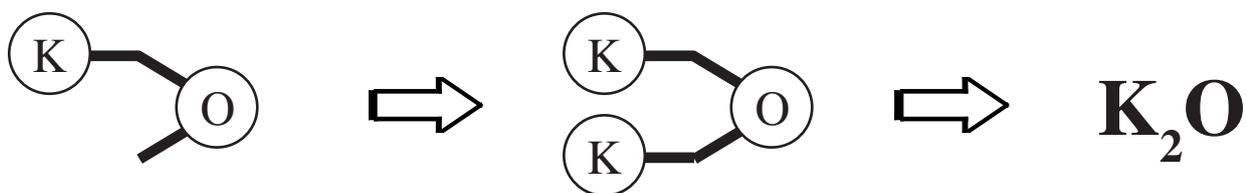


Formula Writing & Chemical Equations



Balanced Equations

Formula Equations

Word Equations

Transition Metals

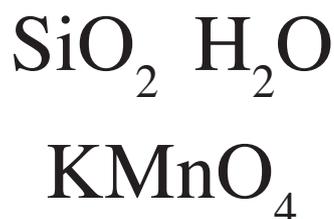
Using Brackets

Awkward Customers

More than 2 Elements

2 Elements Only

Using the Name Only



These sheets belong to _____

What is a Formula ?

The *form* of a *comp* tells you two things about the *comp* :-



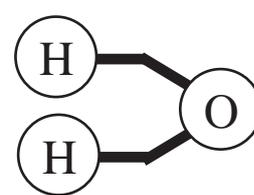
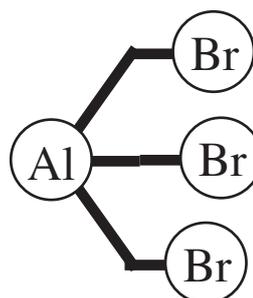
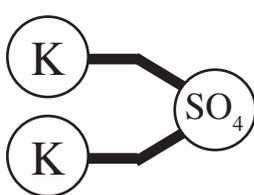
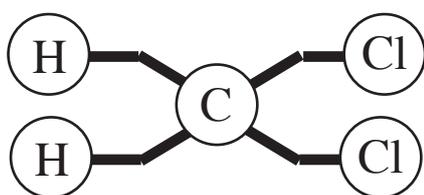
i) *which ele* are in the compound using *sym* ,



ii) *how ma* atoms of each *ele* are in the compound using *num* .

Test Yourself

What would be the formula for each of the following?



Using the Name Only

Some *comp* have extra information in their *na* that allow people to work out and write the correct *form* .

carbon *monoxide* CO

carbon *dioxide* CO_2

dinitrogen tetroxide N_2O_4

The *na* of the elements appear as usual but this time the *num* of each type of atom is included using

mono- = 1 *di-* = *tri-* = *tetra-* =

Test Yourself

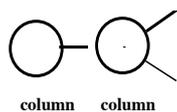
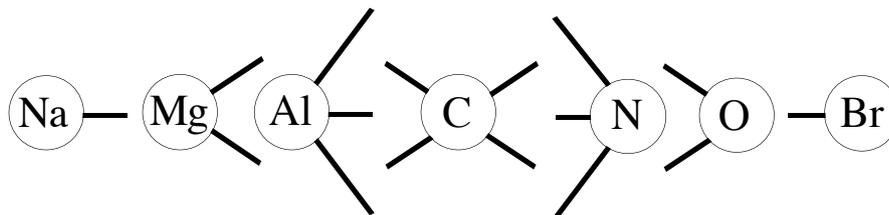
What would be the formula for each of the following?

1. sulphur trioxide
2. silicon tetrafluoride
3. dinitrogen oxide
4. phosphorus trichloride
5. dinitrogen tetroxide
6. nitrogen monoxide
7. nitrogen dioxide
8. tin dibromide
9. sulphur dioxide

Valency Numbers

Apart from the *Noble Gases* (column 8), all *at* can form *bo* and join to other atoms in *comp*.

The *num* of bonds an atom can form is called its *Valency*.



lithium \Leftarrow *Name*

Li 1	Be 2
Na 1	Mg 2
K 1	Ca 2

Li \Leftarrow *Symbol*



\Leftarrow *Valency Picture*

To begin with, you will be given a special *Per Table* which you can use to find the *Val Num* of an *Ele*.

