

# 4.1 Atoms & Isotopes

## Question Paper

Course	AQA GCSE Physics
Section	4. Atomic Structure
Topic	4.1 Atoms & Isotopes
Difficulty	Medium

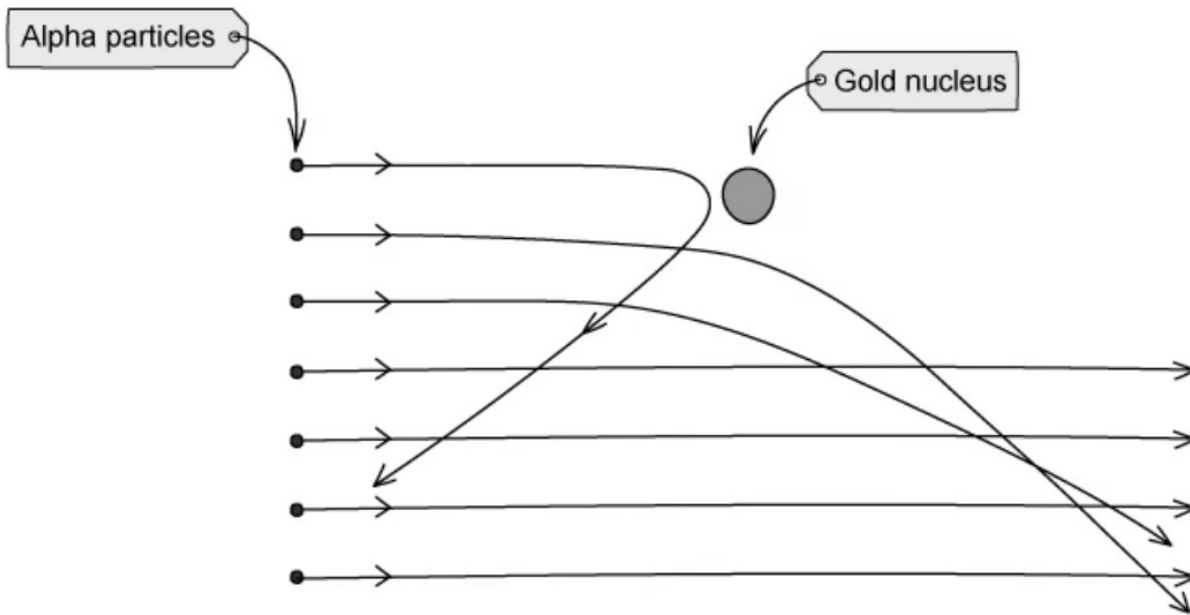
**Time allowed:** 40  
**Score:** /26  
**Percentage:** /100

**Question 1a**

(a) In 1909, Rutherford, Geiger and Marsden developed an experiment where alpha particles were scattered from gold foil.

**Figure 1** shows the paths of some of the alpha particles that were fired at the gold foil during the experiment.

**Figure 1**



Explain how the paths of the alpha particles were used to develop the nuclear model of the atom.

**[4 marks]**

[4 marks]

**Question 1b**

- (b) In 1913, Niels Bohr improved upon Rutherford's nuclear model by suggesting that electrons orbited the nucleus at particular distances.

Explain how the distance at which an electron orbits the nucleus can be changed.

**[3 marks]**

[3 marks]

**Question 2a**

- (a) Two isotopes of uranium are uranium-238 and uranium-235

The nuclear symbols for these are shown below.



What is meant by the term 'isotope'?

**[2 marks]**

[2 marks]

**Question 2b**

(b) How many protons are in the nucleus of a  ${}_{92}^{238}\text{U}$  atom?

[1 mark]

[1 mark]

**Question 2c**

(c) How many neutrons are in the nucleus of a  ${}_{92}^{238}\text{U}$  atom?

[1 mark]

[1 mark]

**Question 2d**

(d) What is the mass number of a  ${}_{92}^{235}\text{U}$  atom?

