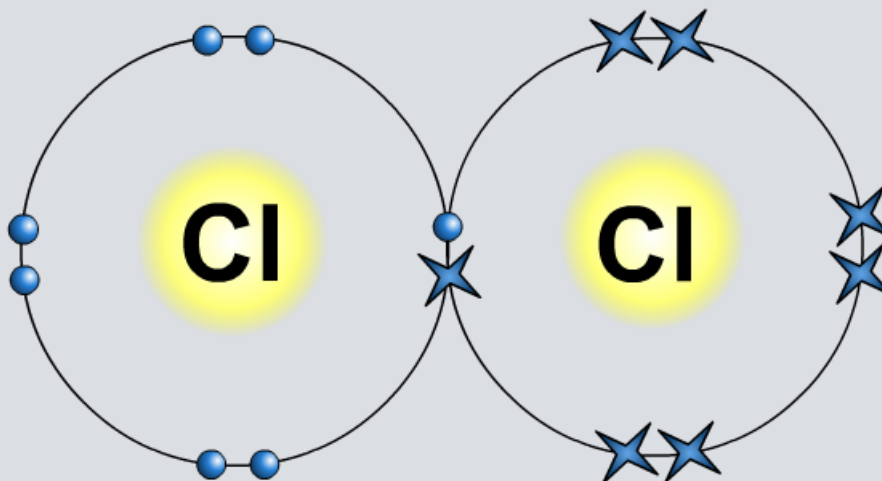


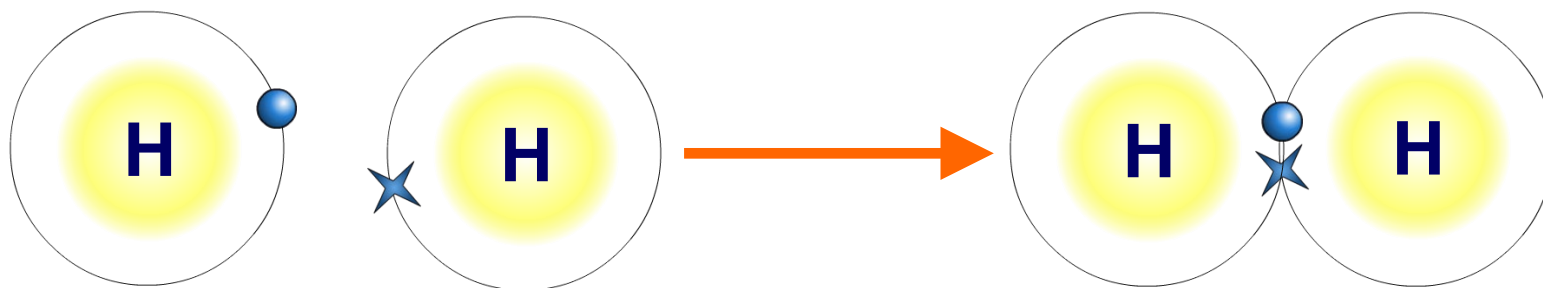
## Covalent Bonding



# Covalent bonding in hydrogen

Many nonmetal elements, such as hydrogen, exist as simple **diatomic** molecules that contain covalent bonds.

How is a covalent bond formed in hydrogen?



Each hydrogen atom needs one more electron in its outer shell, and so each atom shares its single unpaired electron.

This shared pair of electrons forms a covalent bond, and so creates a diatomic molecule of hydrogen.

Some molecules contain double or triple covalent bonds.  
How are these are formed?

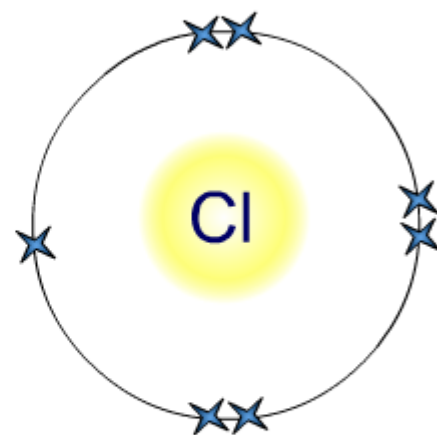
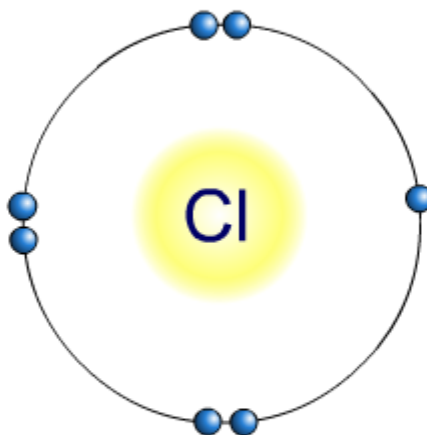


