Electron configuration

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 guidelines 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 20th 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.

### 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

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 another circle around the first shell. This is the second shell.

3. Draw the last circle around the third shell. This is the fourth electron shell.

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An electron configuration diagram

Configuration diagrams for the first 20 elements in the periodic table.

1. Draw a small circle and write the symbol in the centre. This represents the nucleus.
2. 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.
4. TIP: Use a pencil to draw the shells and electrons. You might decide to reposition them later.
5. Add up to two electrons to the first electron shell. Electrons are usually represented by a dot or cross.
6. Add up to eight electrons to the second shell.
7. Draw another circle around the second electron shell. This is the third shell.
8. TIP: Rub out any imperfections such as overlapping sections of your electron shells.
9. Add up to eight electrons to the third shell.
10. Add up to two electrons to the fourth electron shell. For potassium, only one electron is added to this shell.
11. Use these steps to draw electron configuration diagrams of the first 20 elements.
12. The position of the electrons may depend on what you need to draw next.

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.