

# GCSE Physics

## Worksheet: Development of the model of the atom

|                       |                          |                              |                                   |
|-----------------------|--------------------------|------------------------------|-----------------------------------|
| TIME<br><b>35 min</b> | TOTAL<br><b>31 marks</b> | CALCULATOR<br><b>Allowed</b> | DIFFICULTY<br><b>Easy, Medium</b> |
|-----------------------|--------------------------|------------------------------|-----------------------------------|

**Topics:** Development of the model of the atom

| NAME | CLASS | DATE |
|------|-------|------|
|------|-------|------|

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

0 1 . 1

Which scientist provided the experimental evidence for the existence of neutrons?

Tick (✓) **one** box.

Niels Bohr

☐

James Chadwick

☐

Ernest Rutherford

☐

J. J. Thomson

☐

[1 mark]

0 1 . 2

Niels Bohr adapted the nuclear model of the atom.  
What did Bohr suggest about the electrons?

.....

.....

[1 mark]

0 1 . 3

Give the reason why other scientists accepted Bohr's model.

.....

.....

[1 mark]

0 1 . 4

Write these models of the atom in the order in which they were developed, starting with the earliest.

- Bohr model
  - nuclear model
  - plum pudding model
- .....
- .....

[1 mark]

0 2

0 2 . 1

Which model came immediately before the nuclear model of the atom?

Tick (✓) **one** box.

The plum pudding model

☐

The Bohr model

☐

Dalton's solid sphere model

☐

[1 mark]

0 2 . 2

What is meant by a scientific model?

.....

.....

[1 mark]

0 3

0 3 . 1

Before the electron was discovered, what did scientists think atoms were like?

Tick (✓) **one** box.

Tiny spheres that could not be divided

☐

Balls of positive charge with electrons embedded in them

☐

Tiny positive nuclei with electrons orbiting them

☐

Nuclei containing protons and neutrons

☐

[1 mark]

0 3 . 2

The discovery of which particle led to the plum pudding model of the atom?  
Tick (✓) **one** box.

Alpha particle

☐

Electron

☐

Neutron

☐

Proton

☐

[1 mark]

0 3 . 3

Describe the plum pudding model of the atom.

.....

.....

.....

.....

[2 marks]

0 4

Table 1 describes four historical contributions to the model of the atom.

**Table 1**

| Contribution                                                                              | Scientist |
|-------------------------------------------------------------------------------------------|-----------|
| Discovered the electron, leading to the plum pudding model                                |           |
| Provided the experimental evidence for the nuclear model, using alpha-particle scattering |           |
| Suggested that electrons exist in specific energy levels (shells)                         |           |
| Provided experimental evidence for the existence of the neutron                           |           |

0 4 . 1

Complete Table 1 by naming the scientist responsible for each contribution.

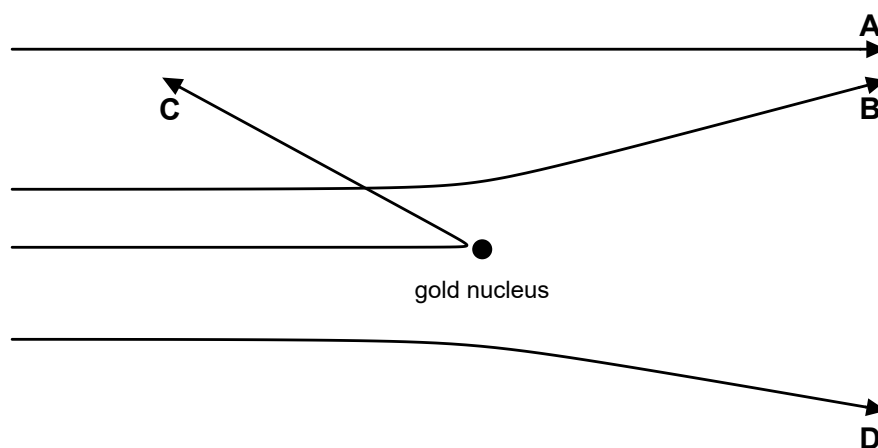
[4 marks]

0 5

In the alpha particle scattering experiment, a beam of alpha particles was directed at a very thin sheet of gold foil.

Figure 1 shows the paths of four alpha particles, A, B, C and D, as they passed near one gold nucleus.

Figure 1



0 5 . 1

Most of the alpha particles passed straight through the foil, like A. What does this suggest about the structure of the atom?

.....

.....

[1 mark]

0 5 . 2

Which alpha particle passed closest to the nucleus?

.....

.....

[1 mark]

0 5 . 3

Explain why alpha particles B, C and D changed direction.

.....

.....

.....

.....

[2 marks]

0 5 . 4

Very few alpha particles bounced back, like C.  
What does this suggest about the nucleus?

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[2 marks]

0 6

The results of the alpha particle scattering experiment led to the plum pudding model of the atom being replaced by the nuclear model.

0 6 . 1

Give **two** differences between the plum pudding model and the nuclear model of the atom.

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[2 marks]

0 6 . 2

Explain why the plum pudding model had to be replaced.

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[2 marks]

0 6 . 3

Later experiments showed that the positive charge of a nucleus could be subdivided into a whole number of smaller particles, each with the same charge. What name was given to these particles?

.....

.....