## How do elements bond?

Many nonmetal elements exist as diatomic molecules with covalent bonds.

These molecules can be bonded by single, double or triple covalent bonds.

Click "**play**" to find out more.

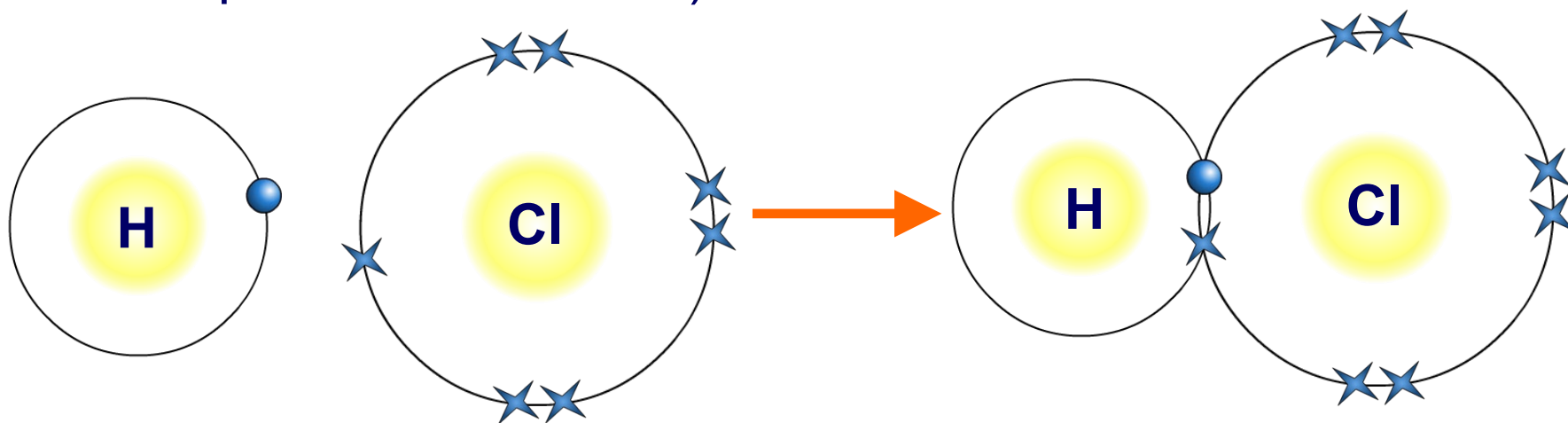


# Can compounds contain covalent bonds?



Covalent bonding can also occur between atoms of different nonmetals to create molecules of **covalent compounds**. These covalent bonds can be single, double or triple.

How is a covalent bond formed in **hydrogen chloride** (HCl, also represented as H–Cl)?



Hydrogen and chlorine both need one more electron to fill outer shells. By sharing one electron each, they both have a stable outer shell and a covalent bond is formed.

