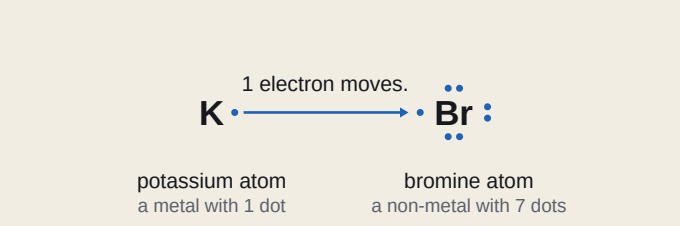
A3 · Ionic bonds · Completed notes

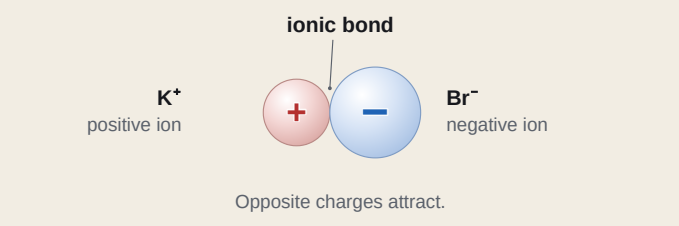
Goals: Explain an ionic bond as electrons moving from a metal atom to a non-metal atom, and the ions attracting. Draw electron dot diagrams for ions. Show an ionic bond forming with electron dot diagrams, and explain the ratio of ions.

These are the completed notes. The blanks are filled in and each question is worked.

Slide 1 of 6 · Electrons move from a metal atom to a non-metal atom

In lesson A2, metals lost electrons and non-metals gained them. Today you see both happen at once. One atom loses the electron that the other gains.





Key ideas

A metal atom **loses** electrons and a non-metal atom **gains** them.

The electron moves from the **potassium** atom to the bromine atom.

Opposite charges **attract**. This attraction is an **ionic bond**.

Example

A potassium atom gives 1 electron to a bromine atom, which had 7. How many valence electrons does the bromine have now?

1. Bromine had 7 valence electrons.
2. It gained 1.
3. Now it has 8, so its outer level is full.

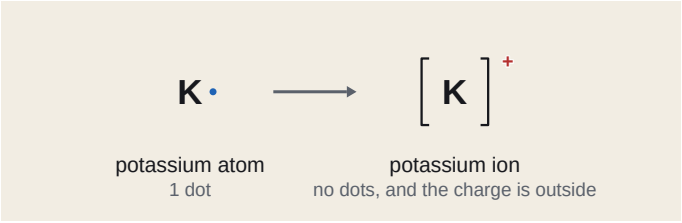
Try it

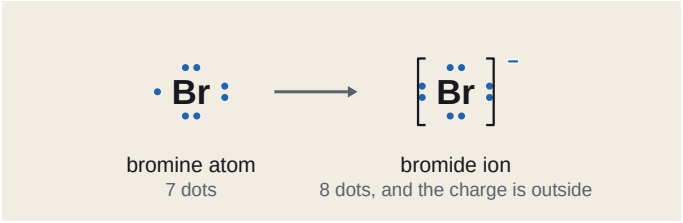
A sodium atom gives 1 electron to an iodine atom. What two ions form, and what holds them together?

1. Sodium lost 1 electron, so it is Na^+.
2. Iodine gained 1 electron, so it is I^-.
3. The attraction between the opposite charges holds them together. It is an ionic bond.

Slide 2 of 6 · Electron dot diagrams for ions

You just saw K^+ and Br^- form. In A2 you drew dot diagrams for atoms. Now you draw them for ions.





Key ideas

A positive ion has **no dots**. The metal atom lost all its valence electrons.

A negative ion has **eight** dots, in four pairs.

Put the symbol in **square brackets**. Write the **charge** outside, at the top right.

Example

A calcium atom has two dots. What does the electron dot diagram of a calcium ion look like?

1. Calcium loses both valence electrons.
2. The ion has no dots.
3. Write Ca in square brackets with 2+ outside.

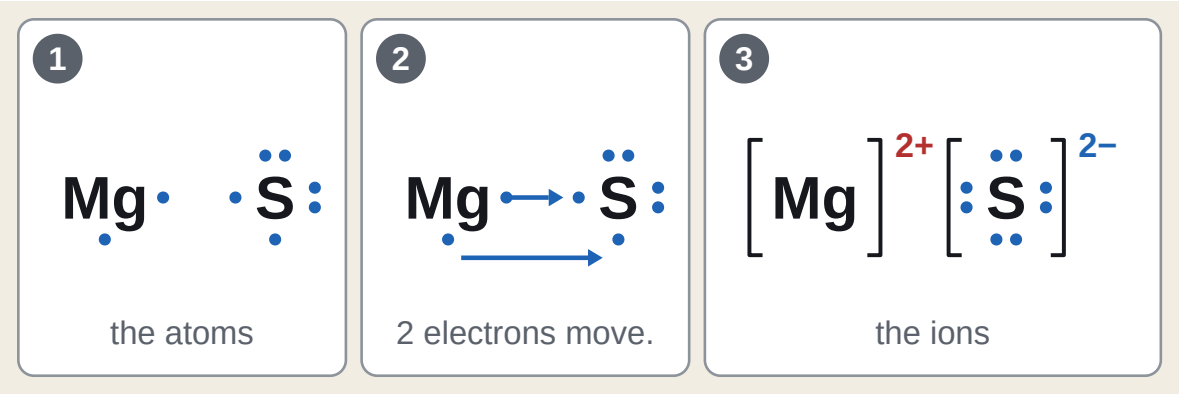
Try it

An oxygen atom has six dots. What does the electron dot diagram of an oxide ion look like?

