

Name of the Student: _____

Max. Marks : 17 Marks

Time : 17 Minutes

Q1.

Many countries use nuclear power stations to generate electricity.
Nuclear power stations use the process of nuclear fission to release energy.

(a) (i) What is nuclear fission?

(1)

(ii) Plutonium-239 is one substance used as a fuel in a nuclear reactor. For nuclear fission to happen, the nucleus must absorb a particle.

What type of particle must be absorbed?

(1)

(b) Nuclear **fusion** also releases energy.
Nuclear fusion happens at very high temperatures. A high temperature is needed to overcome the repulsion force between the nuclei.

(i) Why is there a repulsion force between the nuclei of atoms?

(1)

(ii) Where does nuclear fusion happen naturally?

(1)

(c) In 1991, scientists produced the first controlled release of energy from an experimental nuclear **fusion** reactor. This was achieved by fusing the hydrogen isotopes, deuterium and tritium.

Deuterium is naturally occurring and can easily be extracted from seawater. Tritium can be produced from lithium. Lithium is also found in seawater.

The table gives the energy released from 1 kg of fusion fuel and from 1 kg of fission fuel.

Type of fuel	Energy released from
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	1 kg of fuel in joules
Fusion fuel	3.4×10^{14}
Fission fuel	8.8×10^{13}

- (i) Suggest **two** advantages of the fuel used in a fusion reactor compared with plutonium and the other substances used as fuel in a fission reactor.

1. _____

2. _____

(2)

- (ii) Some scientists think that by the year 2050 a nuclear fusion power station capable of generating electricity on a large scale will have been developed.

Suggest **one** important consequence of developing nuclear fusion power stations to generate electricity.

(1)

- (d) Tritium is radioactive.

After 36 years, only 10 g of tritium remains from an original sample of 80 g.

Calculate the half-life of tritium.

Show clearly how you work out your answer.

Half-life = _____ years

(2)

(Total 9 marks)

Q2.

- (a) Nuclear power stations generate about 14% of the world's electricity.

- (i) Uranium-235 is used as a fuel in some nuclear reactors.

Name **one** other substance used as a fuel in some nuclear reactors.

(1)

(ii) Energy is released from nuclear fuels by the process of nuclear fission.

This energy is used to generate electricity.

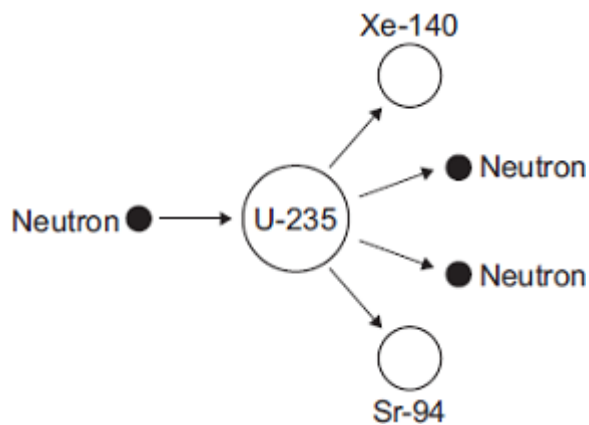
Describe how this energy is used to generate electricity.

Do **not** explain the nuclear fission process.

(3)

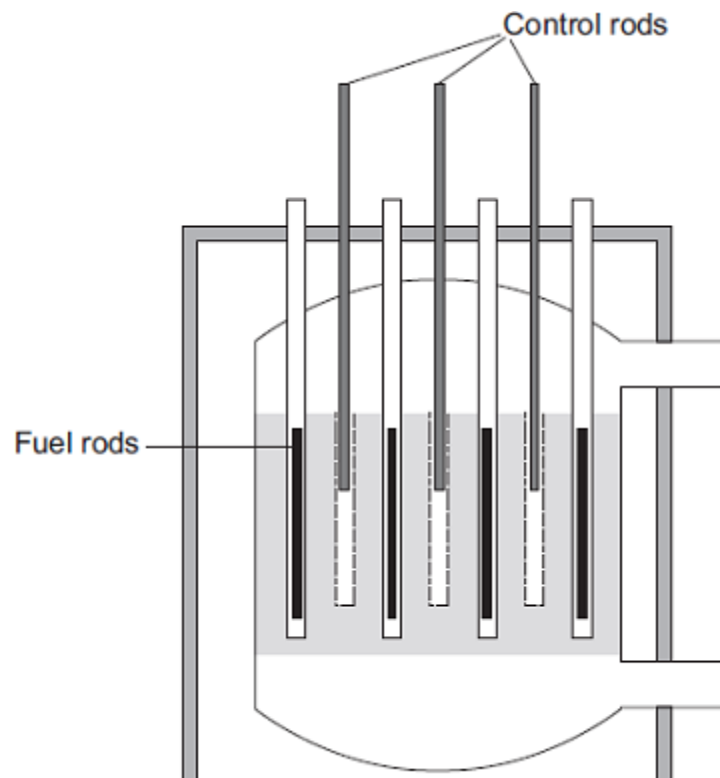
(b) The diagram shows the nuclear fission process for an atom of uranium-235.

Complete the diagram to show how the fission process starts a chain reaction.



(2)

(c) The diagram shows the cross-section through a nuclear reactor.



The control rods, made from boron, are used to control the chain reaction. Boron atoms absorb neutrons without undergoing nuclear fission.

Why does lowering the control rods reduce the amount of energy released each second from the nuclear fuel?

(2)
(Total 8 marks)