THE PHYSICS QUESTION BANK · AQA GCSE PHYSICS

Science Detectives – The Model of the Atom

A one-hour lesson. Use real experimental evidence to work out how our model of the atom changed over time.

Name: _____ Class: _____ Date: _____

How to use this worksheet: work through the steps in order and write your answers in your exercise book. Copy every blue 📝 box neatly – these are your revision notes. When you have finished a step, check your work against the **Answers** at the end and correct anything in a different colour.

📝 COPY INTO YOUR BOOK

By the end of this lesson I will be able to:

1. describe the plum pudding model and the nuclear model

2. explain what the alpha scattering experiment showed

3. explain why scientific models change.

Step 1: Starter (5 minutes)

Draw what you think an atom looks like. Label as many parts as you can. Keep it – you'll come back to it at the end!

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Today's model of the atom: a tiny, positively charged nucleus containing protons and neutrons, with electrons in energy levels around it. Most of the atom is empty space.

Step 2: Read and write (10 minutes)

Copy these three questions into your book. Then read the text and answer them in full sentences.

1. What did the plum pudding model say an atom was like?
2. What were alpha particles fired at in the scattering experiment?
3. What did Bohr add to the model?

📖 READ

How our model of the atom changed

Scientists once thought atoms were tiny spheres that couldn't be divided. Then the **electron** was discovered, which showed atoms contain even smaller particles. This led to the **plum pudding model**: the atom was a ball of positive charge with negative electrons embedded in it, like fruit in a pudding.

In the **alpha scattering experiment**, scientists fired alpha particles at a very thin sheet of **gold foil**. Most went straight through, but a few were deflected and some even bounced back. This showed that the mass of an atom is concentrated in a tiny, positively charged **nucleus**, and most of the atom is empty space – the **nuclear model**. Later, **Niels Bohr** suggested that electrons orbit the nucleus at specific distances, called **energy levels**. Later still, protons were

found in the nucleus, and James Chadwick showed that neutrons are there too.

📝 **COPY AND COMPLETE**

The plum pudding model said the atom was a ball of _____ charge with _____ electrons embedded in it. It was replaced after the _____ _____ experiment.

Step 3: The timeline (8 minutes)

Your task: draw a timeline with five boxes. In each, write a name, a quick sketch and one key idea.

1. Tiny spheres – atoms were thought to be tiny solid spheres that couldn't be divided.

2. Plum pudding model – the discovery of the electron showed atoms could be divided: a ball of positive charge with negative electrons scattered through it.

3. Nuclear model – alpha scattering showed the mass is concentrated in a tiny, positively charged nucleus, with electrons around it; most of the atom is empty space.

4. Bohr's model – electrons orbit the nucleus at specific distances (energy levels); his calculations agreed with experiments.

5. Protons and neutrons – the positive charge of the nucleus is made of protons; about 20 years after the nucleus was accepted, James Chadwick proved neutrons exist.

📝 **COPY INTO YOUR BOOK**

tiny spheres → plum pudding (electron discovered) → nuclear model (alpha scattering) → Bohr's energy levels → protons → neutrons (Chadwick)

Step 4: Main task – Science Detectives (12 minutes)

The case: scientists fired positive alpha particles at thin gold foil. If the plum pudding model was right, they should all pass straight through with only tiny deflections. What they actually saw:

Clue	Observation
Clue 1	Most alpha particles went straight through the foil.
Clue 2	Some alpha particles were deflected (changed direction).
Clue 3	A very small number bounced straight back.

Your task: for each clue write "This tells me that…" and explain what it proves about the atom. Then write a verdict: was the plum pudding model right or wrong, and why?

Alpha particles are positive. What happens when two positive charges get close? What would make something bounce straight back?

📝 **COPY INTO YOUR BOOK**

Alpha scattering showed:

Most went straight through → most of the atom is empty space.

Some were deflected → the nucleus is positively charged.

A few bounced back → the mass is concentrated in a tiny nucleus.

Step 5: Exam practice (15 minutes)

Q1 (2 marks) Describe the plum pudding model of the atom.

Q2 (4 marks) Compare the plum pudding model with the nuclear model of the atom.

Use "whereas" in every point: where is the mass, the positive charge, the electrons – and is there empty space?

Q3 (6 marks) Describe how and why the model of the atom has changed over time.

📝 **COPY INTO YOUR BOOK**

Scientific models change when new evidence can't be explained by the old model.

✅ Add up your marks out of 12.

Step 6: Exit ticket (10 minutes)

Go back to your drawing from Step 1. Draw a new atom next to it and label: nucleus, protons, neutrons, electrons, energy levels, empty space. Then finish:

- My drawing changed because…
- The most important experiment was… because…
- One thing I'm still not sure about is…

Answers

Only look at these once you have written your own answer!

Step 1: Starter (5 minutes)

Check your drawing against the box below.

Step 2: Read and write (10 minutes)

(1) A ball of positive charge with negative electrons embedded in it. (2) A very thin sheet of gold foil. (3) Electrons orbit the nucleus at specific distances – energy levels.

Gaps: positive · negative · alpha scattering

Step 4: Main task – Science Detectives (12 minutes)

Clue 1: most of the atom is empty space. Clue 2: the centre is positively charged – it repels alpha particles passing close by. Clue 3: the mass is concentrated in a tiny, dense nucleus. Verdict: the plum pudding model was wrong – it predicted all would go straight through, but some bounced back, so it was replaced by the nuclear model.

Step 5: Exam practice (15 minutes)

Q1: A ball of positive charge (1) with negative electrons embedded in it (1).

Q2: Mass spread out whereas concentrated in the nucleus (1); positive charge spread out whereas in the nucleus (1); electrons embedded whereas around the nucleus in energy levels (1); no empty space whereas mostly empty space (1).

Q3: Tiny indivisible spheres → electron discovered → plum pudding model → alpha scattering: most passed through but some bounced back, which the old model couldn't explain → nuclear model (tiny positive nucleus, mostly empty space) → Bohr's energy levels, which agreed with experiments → protons, then neutrons (Chadwick). Models change when new evidence can't be explained.