1. Oxygen gains 2 electrons to reach 8.
2. The ion has eight dots, in four pairs.
3. Write O in square brackets with 2− outside.

Slide 3 of 6 · A one-to-one transfer

You can now draw an atom and an ion. Next you draw a whole ionic bond forming. Moving electrons from one atom to another is called a transfer.



Key ideas

First **draw** each atom with its dots.

Then **move** electrons from the metal to the non-metal.

Then draw the ions. Each ion has a **full** outer level.

The charges 2+ and 2− add to **zero**.

Example

Why is one magnesium atom enough for one sulfur atom?

1. Magnesium has two electrons to lose.
2. Sulfur needs exactly two to fill its outer level.
3. So the ratio is one to one, and the formula is MgS.

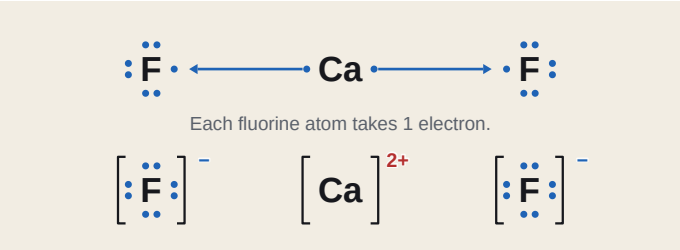
Try it

Barium has 2 valence electrons and oxygen has 6. How many barium atoms does one oxygen atom need? Write the formula.

1. Oxygen needs 2 more electrons.
2. One barium atom has 2 to lose.
3. One barium atom is enough. The formula is BaO.

Slide 4 of 6 · When the numbers of electrons do not match

On the last slide, magnesium gave 2 electrons and sulfur took 2. The numbers matched. Sometimes they do not match.



$$Ca(s) + F_2(g) \rightarrow CaF_2(s)$$

(s) means solid (g) means gas → means "gives"

One F_2 molecule holds the two fluorine atoms.

Key ideas

Calcium has 2 valence electrons to lose. Fluorine needs only **1**.

So a **second** fluorine atom is needed.

A **balanced equation** has the same atoms on both sides.

In a **state symbol**, (s) means solid and (g) means gas.

Example

Strontium has two valence electrons and chlorine needs one. How many chlorine atoms does one strontium atom need?

1. Each chlorine atom can take only one electron.
2. Strontium has two to lose.
3. So two chlorine atoms are needed.

Try it

Magnesium has 2 valence electrons and nitrogen needs 3. How many atoms of each are needed? Write the formula.

1. The smallest total both can reach is 6.
2. Three magnesium atoms lose 6 electrons. Two nitrogen atoms gain 6.
3. The formula is Mg_3N_2.

Slide 5 of 6 · Method: how to show an ionic bond forming

You have now drawn three ionic bonds forming. Each time you did the same four things. Here they are as steps.

1. **Draw** each atom's electron dot diagram.
2. **Move** electrons from the metal to the non-metal.
3. **Add** atoms until every atom is full.
4. **Draw** the ions in brackets, with charges.



Check: electrons lost equal electrons gained.

Used again in: lessons A4 and A7

Key ideas

Step 1: **draw** the electron dot diagram of each atom.

Step 2: **move** electrons from the metal to the non-metal.

Step 3: **add** atoms until every atom is full.

Step 4: draw the ions in **brackets**, with charges.

Example

Use the four steps to show the ionic bond forming between potassium and sulfur.

1. Step 1: potassium has 1 dot. Sulfur has 6.
2. Step 2: one electron moves. Sulfur still needs 1 more.
3. Step 3: a second potassium atom gives it.
4. Step 4: there are two K^{+} ions with no dots and one S^{2-} ion with 8 dots. The formula is K_2S.

Try it

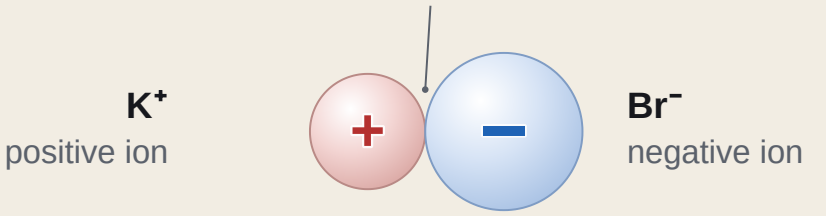
Use the four steps to show the ionic bond forming between calcium and bromine.

1. Step 1: calcium has 2 dots. Bromine has 7.
2. Step 2: one electron moves. Calcium still has 1 dot.
3. Step 3: a second bromine atom takes it.
4. Step 4: there is one Ca^{2+} ion with no dots and two Br^{-} ions with 8 dots each. The formula is $CaBr_2$.

Slide 6 of 6 · Forces inside a substance

All lesson you have drawn ionic bonds. An ionic bond belongs to a family of forces. The family has a name.

An ionic bond is an intramolecular force.



It is a force that holds the ions of a compound together.

Key ideas

A bond is a **force** that holds atoms or ions together.

A force inside a compound is an **intramolecular force**.

"Intra" means **inside**.

An **ionic bond** is one kind of intramolecular force.

Example

Is an ionic bond an intramolecular force? Say why.

1. Yes.
2. It holds the ions of a compound together.
3. So it acts inside the substance.

Try it

What does "intra" mean? Use it to say what an intramolecular force is.

1. "Intra" means inside.
2. An intramolecular force is a force inside a compound.
3. It holds the atoms or ions together.