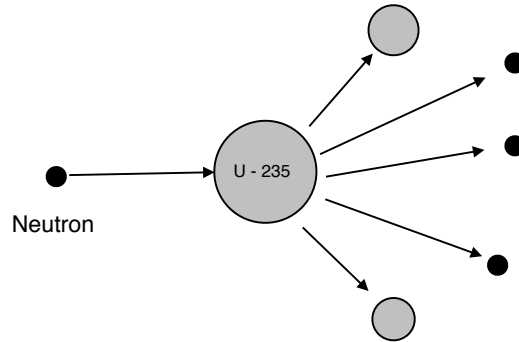
(Energy) used to heat water [1 mark]

And produce (high pressure) steam [1 mark]

The steam drives a turbine (which turns a generator) [1 mark]

(2 marks)

1 (b) The diagram below shows the process that occurs in the fuel rods inside the reactor.



1 (b) (i) Name the process that is being shown in the diagram.

(nuclear) fission [1 mark]

(1 mark)

1 (b) Explain how this process could lead to a chain reaction.

You may add to the diagram above to help you answer.

Neutrons absorbed by a nucleus [1 mark]

Nucleus splits and releases more/three more neutrons [1 mark]

Each neutron is absorbed by another nucleus releasing more neutrons [1 mark]

(2 marks)

Total (8 marks)

3 Explain how stars release energy.

Two atomic nuclei join/fuse to form a bigger one [1 mark]

Process called (nuclear) fusion [1 mark]

(2 marks)

3 (a) Scientists have tried to use nuclear fusion to produce energy. Here is an extract from a news article about an experiment to release energy by fusion.

During the experiment in late September 2013, the amount of energy released through the fusion reaction exceeded the amount of energy being absorbed by the fuel - the first time this had been achieved at any fusion facility in the world.

It (fusion) is markedly different from current nuclear power, which operates through fission rather than fusion.

3 (a) (i) The fuel used in the experiment was the same as the fuel in the sun.

Suggest what is used as the fuel.

Hydrogen (nuclei) [1 mark]

(1 mark)

3 (a) (ii) Based on the extract, suggest why it has not been economically feasible to provide energy through nuclear fusion reactions.

The amount of energy released less than the amount used [1 mark]

So not cost effective or costs more than it makes [1 mark]

(2 marks)

3 (a) (iii) What is would the energy released by nuclear fusion be used for?

To heat water [1 mark]

(1 mark)

3 (a) (iv) Suggest one difference between the process of fusion and fission.

Fusion joining of nuclei, fission splitting [1 mark]

Fusion no neutrons released, fission neutrons released [1 mark]

Fusion larger nuclei produced, fission smaller nuclei [1 mark]

(1 mark)

Total (7 marks)