Use the *Na* of the *Ele* to find its *Sym* and then draw the correct *Val Picture*.

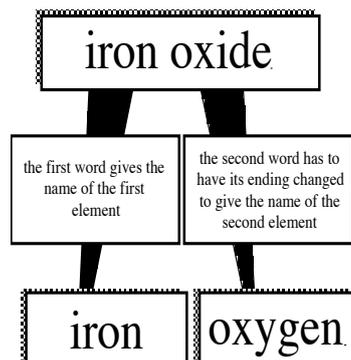
Test Yourself

Draw the Valency Picture for each of these Elements.

- | | | | |
|--------------|------------|-------------|--------------|
| 1. beryllium | 2. boron | 3. nitrogen | 4. fluorine |
| 5. sodium | 6. silicon | 7. sulphur | 8. calcium |
| 9. chromium | 10. cobalt | 11. arsenic | 12. selenium |

2 Elements Only

The name of a 2-element *comp* usually lists *both* the *ele* in the compound.



-ide

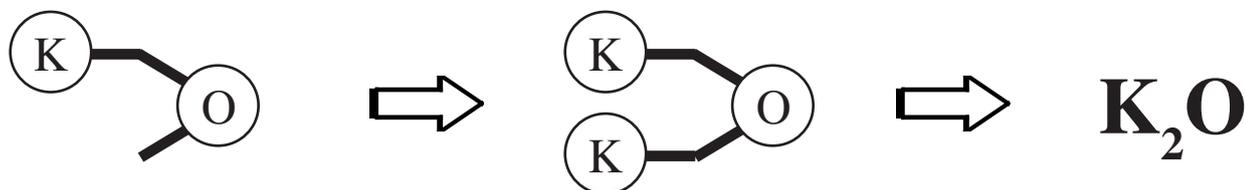
endings are used to emphasise that there are *only two elements* in the compound.

exceptions:

compounds ending *hydroxide* or *cyanide* have *more* than 2 elements in them

Writing a **correct formula** is all about looking up the **correct symbol**, identifying the **correct valency number** and then **balancing** the two halves of the compound. This is easier if you use **Valency Pictures**.

For example, to work out the formula for **potassium oxide**.



1. Draw the Valency Pictures for atoms of **potassium** and **oxygen**.
2. Draw them as shown. This valency picture is not complete.
3. Draw another **potassium** atom to complete the picture.
4. Now write the correct formula for **potassium oxide**.

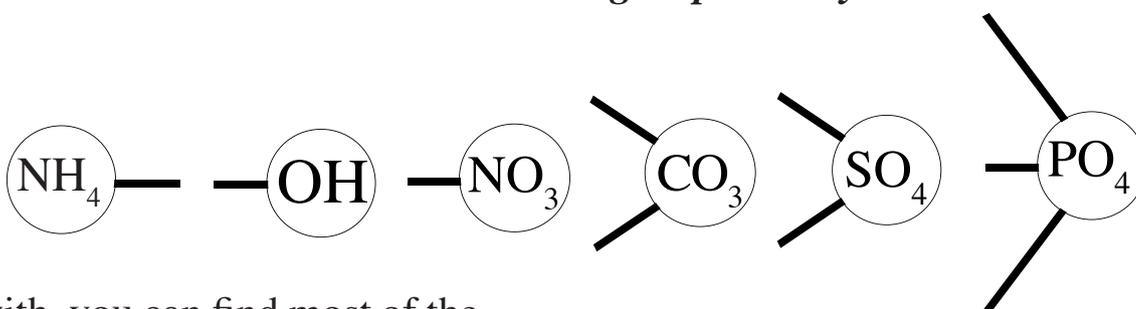
Test Yourself

Work out the formula for each of these compounds.

- | | | |
|--------------------|---------------------|------------------------|
| 1. hydrogen oxide | 2. sodium bromide | 3. phosphorus fluoride |
| 4. magnesium oxide | 5. sulphur chloride | 6. aluminium sulphide |
| 7. silicon oxide | 8. calcium sulphide | 9. nitrogen iodide |

Group Valencies

Atoms often join together to form "**Groups**" - fixed numbers of **atoms** with a certain number of **spare bonds** still available - a **group valency**.



