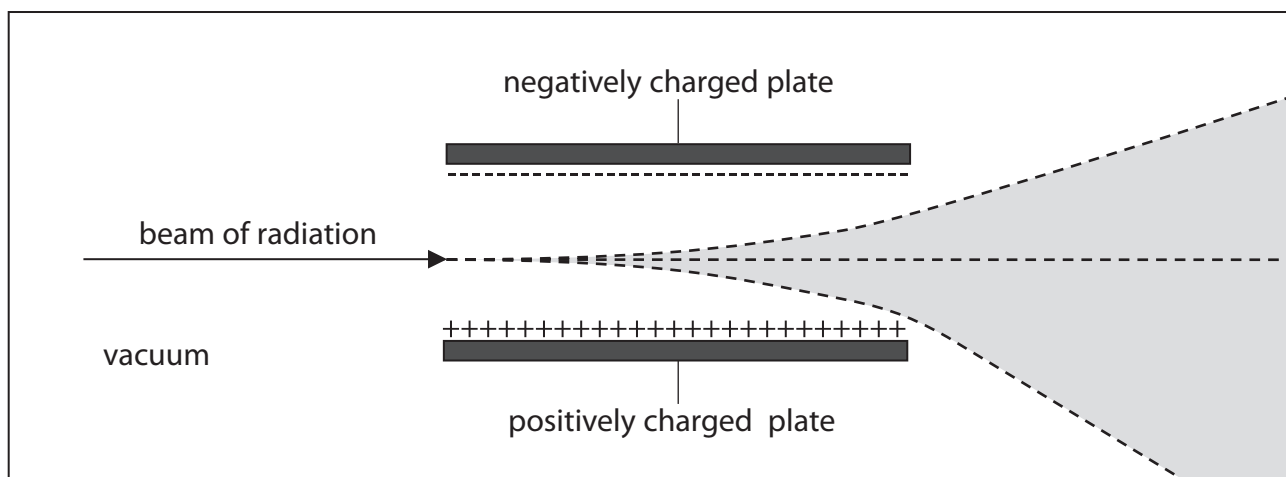


- 3 (a) Scientists use deflection in an electric field to help distinguish between different radiations.

The diagram shows a beam containing several types of radiation. This beam travels in a vacuum between two charged plates.

Some of the radiations are deflected upwards, some are deflected downwards and some are not deflected at all.



Put one tick in each row to show the correct deflection for each type of radiation.

One has been done for you.

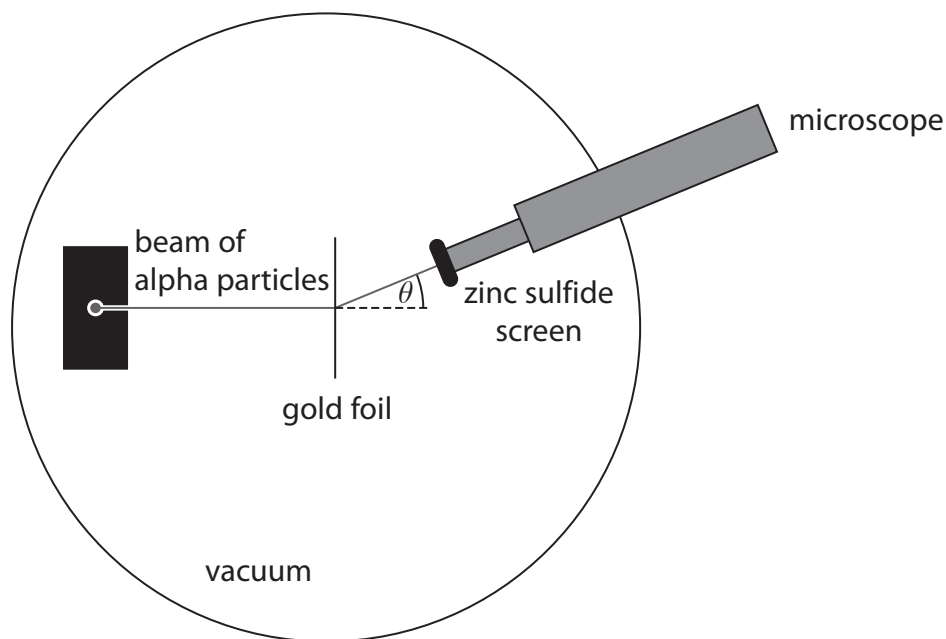
(4)

Type of radiation	Deflected upwards	Deflected downwards	Not deflected
alpha	✓		
beta			
gamma			
neutrons			
protons			

- (b) The diagram shows the apparatus Geiger and Marsden used to investigate the structure of an atom.

They aimed a beam of alpha particles at a very thin sheet of gold foil.

They used a zinc sulfide screen to detect the alpha particles.



- (i) Suggest why Geiger and Marsden removed the air from the apparatus.

(1)

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- (ii) Describe Geiger and Marsden's results.

(2)

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(c) Rutherford produced a model of the atom.

Describe how Rutherford's model explains Geiger and Marsden's results.

You may draw a diagram to help your answer.

(4)

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(Total for Question 3 = 11 marks)

2 Carbon-14 is a radioactive isotope of carbon.

It has the symbol



(a) (i) The number of **nucleons** in a carbon-14 nucleus is

(1)

- ☐ A 6
- ☐ B 8
- ☐ C 14
- ☐ D 20

(ii) The number of **neutrons** in a carbon-14 nucleus is

(1)

- ☐ A 6
- ☐ B 8
- ☐ C 14
- ☐ D 20

(iii) The number of **electrons** in a neutral carbon-14 atom is

(1)

- ☐ A 6
- ☐ B 8
- ☐ C 14
- ☐ D 20

(b) When carbon-14 decays it emits a beta particle.