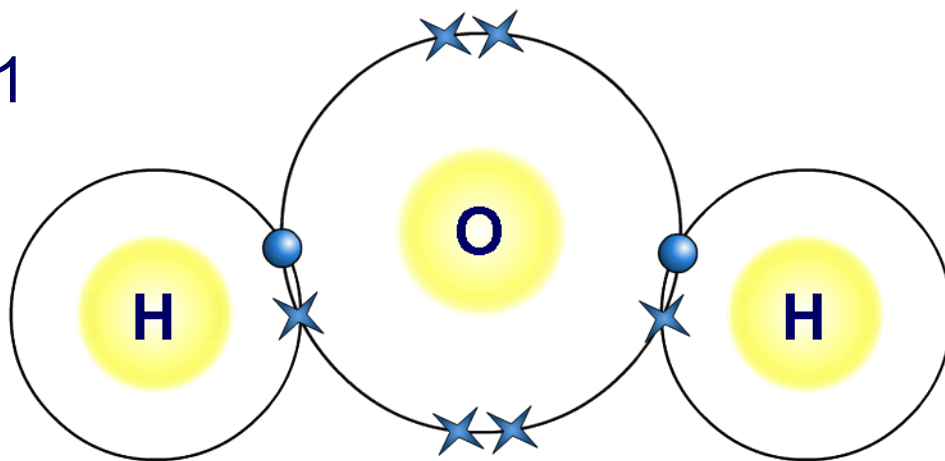


# Covalent bonding in water

Compounds can contain more than one covalent bond.

Oxygen (2.6) needs 2 more electrons, but hydrogen [1] only needs 1 more. How can these three elements be joined by covalent bonding?

The oxygen atom shares 1 electron with 1 hydrogen atom, and a second electron with another hydrogen atom.



What is the name of the molecule that is formed?

$\text{H}_2\text{O}$  (or  $\text{H}-\text{O}-\text{H}$ ) is water.



# How is the ratio of atoms calculated?

To calculate the ratio of atoms in a stable covalent compound:

1. Work out how many electrons are needed by each nonmetal element to complete its outer electron shell.
2. Work out the ratio of atoms that will provide enough shared electrons to fill all the outer shells.

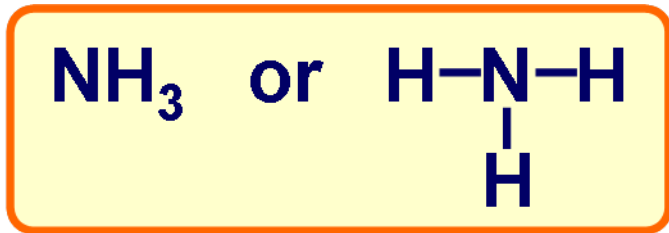
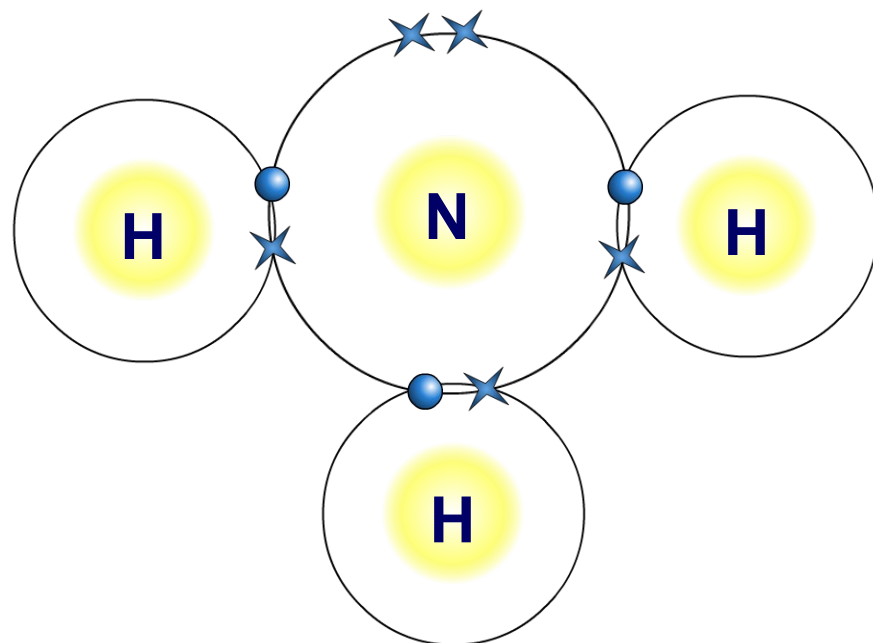
For example, how many nitrogen and hydrogen atoms bond together in an ammonia molecule?

element	N	H
electron configuration	(2.5)	(1)
electrons needed	3	1
ratio of atoms	1	3

# Covalent bonding in ammonia

How do nitrogen and hydrogen atoms form covalent bonds in a molecule of **ammonia**?

