

Eduqas Physics GCSE
Topic 9.4: Nuclear fission and fusion
Questions by topic

1.

The process of nuclear fusion results in the release of energy.

(a) (i) Describe the process of nuclear fusion.

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(2)

(ii) Where does nuclear fusion happen naturally?

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(1)

(b) For many years, scientists have tried to produce a controlled nuclear fusion reaction that lasts long enough to be useful. However, the experimental fusion reactors use more energy than they produce.

(i) From the information given, suggest **one** reason why nuclear fusion reactors are not used to produce energy in a nuclear power station.

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(1)

(ii) Suggest **one** reason why scientists continue to try to develop a practical nuclear fusion reactor.

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(1)

(Total 5 marks)

(a) Nuclear fission is used in nuclear power stations to generate electricity. Nuclear fusion happens naturally in stars.

(i) Explain briefly the difference between *nuclear fission* and *nuclear fusion*.

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(2)

(ii) What is released during both nuclear fission and nuclear fusion?

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(1)

(b) Plutonium-239 is used as a fuel in some nuclear reactors.

(i) Name another substance used as a fuel in some nuclear reactors.

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(1)

(ii) There are many isotopes of plutonium.

What do the nuclei of different plutonium isotopes have in common?

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(1)

(Total 5 marks)

3.

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

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

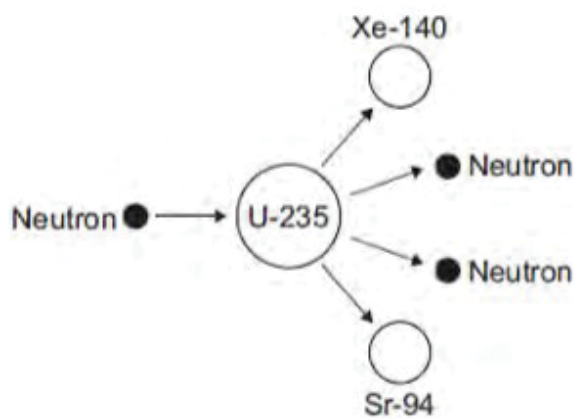
Name **one** other substance used as a fuel in some nuclear reactors.

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(1)

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

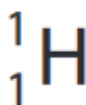
Complete the diagram to show how the fission process starts a chain reaction.



(2)

4.

(a) The nucleus of a hydrogen atom can be represented by this symbol:



(i) Complete this sentence by putting a cross (☒) in the box next to your answer.

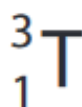
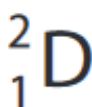
The symbol shows that the nucleus consists of

(1)

- A 1 proton and 1 neutron
- B 1 proton only
- C 1 neutron only
- D 1 neutron and 1 electron.

(ii) Two other isotopes of hydrogen are deuterium (D) and tritium (T).

Their nuclei can be represented by these symbols:



State how these symbols show that they are isotopes of hydrogen.

(1)

(b) Nuclear fusion can occur if a deuterium and a tritium nucleus can be brought close enough to each other.

This fusion produces a helium nucleus and releases a neutron.

(i) Compare the charges of a helium nucleus and a neutron.

(2)

*(c) Neutrons are also released during nuclear fission.
Describe how the neutrons released in nuclear fission are used to produce a controlled chain reaction in a nuclear reactor.

(6)

5.

Beryllium-9 is a stable isotope of beryllium.