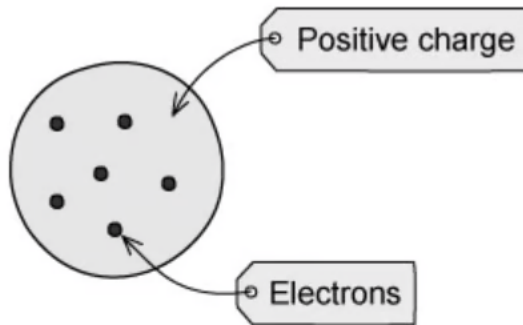
[1 mark]

[1 mark]

### Question 3

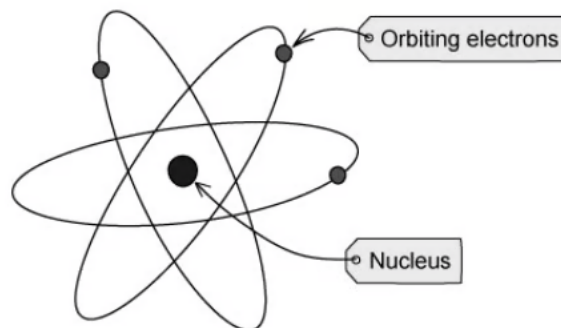
In the early 20th century, one model of the atom which was popular was the 'plum pudding' model, shown in **Figure 2**.

**Figure 2**



In 1909, Rutherford, Geiger and Marsden suggested a new model of the atom, called the 'nuclear' model, shown in **Figure 3**.

**Figure 3**



Describe the differences between the two models.

[4 marks]

[4 marks]

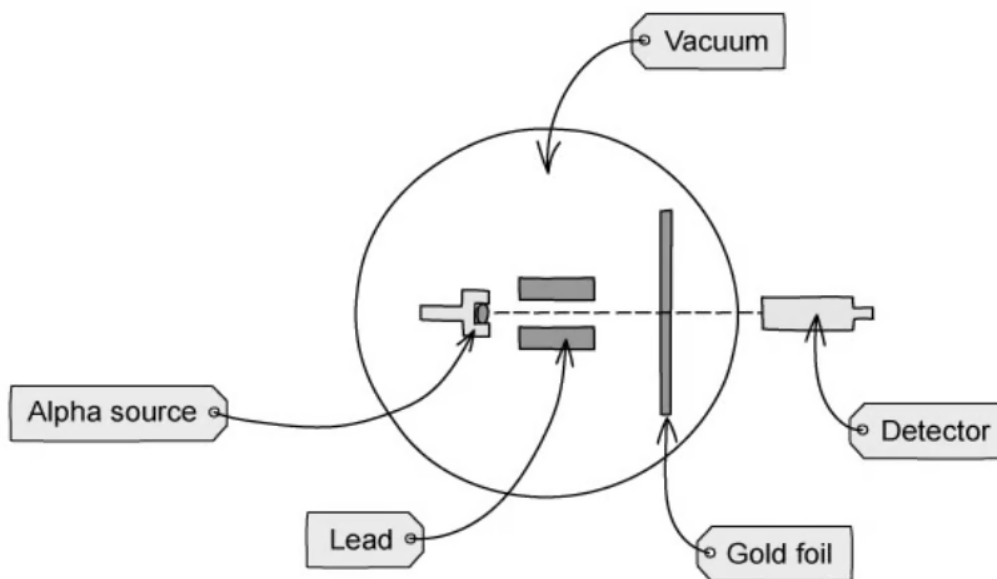


**Question 4a**

- (a) Rutherford's experiment, as shown in **Figure 4**, was designed to test the plum pudding model.

It involved firing alpha particles at a thin sheet of gold foil, and then detecting which direction the alpha particles left the gold foil.

**Figure 4**



The plum pudding model predicted that alpha particles would pass straight through the atom with very few deflections, and even those would be small: no more than  $4^\circ$ .

The results of the experiment were that most of the alpha particles did go straight through, but some were deflected through large angles, and around 1 in 8000 was deflected straight back at the alpha source.

Why did this model lead to the plum pudding model being replaced by the nuclear model?