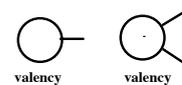
To begin with, you can find most of the **Group Valencies** on the other side of the special "**Periodic Table**".

This will show you the **Symbol** and the **Valency Number** for most of the **Groups** you will need.

Name ⇒ carbonate

Symbol ⇒ CO₃

Valency ⇒



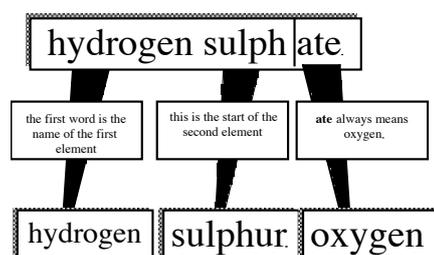
1		2	
name	formula	name	formula
ammonium	NH ₄	carbonate	CO ₃
cyanide	CN	chromate	CrO ₄
hydroxide	OH	sulphate	SO ₄
nitrate	NO ₃	sulphite	SO ₃

Test Yourself

Draw the valency picture for each of these Groups.

- | | | | |
|--------------|--------------|-------------|----------------------|
| 1. hydroxide | 2. sulphate | 3. ammonium | 4. permanganate |
| 5. silicate | 6. phosphate | 7. sulphite | 8. hydrogencarbonate |
| 9. carbonate | 10. chromate | 11. nitrate | 12. thiosulphate |

More than 2 Elements

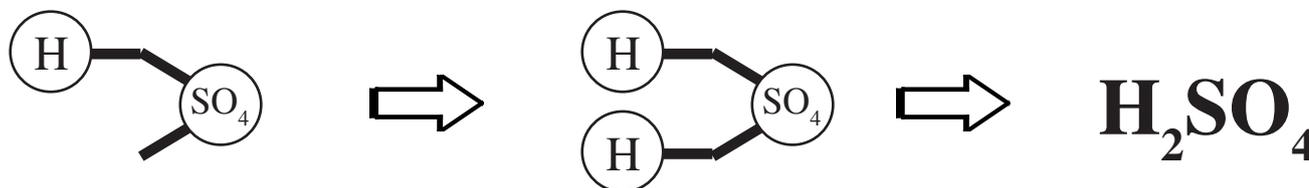


-ite endings are used to warn that there are *more than two elements* in the compound.

exceptions: none

Comp may have *more than 2 ele*, but they will still only involve *two parts* :- one of which is a **Gr**.

For example, to work out the formula for *hydrogen sulphate*.



1. Draw the Valency Pictures for an atom of **hydrogen** and the **sulphate group**.
2. Draw them as shown. This valency picture is not complete.
3. Draw another **hydrogen** atom to complete the picture.
4. Now write the correct formula for **hydrogen sulphate**.

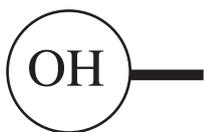
Test Yourself

Work out the formula for each of these compounds.

- | | | |
|---------------------|------------------------|----------------------|
| 1. ammonium nitrate | 2. potassium hydroxide | 3. calcium sulphate |
| 4. sodium carbonate | 5. ammonium chloride | 6. lithium phosphate |
| 7. copper chromate | 8. sodium sulphate | 9. caesium nitrate |

Awkward Customers

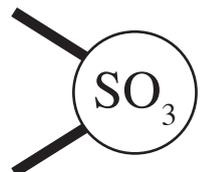
Some *Gro* are particularly *awkward* and you need to watch out for them.



The *Hydroxide Gro* is particularly *awkward* because it *contains two elements* but ends in **-IDE**.



The *Cyanide Gro* is particularly *awkward* because it *contains two elements* but ends in **-IDE**.



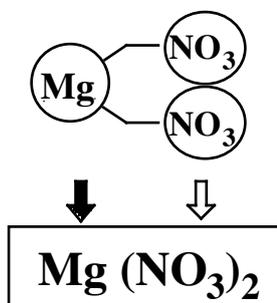
The *Sulphite Gro* is particularly *awkward* because it is very similar to the *Sulphate Group*, SO_4 .



The *Ammonium Gro* is particularly *awkward* because it *comes at the beginning* of the compounds name.

Using Brackets

Whenever *two or more* of a *gr* appears in a *form*, *bra* must be used to avoid confusion.



Wrong because it means 1Mg, 1N and 32 O atoms.



