

## Fact sheet: electron configuration diagrams

### Education in Chemistry

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An electron configuration diagram is a model that depicts the position of electrons as they orbit the nucleus of an atom. Electrons are represented by dots or crosses and are positioned in energy levels, or 'shells', around the central nucleus. This is sometimes called the Bohr, or the 'solar system', model.

In the **Bohr model**, there are a few rules that will help you draw accurate diagrams.

- **Electrons** must occupy the lowest available **shell**, closest to the **nucleus**.
- The maximum number of electrons that can fill each **shell** is:
  - **two in the first shell,**
  - **eight in the second shell,**
  - **eight in the third shell.**
- **Calcium**, the 20<sup>th</sup> element, has two further electrons that go in the **fourth shell**.

In the **shorthand notation** for electron configuration, the number of electrons in each shell can be written rather than drawn. Each shell is separated by a full stop or a comma. For nitrogen this would be 2.5 or 2,5 and for calcium this would be 2.8.8.2 or 2,8,8,2.

**Did you know ...?** The arrangement of an element's electrons tells you where it is on the **periodic table**. The **number of shells** shows which **period**, or row, it's in and the **number of electrons in the outer shell** shows which **group** it's in.

### Niels Bohr

The idea that electrons orbit the atom in fixed shells, or **energy levels**, was first suggested by Niels Bohr in 1913. Bohr observed that bursts of energy emitted from hydrogen atoms, visible as **light**, only occurred at specific **wavelengths**. He suggested this was due to electrons **moving between energy levels** rather than being scattered randomly around the nucleus. He was awarded a Nobel prize for his work.

**Did you know ...?** Bohr impressed fellow scientist **Rutherford**, who **discovered the nucleus** of the atom, but didn't win over **JJ Thomson** whose '**plum pudding**' model of the atom was replaced by Rutherford's, then Bohr's, model.

### How to draw an electron configuration diagram

Use these steps to draw electron configuration diagrams for the first 20 elements in the periodic table.

1. Find the element on the periodic table. The **atomic number** tells you how many electrons to draw in total. For example, **potassium has 19 electrons**.
2. Draw a small circle and write the symbol in the centre. This represents the nucleus.

**Tip:** Leave plenty of space around the nucleus when you start. Your diagram is going to get much bigger!

3. Draw a circle around the nucleus. This is the first electron shell.

**Tip:** Use a pencil to draw the shells and electrons. You might decide to reposition them later.

4. Add up to two electrons to the first electron shell. Electrons are usually represented by a dot or cross.
5. Draw another circle around the first shell. This is the second shell.
6. Add up to eight electrons to the second shell.

**Tip:** Group electrons in pairs to keep track of how many you have drawn. This will also help you draw dot and cross diagrams later.

7. Draw another circle around the second electron shell. This is the third shell.
8. Add up to eight electrons to the third shell.
9. Draw the last circle around the third shell. This is the fourth electron shell.
10. Add up to two electrons to the fourth electron shell. For potassium, only one electron is added to this shell.