.....

.....

[1 mark]

0 7

In 1911, Rutherford published his nuclear model of the atom, based on alpha-particle scattering results gathered by Geiger and Marsden, who worked in his laboratory.

0 7 . 1

Explain why it was important that Rutherford published his methods and results in detail, rather than simply announcing his conclusion (the nuclear model).

.....

.....

.....

.....

[2 marks]

0 8

0 8 . 1

Before a new scientific model, such as the nuclear model of the atom, is generally accepted by the scientific community, it must be peer reviewed. Describe what happens during peer review, and explain why it is an important part of the scientific process.

.....

.....

.....

.....

.....

.....

.....

.....

[4 marks]

END OF QUESTIONS

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# Mark scheme

## GCSE Physics · Worksheet: Development of the model of the atom · 31 marks

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### Question 1 (4 marks)

01.1 [1 mark]

**Correct:** James Chadwick

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01.2 [1 mark]

**Answer:** The electrons orbit the nucleus at specific distances.

- electrons orbit the nucleus at specific distances / in fixed energy levels (shells) (1)
- 

01.3 [1 mark]

**Answer:** His theoretical calculations agreed with experimental observations.

- Bohr's theoretical calculations agreed with experimental observations (1)
- 

01.4 [1 mark]

**Answer:** Plum pudding model → nuclear model → Bohr model

- plum pudding model, nuclear model, Bohr model (1)
- 

### Question 2 (2 marks)

02.1 [1 mark]

**Correct:** The plum pudding model

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02.2 [1 mark]

**Answer:** A simplified representation of something, based on the evidence available, used to explain and predict.

- a simplified representation/description of something (based on the evidence available) that is used to explain observations and make predictions (1)
-

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### Question 3 (4 marks)

03.1 [1 mark]

**Correct:** Tiny spheres that could not be divided

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03.2 [1 mark]

**Correct:** Electron

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03.3 [2 marks]

**Answer:** A ball of positive charge with negative electrons embedded in it.

- a ball / sphere of positive charge (1)
  - with (negative) electrons embedded in it (1)
- 

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### Question 4 (4 marks)

04.1 [4 marks]

**Answer:** Thomson; Rutherford; Bohr; Chadwick.

- J. J. Thomson (1)
  - Ernest Rutherford (allow Geiger and / or Marsden) (1)
  - Niels Bohr (1)
  - James Chadwick (1)
-

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### Question 5 (6 marks)

#### 05.1 [1 mark]

**Answer:** The atom is mostly empty space.

- the atom is mostly empty space (1)
- 

#### 05.2 [1 mark]

**Answer:** C

- C (1)
- 

#### 05.3 [2 marks]

**Answer:** The positive nucleus repels the positive alpha particles, and more strongly the closer they pass.

- the nucleus and the alpha particles are both positively charged (1)
  - so the alpha particles are repelled by the nucleus (more strongly the closer they pass) (1)
- 

#### 05.4 [2 marks]

**Answer:** The mass and charge of the atom are concentrated in a very small nucleus.

- the mass (and positive charge) of the atom is concentrated in the nucleus (1)
  - the nucleus is very small compared with the atom (1)
-

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## Question 6 (5 marks)

### 06.1 [2 marks]

**Answer:** In the nuclear model the mass and the positive charge are concentrated in a tiny central nucleus and most of the atom is empty space; in the plum pudding model they are spread through the whole atom.

- nuclear model: mass concentrated in the nucleus; plum pudding: mass spread throughout the atom (1)
- nuclear model: positive charge concentrated in the nucleus; plum pudding: positive charge spread throughout the atom (1)
- nuclear model: the atom is mostly empty space; plum pudding: no empty space (a solid ball) (1)
- nuclear model: electrons outside the nucleus / in orbits; plum pudding: electrons embedded in the ball of positive charge (1)

Any 2 of the points above.

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### 06.2 [2 marks]

**Answer:** The new evidence (large deflections and alpha particles bouncing back) could not be explained by the plum pudding model.

- the scattering experiment gave new (experimental) evidence / results that the plum pudding model could not explain (1)
- (for example) some alpha particles were deflected through large angles / bounced back, which needs a small, concentrated nucleus (1)

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### 06.3 [1 mark]

**Answer:** Protons

- protons (1)

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## Question 7 (2 marks)

### 07.1 [2 marks]

**Answer:** Publishing the full method and data lets other scientists check and repeat the work — this scrutiny is needed before the model can be trusted and accepted.

- publishing the full methods and results allows other scientists to check the evidence and to repeat the experiment themselves, to see if they get the same results (1)
  - this scrutiny (peer review) is needed before a new model can be widely accepted as reliable, rather than just taking one scientist's word for it (1)
-

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## Question 8 (4 marks)

### 08.1 [4 marks]

**Answer:** Independent experts check the methods, data and conclusions before publication, filtering out flawed or poor work so the wider community can trust findings once accepted.

- other scientists who are experts in the field examine the work, usually before it is published (1)
  - they check that the methods and data are sound and that the conclusions follow from the evidence, looking for errors or flaws (1)
  - this helps filter out poor-quality or fraudulent work, so it is not accepted more widely until it has been checked by other experts (1)
  - this gives the wider scientific community confidence in a new model or finding before it is accepted and used or taught (1)
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