Better, but we lose the fact that we have NO_3 groups.



Ideal. We can see the nitrate group present, and tell how many

Test Yourself

Work out the formula for each of these compounds.

- | | | |
|------------------------|------------------------------|----------------------|
| 1. aluminium nitrate | 2. calcium hydrogencarbonate | 3. ammonium sulphate |
| 4. magnesium hydroxide | 5. sodium chloride | 6. carbon monoxide |
| 7. magnesium sulphate | 8. cobalt nitrate | 9. potassium oxide |
| 10. lithium carbonate | 11. magnesium cyanide | 12. copper carbonate |

Transition Metals

The **Transition Metals** are awkward because they can change the number of bonds they use from compound to compound.

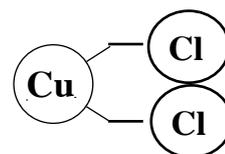
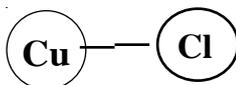
This problem is solved by including the **valency number** in the name of the compound.

Roman numerals are used

(**I** = one, **II** = two, **III** = three and **IV** = four).

name copper (**I**) chloride copper (**II**) chloride

picture



formula



Remember that the **Roman numeral** tells you the **number of bonds**, it does not tell you how many atoms should be in the formula.

Test Yourself

Work out the formula for each of these compounds.

- | | | |
|---------------------------|-------------------------|------------------------|
| 1. copper (II) chromate | 2. lead (II) nitrate | 3. barium permanganate |
| 4. silver (I) hydroxide | 5. iron (III) phosphate | 6. lead (IV) oxide |
| 7. chromium (III) nitrate | 8. nickel (II) sulphate | 9. sodium bromide |

Word Equations

We write a “*Word Equation*” to describe the *changes* that take place during a *chemical reaction*.



- The + sign means *and*.
- The → sign means *change into*.
- The chemicals which react are called the *Reactants* and are written on the *left*.
- The chemicals which are produced are called the *Products* and are written on the *right*.

Test Yourself

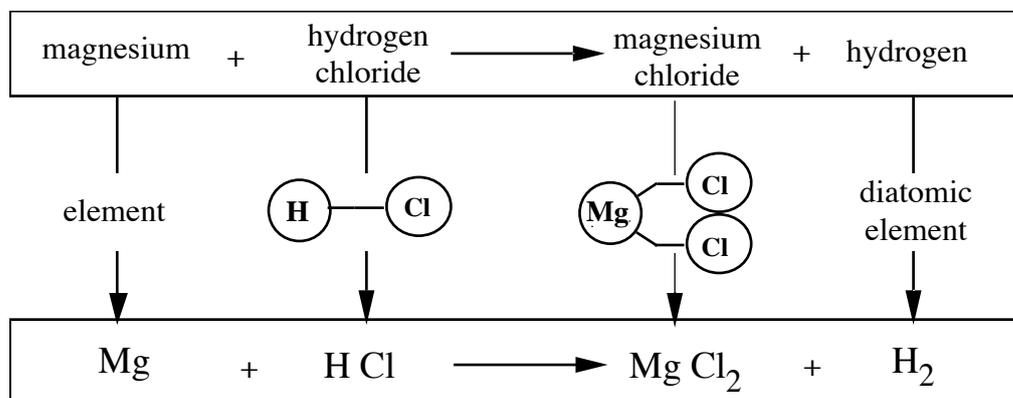
Write a *Word Equation* for each of the reactions described below.

- When magnesium metal burns, it reacts with oxygen in the air to form magnesium oxide, a white powder.
- In the Blast Furnace, iron is made by reacting iron (III) oxide with carbon monoxide gas. Carbon dioxide gas is also produced.
- In our bodies, starch, which we get from our food, reacts with water and breaks down to form glucose.
- When calcium metal is added to water, a gas is given off and calcium hydroxide solution is formed. When tested with a burning splint, the gas burns with a "pop".

Formula Equation

The next stage is to replace all the *names* of chemicals with their *formulas*, i.e. write a *Formula Equation*. e.g.

word equation



formula equation

Elements in Equations

Most *ele* are easy. They are simply represented by their *symbol*.



There are, however, **7 elem** which are made up of *mol*, each with **2 at**. This needs to be shown in their *form*, such as H_2 for *hydr*.