What is a **beta particle**?

(1)

- ☐ **A** an electron
- ☐ **B** a neutron
- ☐ **C** a nucleus
- ☐ **D** a proton

(c) Carbon-14 has a half-life of 5700 years.

A sample of cloth contains 6.0 g of carbon-14.

What mass of carbon-14 will remain in the cloth after 11 400 years?

(1)

- ☐ **A** 1.5 g
- ☐ **B** 2.0 g
- ☐ **C** 2.5 g
- ☐ **D** 3.0 g

(d) The carbon atoms in the cloth are mainly atoms of carbon-12, a different isotope of carbon.

What are **isotopes**?

(2)

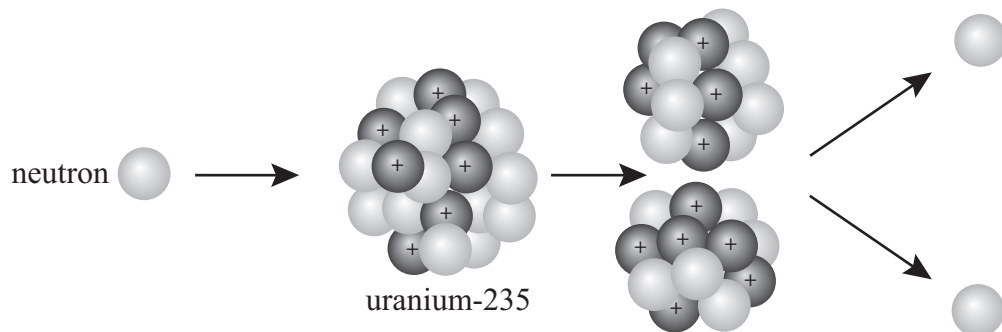
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(Total for Question 2 = 7 marks)

- 3 The diagram shows a neutron colliding with a nucleus of uranium-235, producing a number of products.



- (a) Name the process shown in the diagram.

(1)

- (b) Explain how the process shown in the diagram can lead to a chain reaction.

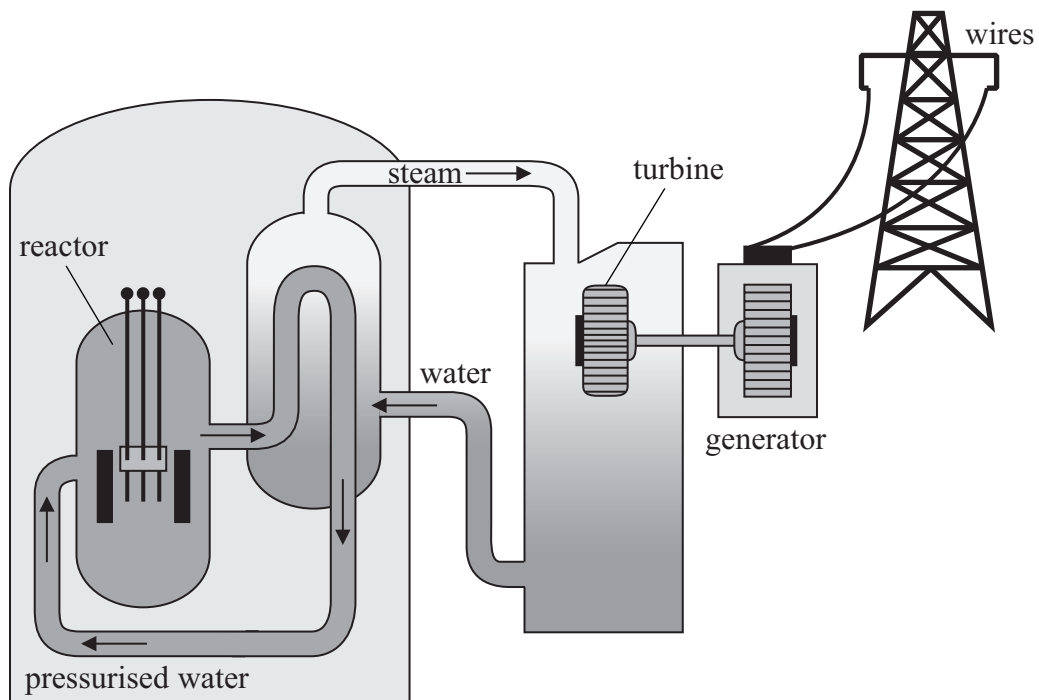
(3)

- (c) This process releases energy.

Explain the form that this energy takes.

(2)

(d) The energy released in this process can be used in a nuclear power station.



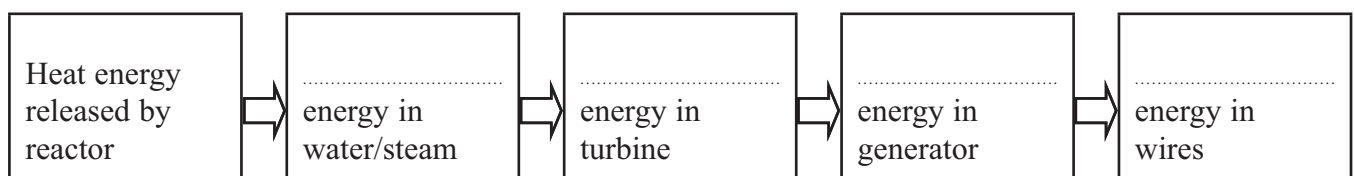
(i) The pressurised water acts as a coolant. It also acts as a moderator.

What is the purpose of a **moderator**?

(1)

(ii) Complete the chart below to show the main useful energy transfers in a nuclear power station.

(4)



(Total for Question 3 = 11 marks)