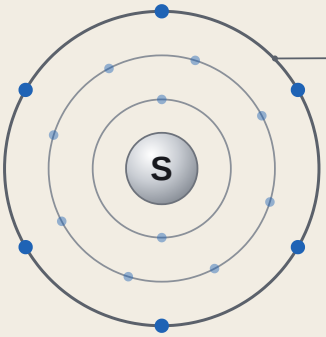
A2 · Valence electrons and electron dot diagrams for atoms · Notes

Goals: Find the number of valence electrons of an atom from its group number. Draw the electron dot diagram of an atom. Tell bonding electrons from lone pairs, and state the octet rule.

Name: _____ Date: _____

Slide 1 of 6 · Valence electrons

In lesson A1 you used group numbers to find ion charges. Today you use them to count outer electrons. Atoms join to each other with their outer electrons.



outer energy level

6 valence electrons

The 10 inner electrons take no part in bonding.

Key ideas

Electrons are in layers. Each layer is an _____.

The electrons in the outer level are the _____.

Only valence electrons take part in _____.

For groups 13 to 18, the _____ gives the number of valence electrons.

Example

Phosphorus is in group 15. How many valence electrons does it have?

Try it

Calcium is in group 2. Bromine is in group 17. How many valence electrons does each have?

Slide 2 of 6 · Drawing an electron dot diagram

On the last slide you counted valence electrons. Drawing every energy level is slow. A dot diagram shows only the valence electrons.



phosphorus
5 dots



sulfur
6 dots



chlorine
7 dots



argon
8 dots

Key ideas

An _____ shows the valence electrons of an atom as dots.

The _____ stands for the nucleus and the inner electrons.

Put one dot on each of the _____ sides first.

A fifth dot must share a side and make a _____.

Example

Draw the electron dot diagram for chlorine. How many pairs and single dots does it have?

Try it

Draw the electron dot diagram for nitrogen, in group 15. How many pairs and single dots does it have?

Slide 3 of 6 · Method: how to draw the electron dot diagram of an atom

You just drew eight dot diagrams. Each time you did the same four things. Here they are as steps.

1. **Find** the group number.
2. **Count** the valence electrons.
3. **Place** one dot on each side, up to four.
4. **Pair** the rest, one side at a time.



Check: the dots equal the valence electrons, and 8 is the most.

Used again in: lessons A3 to A8

Key ideas

Step 1: find the _____ number.

Step 2: _____ the valence electrons.

Step 3: _____ one dot on each side, up to four.

Step 4: _____ the rest, one side at a time.

Example

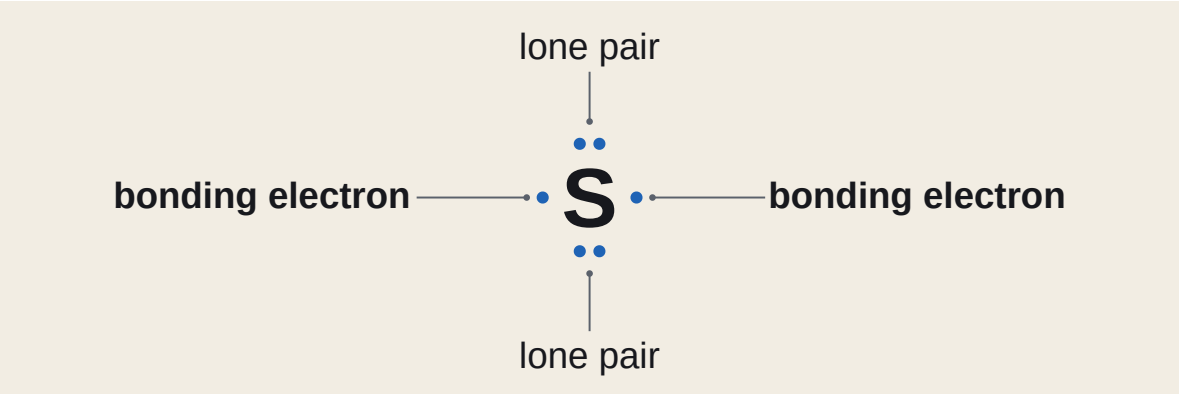
Use the four steps to draw the electron dot diagram of oxygen.

Try it

Use the four steps to draw the electron dot diagram of aluminium.

Slide 4 of 6 · Bonding electrons and lone pairs

Your diagrams have single dots and pairs of dots. The two kinds behave differently. Each kind has a name.



Key ideas

A single dot is a _____. It can be shared with another atom.

Two dots together are a _____. A lone pair is not shared.

Hydrogen and helium hold only _____ electrons in their outer level.

Example

Sulfur has 6 valence electrons. How many bonding electrons and lone pairs does it have?

Try it

Phosphorus has 5 valence electrons. How many bonding electrons and lone pairs does it have?

Slide 5 of 6 · A full outer level is stable

On the last slide, helium had a full level and no bonding electrons. A whole group of elements is like that. Their diagrams show why they do not bond.



chlorine has 7
It needs 1 more.



sulfur has 6
It needs 2 more.



hydrogen has 1
It needs 1 to reach 2.

Key ideas

The noble gases are in group _____. They almost never react.

An atom with a full outer level is _____.

For most atoms, full means _____ valence electrons. This is the _____.

Example

Chlorine has 7 valence electrons. How many more does it need to be stable?

Try it

Oxygen has 6 valence electrons. How many more does it need to be stable?

Slide 6 of 6 · Three ways to fill the outer level

On the last slide, a full outer level made an atom stable. An atom without one can change to get one. There are three ways.

1. lose



A metal atom forms a positive ion.

2. gain



A non-metal atom forms a negative ion.

3. share



Two non-metals share one pair.

Key ideas

An atom can _____ electrons. Metals do this and become positive ions.

An atom can _____ electrons. Non-metals do this when they meet a metal.

Two non-metals _____ electrons.

Example

Potassium has 1 valence electron. Which of the three ways does it use, and what ion forms?

Try it

Fluorine has 7 valence electrons. Which way does it use when it meets a metal, and what ion forms?