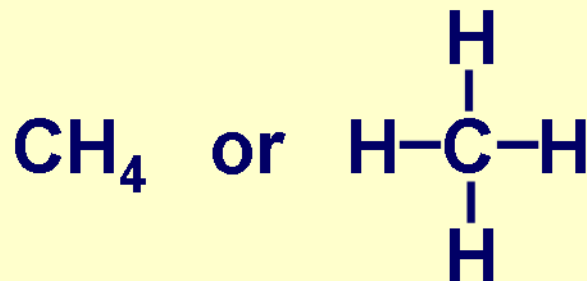
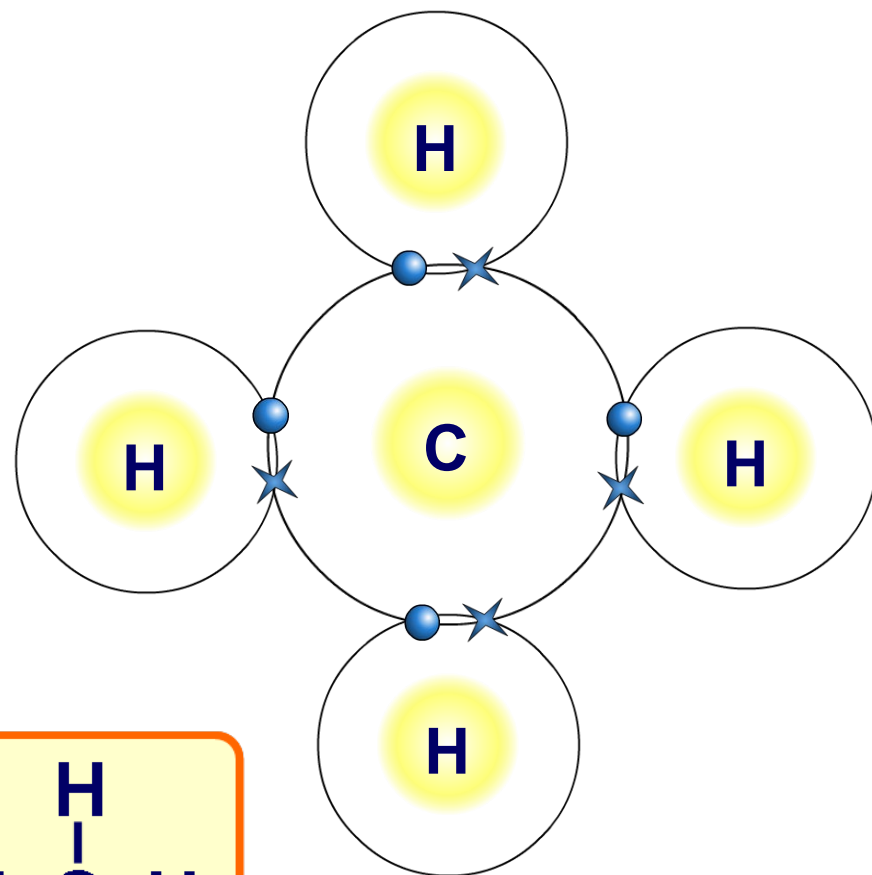
element	N	H
electron configuration	(2.5)	(1)
electrons needed	3	1
ratio of atoms	1	3



# Covalent bonding in methane

How do carbon and hydrogen atoms form covalent bonds in a molecule of **methane**?

<b>element</b>	<b>C</b>	<b>H</b>
<b>electron configuration</b>	(2.4)	(1)
<b>electrons needed</b>	4	1
<b>ratio of atoms</b>	1	4

