

# GCSE Chemistry

## 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

|             |              |             |
|-------------|--------------|-------------|
| <b>NAME</b> | <b>CLASS</b> | <b>DATE</b> |
|-------------|--------------|-------------|

- 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

Several scientists contributed to the model of the atom used today.

0 1 . 1

Which scientist suggested that electrons orbit the nucleus at specific distances?

Tick (✓) **one** box.

Niels Bohr

☐

James Chadwick

☐

John Dalton

☐

J. J. Thomson

☐

[1 mark]

0 1 . 2

Experiments showed that the positive charge of a nucleus can be divided into a whole number of smaller particles. Each particle has the same amount of positive charge.

What name was given to these particles?

.....

.....

.....

[1 mark]

0 1 . 3

Give **one** reason why a scientific model of the atom may be changed or replaced.

---

---

[1 mark]

0 1 . 4

About how many years after the nucleus became an accepted scientific idea did Chadwick provide evidence for the neutron?

Tick (✓) **one** box.

2

☐

20

☐

50

☐

100

☐

[1 mark]

0 2

Scientists' ideas about atoms have changed over time.

0 2 . 1

Which statement describes the model of the atom that scientists used before the plum pudding model?

Tick (✓) **one** box.

Tiny spheres that could not be divided

☐

Particles made of protons, neutrons and electrons

☐

Nuclei with electrons orbiting at fixed distances

☐

Mostly empty space with a tiny nucleus

☐

[1 mark]

0 2 . 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 2 . 3

Describe the plum pudding model of the atom.

.....

.....

.....

.....

[2 marks]

0 2 . 4

Name the scientist whose experimental work provided evidence for neutrons.

.....

.....

.....

[1 mark]

0 3

Scientists' models of the atom have changed as new evidence was found.

0 3 . 1

Complete the sentences. Use words from the box.

**electron ion neutron nucleus shell**

The discovery of the ..... led to the plum pudding model of the atom.

The alpha particle scattering experiment showed that the mass of an atom is concentrated in the .....

James Chadwick's experimental work provided evidence for the existence of the .....

.....

.....

.....

.....

.....

.....

[3 marks]

0 3 . 2

Which model of the atom replaced the plum pudding model?

Tick (✓) **one** box.

The nuclear model

☐

The indivisible sphere model

☐

The solid ball model

☐

The standard model

☐

[1 mark]

0 4

In the alpha particle scattering experiment, positively charged alpha particles were fired at a very thin sheet of gold.

0 4 . 1

Most of the alpha particles passed straight through the gold.

What does this show about atoms?

.....

.....

[1 mark]

0 4 . 2

A very small number of alpha particles bounced back towards the source.

Explain what this shows about the nucleus of an atom.

.....

.....

.....

.....

.....

.....

[3 marks]

0 4 . 3

Explain why these results could not be explained by the plum pudding model.

.....

.....

.....

.....

[2 marks]

---

0 5

The nuclear model of the atom replaced the plum pudding model.

0 5 . 1

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

.....

.....

.....

.....

[2 marks]

0 5 . 2

Niels Bohr adapted the nuclear model.

What did Bohr suggest about the electrons in an atom?

.....

.....

[1 mark]

0 5 . 3

Other scientists accepted Bohr's model.

Suggest why.

.....

.....

[1 mark]

0 5 . 4

Neutrons were discovered many years after electrons and protons.  
Suggest why neutrons were more difficult to detect.

.....

.....

[1 mark]

0 6

Table 1 lists five developments in the model of the atom, **A** to **E**, in a random order.

**Table 1**

|   | Development                                                                 |
|---|-----------------------------------------------------------------------------|
| A | Niels Bohr suggested that electrons orbit the nucleus at specific distances |
| B | James Chadwick’s experimental work provided evidence for neutrons           |
| C | Atoms were thought to be tiny spheres that could not be divided             |
| D | The discovery of the electron led to the plum pudding model                 |
| E | The alpha particle scattering experiment led to the nuclear model           |

0 6 . 1

Put the developments in Table 1 in the order in which they happened. Start with the earliest.

.....

.....

.....

.....

[2 marks]

0 6 . 2

Which development in Table 1 was the first evidence that atoms contain smaller particles?

.....

.....

.....

[1 mark]

0 6 . 3

Which development in Table 1 showed that the mass of an atom is concentrated in a tiny, charged centre?

.....

.....

