Your notes

GCSE Physics: revision notes

Atoms and isotopes

Contents

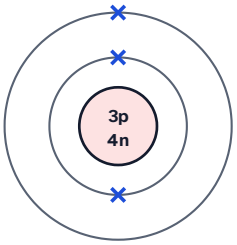
1. Start here: inside the atom
2. The atom
3. Electrons and radiation
4. Atomic number, mass number and isotopes
5. The model of the atom
6. Exam tip
7. Common mistakes
8. Worked examples
9. Key terms
10. Quick questions
11. What to do next

Start here: inside the atom

- An atom is about 1×10^{-10} m across, yet almost all of its mass is in the **nucleus**, which is about 10 000 times smaller still.
- The **nucleus** contains **protons** (positive) and **neutrons** (no charge). Electrons (negative) are in energy levels around it.
- Atoms of the same element always have the same number of **protons**, but can have different numbers of **neutrons**. These are **isotopes**.

The atom

- Atoms are very small, with a radius of about 1×10^{-10} m.
- An atom has a positively charged **nucleus** made of **protons** and **neutrons**, surrounded by negatively charged electrons.
- The radius of the **nucleus** is less than 1/10 000 of the radius of the atom, but most of the mass of the atom is in the **nucleus**.
- **Electrons** are arranged at different distances from the **nucleus** (different **energy levels**).



Li

Lithium

2, 1

× = an electron

p = proton, n = neutron

Electrons and radiation

- **Electron** arrangements can change when electromagnetic radiation is absorbed or emitted.
- If an **electron** absorbs radiation, it moves further from the **nucleus** to a higher **energy level**.
- If it emits radiation, it moves closer to the **nucleus** to a lower **energy level**.
- If an atom loses one or more outer **electrons**, it becomes a positive ion.

Atomic number, mass number and isotopes

- Atoms have no overall charge: the number of **electrons** equals the number of **protons**.
- All atoms of an element have the same number of **protons**: the **atomic number**.
- The **mass number** is the total number of **protons** and **neutrons**.
- **Isotopes** are atoms of the same element with different numbers of **neutrons**, so they have different **mass numbers**.
- Notation: in $^{23}_{11}\text{Na}$, 23 is the **mass number** and 11 is the **atomic number**, so there are 23 – 11 = 12 **neutrons**.

The model of the atom

- The plum pudding model (a ball of positive charge with **electrons** embedded) was replaced after the alpha scattering experiment, which showed that the mass is concentrated in a small, positive **nucleus**.
- Bohr suggested **electrons** orbit at specific distances. Later, **protons** were found in the **nucleus**, and James Chadwick found evidence for neutrons.
- New evidence can lead to a scientific model being changed or replaced.

Your notes

Exam tip

- Read nuclear notation carefully: the bottom number is **protons**, and the top is **protons** plus **neutrons**.
- Link the alpha-scattering results to the conclusions: most passed through, so an atom is mostly empty space. A few bounced back, so the **nucleus** is small, dense and positive.

Common mistakes

- Saying **isotopes** differ in **protons** or **electrons**. They differ in neutrons.
- Mixing up the **atomic number** and the **mass number**.

Worked examples

Carbon-14 has an atomic number of 6. How many protons, neutrons and electrons are in one atom?

The atomic number is the number of protons. **6 protons**

In a neutral atom, there are as many electrons as protons. **6 electrons**

The mass number (14) is protons + neutrons. **14 – 6 = 8 neutrons**

Answer: 6 protons, 8 neutrons and 6 electrons

Key terms

Nucleus	The tiny, positively charged centre of an atom, containing protons and neutrons.
Proton	A positive particle in the nucleus with relative mass 1.
Neutron	A neutral particle in the nucleus with relative mass 1.
Electron	A negative particle with very small mass, found in energy levels around the nucleus.
Atomic number	The number of protons in an atom.
Mass number	The number of protons plus neutrons.
Isotope	An atom of an element with a different number of neutrons.
Ion	An atom that has lost or gained electrons, so it has a charge.
Energy level	A fixed distance from the nucleus at which electrons are found.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

Your notes

1. What is the approximate radius of an atom?
2. Where is most of the mass of an atom?
3. What is the charge of the nucleus?
4. What happens when an electron absorbs electromagnetic radiation?
5. What is an isotope?
6. How many neutrons are in $^{23}_{11}Na$?
7. What is the atomic number?
8. What does an atom become if it loses an electron?

Answers

1. 1×10^{-10} m
2. In the nucleus
3. Positive
4. It moves to a higher energy level, further from the nucleus
5. An atom of the same element with a different number of neutrons
6. 12
7. The number of protons
8. A positive ion

What to do next

Practise 10 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

Your notes