Your notes

GCSE Chemistry: revision notes

# Electronic structure

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## Start here: where the electrons are

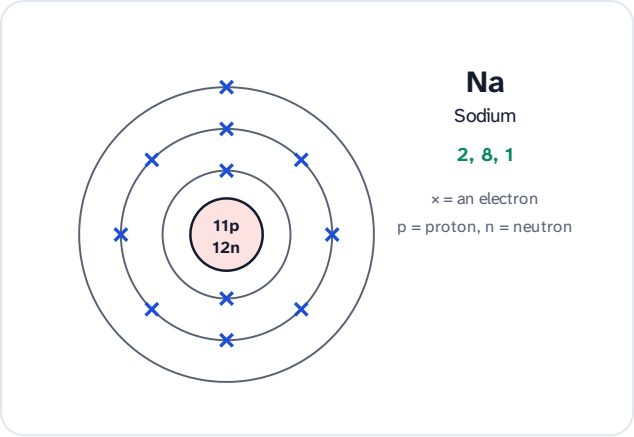
- Electrons are not scattered randomly round the nucleus: they are in shells (**energy levels**), and the shells nearest the nucleus fill first.
- For the first 20 elements, the first shell holds up to 2 electrons, and the second and third shells up to 8 each.
- The number of electrons in the **outer shell** decides how an element reacts, and it is the same as its **group** number.

## Electron shells

- Electrons occupy the lowest available **energy levels** (shells), starting nearest the nucleus.
- For the first 20 elements, the first shell holds up to 2 electrons, the second up to 8, and the third up to 8 (the fourth shell starts at potassium).
- **Electronic structures** are written as numbers, for example sodium (11 electrons) is 2,8,1.

## Working out electronic structure

- The number of electrons equals the atomic number (for a neutral atom).
- Fill the shells in order: 2, then 8, then 8, then the rest.
- Examples: carbon (6) is 2,4; oxygen (8) is 2,6; chlorine (17) is 2,8,7; calcium (20) is 2,8,8,2.




## Structure and the periodic table

- The number of shells tells you the **period** (row). The number of electrons in the **outer shell** tells you the **group** (for groups 1 to 7).
- For example, magnesium is 2,8,2: **period** 3, **group** 2.
- Elements in the same **group** have the same number of outer electrons, so they react in similar ways.
- **Group** 0 elements have full **outer shells**, which is why they are unreactive.

## Electronic structure of ions

- Metal atoms lose outer electrons to form positive ions: Na (2,8,1) becomes $Na^+$ (2,8).
- Non-metal atoms gain electrons to form negative ions: Cl (2,8,7) becomes $Cl^-$ (2,8,8).
- The ions have the same **electronic structure** as a noble gas.

### Exam tip

- Link electrons to the periodic table: outer electrons give the **group**, and the number of shells gives the **period**.
- Fill shells as 2, 8, 8 for the first 20 elements, and show them clearly in a diagram.

### Common mistakes

- Putting three electrons in the first shell.
- Counting electrons for an atom when the question asks about an ion.

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## Worked examples

**Write the electronic structure of aluminium (atomic number 13).**

The atomic number is the number of electrons in an atom. **13 electrons**

Fill the first shell with 2, then the second with up to 8. **2 + 8 = 10, so 3 are left**

The rest go in the third shell. **2, 8, 3**

**Answer: 2, 8, 3 (3 shells: period 3; 3 outer electrons: group 3)**

## Key terms

| | |
|---|---|
| **Electronic structure** | The arrangement of electrons in shells, such as 2,8,1. |
| **Energy level** | A shell in which electrons are found, at a particular distance from the nucleus. |
| **Outer shell** | The highest occupied energy level; its electrons decide how an element reacts. |
| **Period** | A horizontal row in the periodic table; its number equals the number of occupied shells. |
| **Group** | A vertical column in the periodic table; for groups 1 to 7 it matches the number of outer electrons. |
| **Ion** | An atom or group of atoms that has gained or lost electrons, so it has a charge. |
| **Noble gas structure** | A full outer shell, which is very stable. |

## Quick questions

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

1. How many electrons can the first shell hold?
2. What is the electronic structure of sodium (11 electrons)?
3. What is the electronic structure of chlorine (17 electrons)?
4. An element has the structure 2,8,3. Which group is it in?
5. An element has the structure 2,8,3. Which period is it in?
6. What is the electronic structure of calcium (20 electrons)?
7. Why do elements in the same group react in similar ways?
8. What is the electronic structure of a sodium ion, $Na^+$?

### Answers

1. 2
2. 2,8,1
3. 2,8,7
4. Group 3
5. Period 3
6. 2,8,8,2
7. They have the same number of outer electrons

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8. 2,8

## What to do next

**Practise 10 questions on this topic**

**Try 5 exam questions, with mark schemes**

**Read the lesson, one step at a time**

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