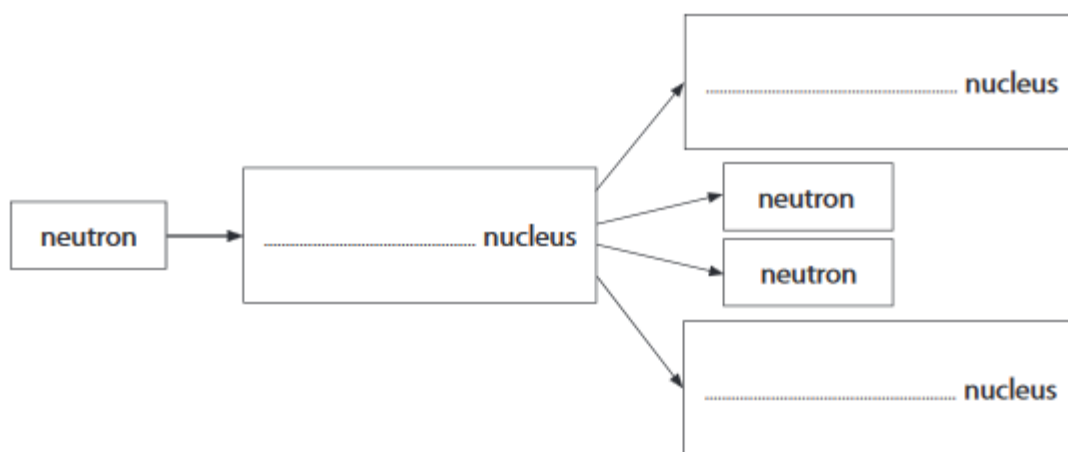
(a) (i) State the meaning of the term **stable**.

(1)

(b) A beryllium-9 nucleus absorbs a neutron.
After a short time the new nucleus splits into two neutrons and two alpha particles.

(i) Complete the flow chart for this reaction.

(2)



(ii) Compare this nuclear reaction with the fission of a uranium nucleus.

(3)

(iii) A fission reaction can be the start of a chain reaction.

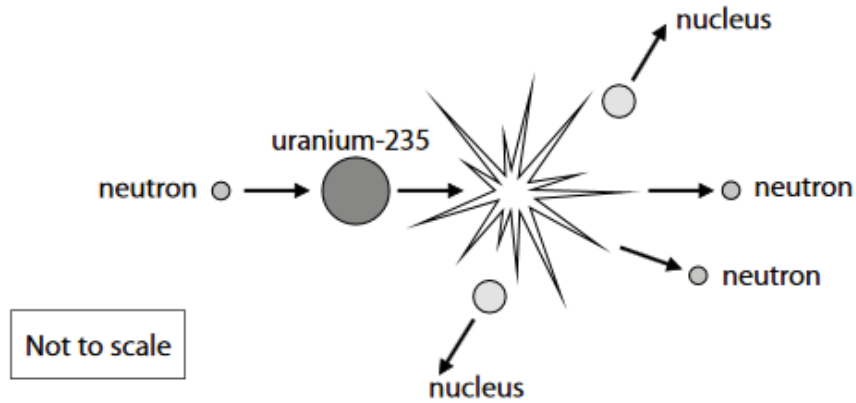
Describe what needs to happen next to produce a chain reaction.

(2)

6.

(c) Nuclear fission can cause changes to nuclei.

The diagram shows the fission of a uranium-235 nucleus.



Describe how this fission could cause a chain reaction.

(2)

(d) Nuclei can also be changed by nuclear fusion.

Describe what happens during nuclear fusion.

(3)

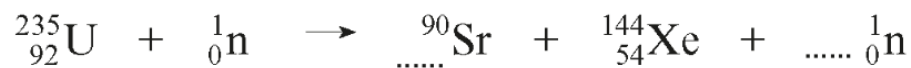
7.

When two nuclei undergo nuclear fusion, their total mass decreases. Where does this mass go? [1 mark]

8.

Nuclear fission and nuclear fusion are examples of nuclear reactions. Typical nuclear fission and nuclear fusion reactions are shown below.

- (a) (i) Complete the equation for the first reaction. [2]



- (ii) Explain how the first reaction could lead to an uncontrolled chain reaction. [2]

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- (b) ${}_1^2\text{H}$ and ${}_1^3\text{H}$ are both isotopes of hydrogen.

Compare the structure of the **nuclei** of these two isotopes. [2]

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(c) Nuclear fission and nuclear fusion both produce heat energy. Describe and compare nuclear fission and nuclear fusion reactions. [6 QWC]

Include in your answer:

- what happens in each of the reactions;
- the problems associated with each reaction.

(You are not required to include any detail on moderators or control rods.)

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