.....

.....

[1 mark]

0 7

A student says:

‘The plum pudding model was wrong, so it was a bad, useless model.’

0 7 . 1

Evaluate this statement.

.....

.....

.....

.....

.....

.....

[3 marks]

**END OF QUESTIONS**

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

# Mark scheme

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

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### Question 1 (4 marks)

01.1 [1 mark]

**Correct:** Niels Bohr

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01.2 [1 mark]

**Answer:** protons

- proton(s) (1)
- 

01.3 [1 mark]

**Answer:** New experimental evidence that the old model cannot explain.

- new (experimental) evidence / results (that the old model cannot explain) (1)
- 

01.4 [1 mark]

**Correct:** 20

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### Question 2 (5 marks)

02.1 [1 mark]

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

---

02.2 [1 mark]

**Correct:** Electron

---

02.3 [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 / scattered through it (1)
- 

02.4 [1 mark]

**Answer:** (James) Chadwick

- (James) Chadwick (1)
-

---

### Question 3 (4 marks)

#### 03.1 [3 marks]

**Answer:** electron; nucleus; neutron

- electron (1)
- nucleus (1)
- neutron (1)

---

#### 03.2 [1 mark]

**Correct:** The nuclear model

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### Question 4 (6 marks)

#### 04.1 [1 mark]

**Answer:** Most of an atom is empty space.

- most of the atom is empty space (1)

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#### 04.2 [3 marks]

**Answer:** The nucleus is positively charged (it repels the alpha particles), it contains most of the mass of the atom, and it is very small.

- the nucleus is positively charged so it repels the (positive) alpha particles (1)
- most of the mass of the atom is concentrated in the nucleus (1)
- the nucleus is very small compared with the atom (because very few alpha particles bounced back) (1)
- the nucleus is at the centre of the atom (1)

Any 3 of the points above.

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#### 04.3 [2 marks]

**Answer:** In the plum pudding model the positive charge and mass are spread out, so the alpha particles would all pass through with little or no deflection.

- (in the plum pudding model) the positive charge / mass is spread out through the atom (1)
  - so the alpha particles would (all) pass through with little or no deflection / none would bounce back (1)
-

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## Question 5 (5 marks)

### 05.1 [2 marks]

**Answer:** The nuclear model has a nucleus where the positive charge and mass are concentrated, with electrons outside it; the plum pudding model has positive charge spread through the atom with electrons embedded in it.

- the nuclear model has a nucleus but the plum pudding model does not (1)
- nuclear model: positive charge concentrated in the nucleus; plum pudding model: positive charge spread throughout (1)
- nuclear model: mass concentrated in the nucleus; plum pudding model: mass spread throughout (1)
- nuclear model: electrons outside the nucleus / in shells; plum pudding model: electrons embedded in the ball of positive charge (1)
- nuclear model: the atom is mostly empty space; plum pudding model: the atom is a solid ball of charge (1)

Any 2 of the points above.

**Notes:** Each difference must refer to both models, but allow a comparison implied by 'only' or 'whereas'.

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### 05.2 [1 mark]

**Answer:** Electrons orbit the nucleus at specific distances (in energy levels / shells).

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

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### 05.3 [1 mark]

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

- (his) theoretical calculations agreed with experimental observations / results (1)

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### 05.4 [1 mark]

**Answer:** Neutrons have no charge.

- neutrons have no (electrical) charge / are neutral (1)
-

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## Question 6 (4 marks)

### 06.1 [2 marks]

**Answer:** C, D, E, A, B

- C, D, E in this order, at the start (1)
- A then B, after E (1)

**Notes:** Award 1 mark only if one letter is out of place.

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### 06.2 [1 mark]

**Answer:** D

- D (1)
- 

### 06.3 [1 mark]

**Answer:** E

- E (1)
- 

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## Question 7 (3 marks)

### 07.1 [3 marks]

**Answer:** The plum pudding model was the best explanation for the evidence available at the time, and models are expected to change as new evidence is found, so it was a useful step rather than simply 'bad'.

- the plum pudding model was the best explanation of the evidence available at the time (before the alpha particle scattering experiment) (1)
- it explained why atoms are neutral overall (positive and negative charges balance) (1)
- it was a model that could be tested, and scientific models are expected to change when new evidence is found (1)
- so it was a useful step in developing understanding, not simply a 'bad' model (1)

Any 3 of the points above.

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