

GCSE Physics (9 – 1)

Development of the model of the atom

Name:

Group:



Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.

For markers use	
Question	Mark
1	/4
2	/4
3	/10
4	/6
5	/6
Total	/30
%	
Grade	

Information

- The maximum mark for this paper is 30 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. The model of the atom hasn't always looked the way it does today. It has been an incredible scientific journey that has led to our modern understanding of matter.

For each of the following questions **circle** the letter of the correct answer.

- a) Which of the following best describes the '**plum pudding**' model of the atom?

- A** A central nucleus containing protons and neutrons.
- B** A ball of positive charge with negative electrons embedded inside it.
- C** Tiny solid spheres that cannot be divided into smaller parts.
- D** A positive nucleus with electrons orbiting at specific distances.

(1 mark)

- b) In the alpha particle scattering experiment, most of the alpha particles passed straight through the gold foil without changing direction. What did this observation prove?

- A** The atom is mostly empty space
- B** Electrons orbit the nucleus in fixed energy levels.
- C** The nucleus contains neutral particles called neutrons.
- D** The nucleus has a negative charge.

(1 mark)

- c) How did Niels Bohr adapt the nuclear model of the atom?

- A** He discovered the proton.
- B** He discovered the neutron.
- C** He suggested that electrons orbit the nucleus at specific distances (energy levels).
- D** He suggested that electrons are spread evenly throughout the atom.

(1 mark)

- d) Which scientist provided the experimental evidence to prove the existence of neutrons within the nucleus?

A	B	C	D
J.J. Thomson	Ernest Rutherford	John Dalton	James Chadwick
(1 mark)			

(Total for Question 1 is 4 marks)

2. Over the last 200 years, the scientific model of the atom has changed significantly as new evidence has been discovered.

a) Before the nuclear model was accepted, scientists believed in the '**plum pudding**' model.

Describe the plum pudding model of the atom.

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(2 marks)

b) In 1909, Ernest Rutherford's team conducted the alpha particle scattering experiment. They fired a beam of alpha particles at a very thin piece of gold foil.

During the experiment, they observed that approximately **1 in every 8000** alpha particles bounced straight back towards the source.

If the radioactive source emitted 3.2×10^6 alpha particles during a test, calculate the expected number of alpha particles that would bounce straight back.

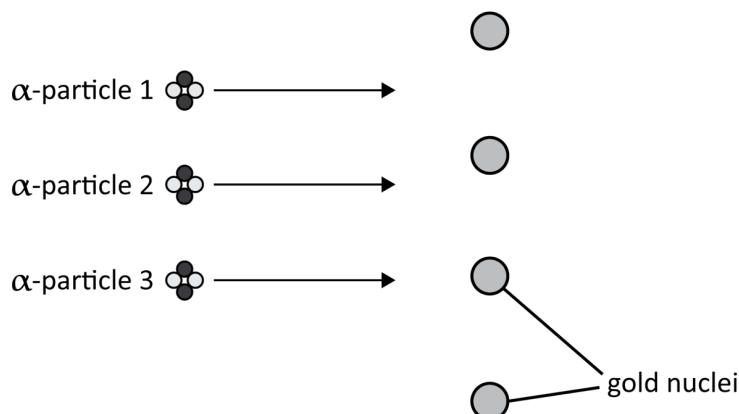
Expected number of alpha particles = ...

(2 marks)

(Total for Question 2 is 4 marks)

3. In 1909, Hans Geiger and Ernest Marsden conducted an experiment by firing α -particles at a thin sheet of gold foil.

The figure below shows three of the alpha particles being fired at a layer of the gold foil. Also shown are the paths of the three α -particles directed at the foil.



- a) State the result of the experiment that shows that an atom consists of a very tiny, charged core, containing almost all the mass of the atom.

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(2 marks)

- b) Give the sign of the charge on this core.

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(1 mark)

- c) State what particle occupies the space between these charged cores.

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(1 mark)

- d) Some of the alpha particles fired at the gold foil were reflected back.
Why did this occur?

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(2 marks)

e) Our understanding of atomic structure has changed over time.

Compare the structure of the **plum pudding** model with the **current** (nuclear) **model** of the atom.

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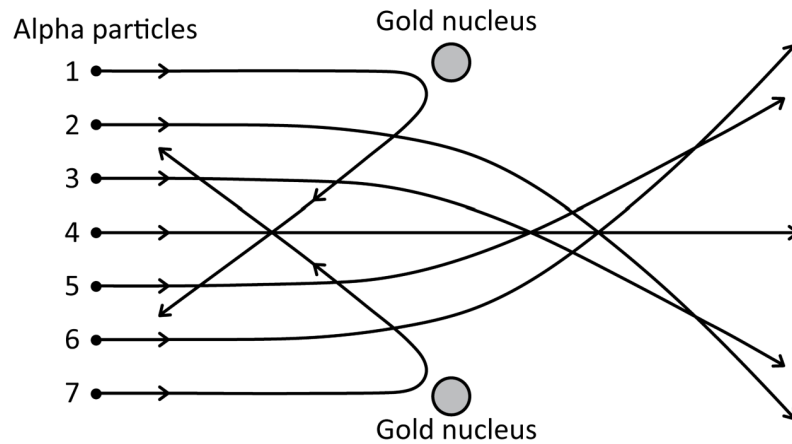
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(4 marks)

(Total for Question 3 is 10 marks)

5. The nucleus was discovered by Geiger and Marsden using an alpha particle scattering experiment. In this experiment alpha particles were fired at a very thin sheet of gold foil.

The figure below shows a part of the experiment in action.



- a) Explain why alpha particle 1 takes the path shown in the figure above.

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(2 marks)

- b) Explain why the path of alpha particle 2 is more tightly curved than the path of alpha particle 3.

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(2 marks)

- c) Describe how the Bohr model of the atom is different from the modern nuclear model of the atom?

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(2 marks)

(Total for Question 5 is 6 marks)