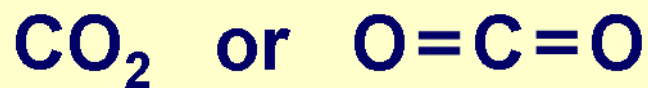
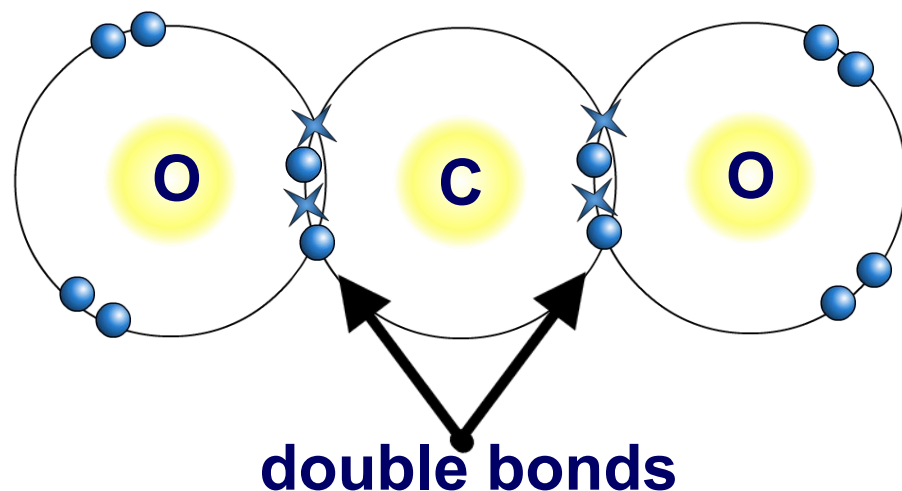




# Covalent bonding in carbon dioxide

How do carbon and oxygen atoms form covalent bonds in a molecule of **carbon dioxide**?

element	C	O
electron configuration	(2.4)	(2.6)
electrons needed	4	2
ratio of atoms	1	2



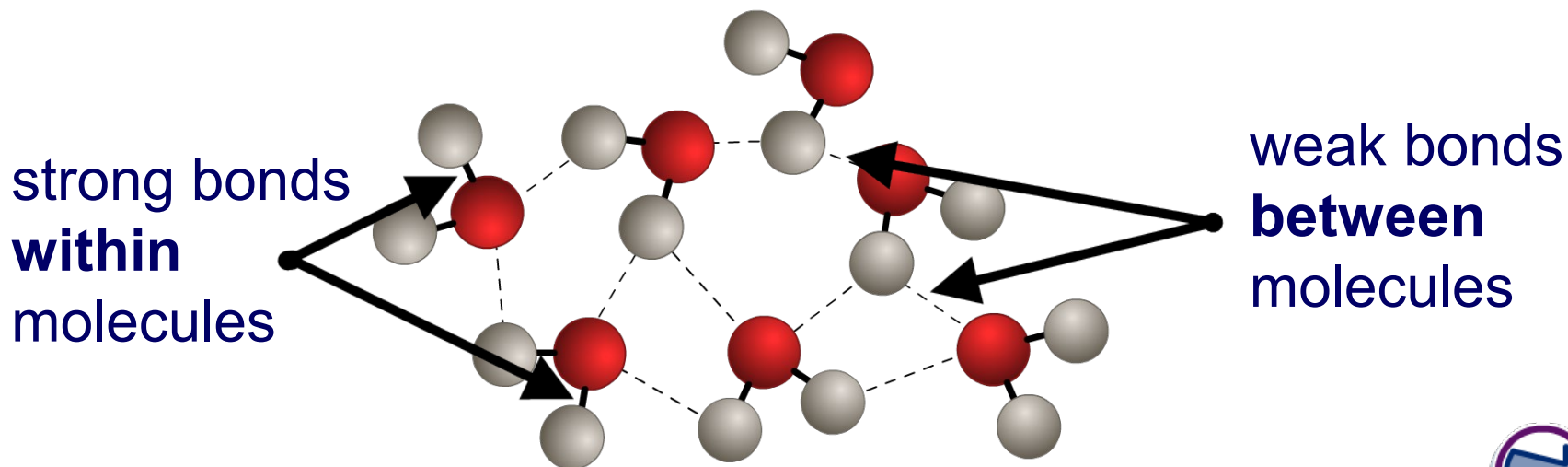
A double bond is when two pairs of electrons are shared. In carbon dioxide there are two double bonds – one between each oxygen atom and the carbon atom.

# What are simple covalent structures?

Covalent molecules that contain only a few atoms are called **simple covalent structures**.

Most substances that contain simple covalent molecules have low melting and boiling points, and are therefore liquids or gases at room temperature, e.g. water, oxygen, carbon dioxide, chlorine and hydrogen. Why?

The covalent bonds **within** these molecules are **strong**, but the bonds **between** molecules are **weak** and easy to break.



# Covalent bonds – true or false?