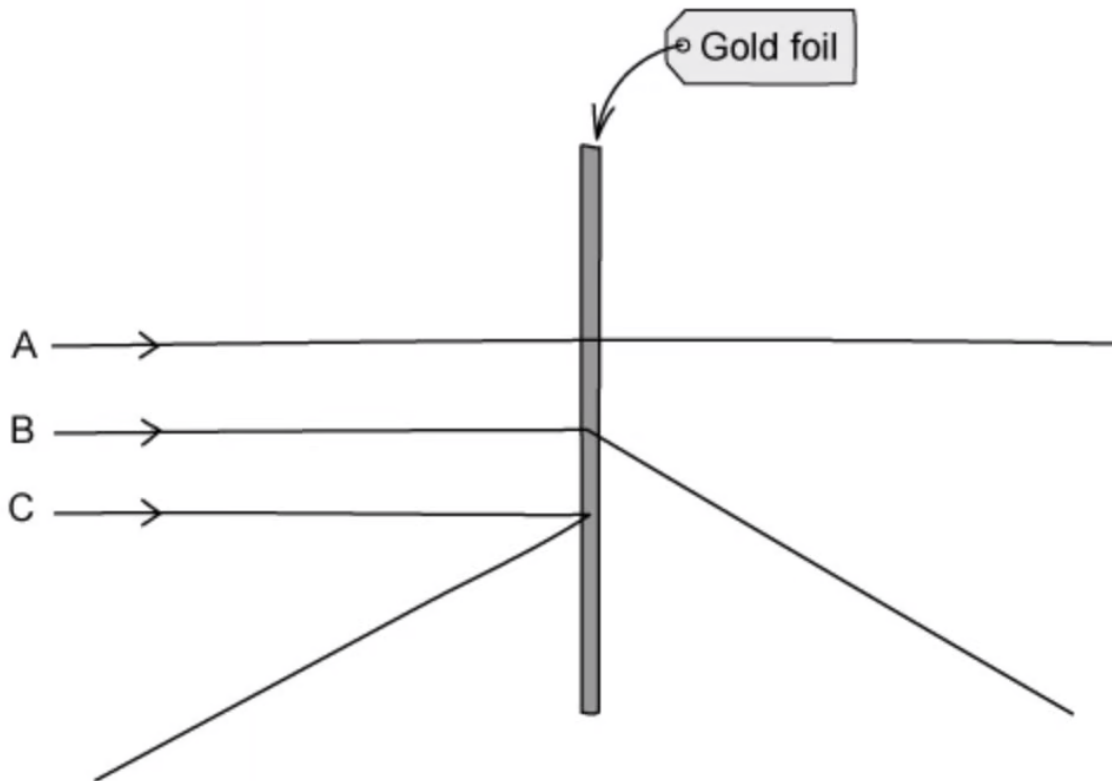
[1 mark]

[1 mark]

Question 4b

(b) **Figure 5** shows the paths of three of the alpha particles that were fired at the gold foil.

**Figure 5**



Use the nuclear model to explain the three paths, **A**, **B**, and **C**.

[3 marks]

[3 marks]



### Question 5a

A nuclear power station uses uranium to generate thermal energy. The fuel for the power station is an isotope of uranium.

(a)

Explain the meaning of the term isotope.

[2 marks]

[2 marks]

### Question 5b

When the nucleus of one particular isotope of uranium decays, it releases a  $\beta$ -particle. In the periodic table the entry for this isotope looks like this:



(b)

State the number of protons number, the mass number and the number of neutrons in this isotope.

[3 marks]

[3 marks]

### Question 5c

There are three naturally occurring isotopes of hydrogen: hydrogen-1, hydrogen-2 and hydrogen-3.

Hydrogen-1 is the simplest nuclide containing only one proton. Each isotope of hydrogen is represented by the symbol  $H$ .

(c)

Write down the symbols, using nuclide notation, for:

hydrogen-1 .....

hydrogen-2 .....

hydrogen-3 .....

[1 mark]

[1 mark]