H_2 ----->										He					
										B	C	N_2	O_2	F_2	Ne
										Al	Si	P	S	Cl_2	Ar
Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br_2	Kr					
Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I_2	Xe					
Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn					

“The Diatomic 7”

hydr
nitr
ox
fluor
chlor
brom
iod

Test Yourself

Write a **Formula Equation** for each of the reactions describe by the **Word Equations** shown below.

- When magnesium metal burns, it reacts with oxygen in the air to form magnesium oxide, a white powder.
- In the Blast Furnace, iron is made by reacting iron (III) oxide with carbon monoxide gas. Carbon dioxide gas is also produced.
- In our bodies, starch, which we get from our food, reacts with water and breaks down to form glucose.
- When calcium metal is added to water, a gas is given off and calcium hydroxide solution is formed. When tested with a burning splint, the gas burns with a "pop".
- Black copper oxide powder and carbon dioxide are made when green copper carbonate powder is heated.

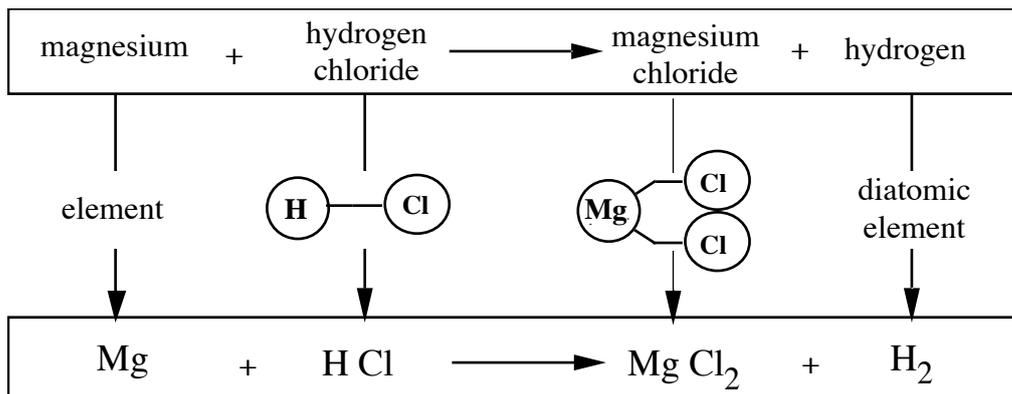
Balancing Equations



A *balanced* equation has the *same number* of each *type of atom* in the *Reactants* & *Products*.

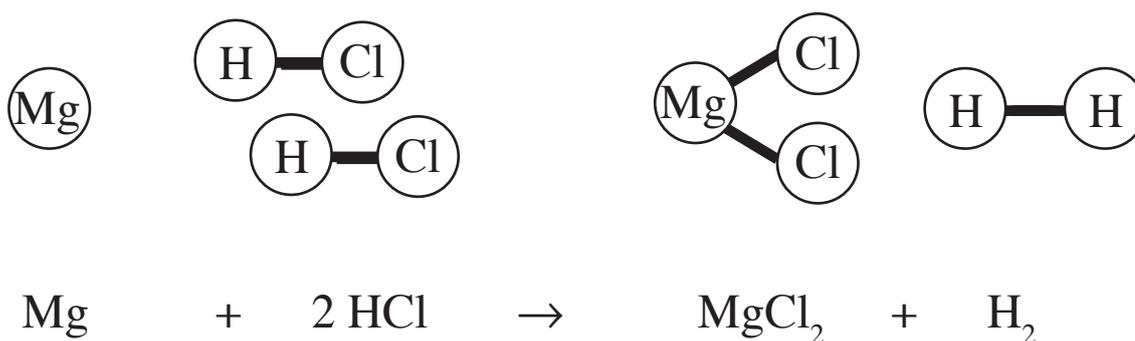
In other words, *all the atoms that are there at the beginning of a reaction (Reactants) must still be there at the end (Products)*.

If we look at our earlier example,



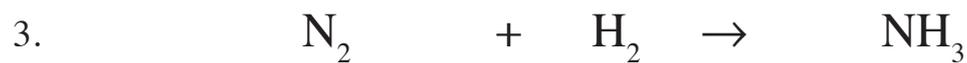
This is an *unbalanced* reaction, *there is 1 H on the left but 2 on the right*
there is 1 Cl on the left but 2 on the right

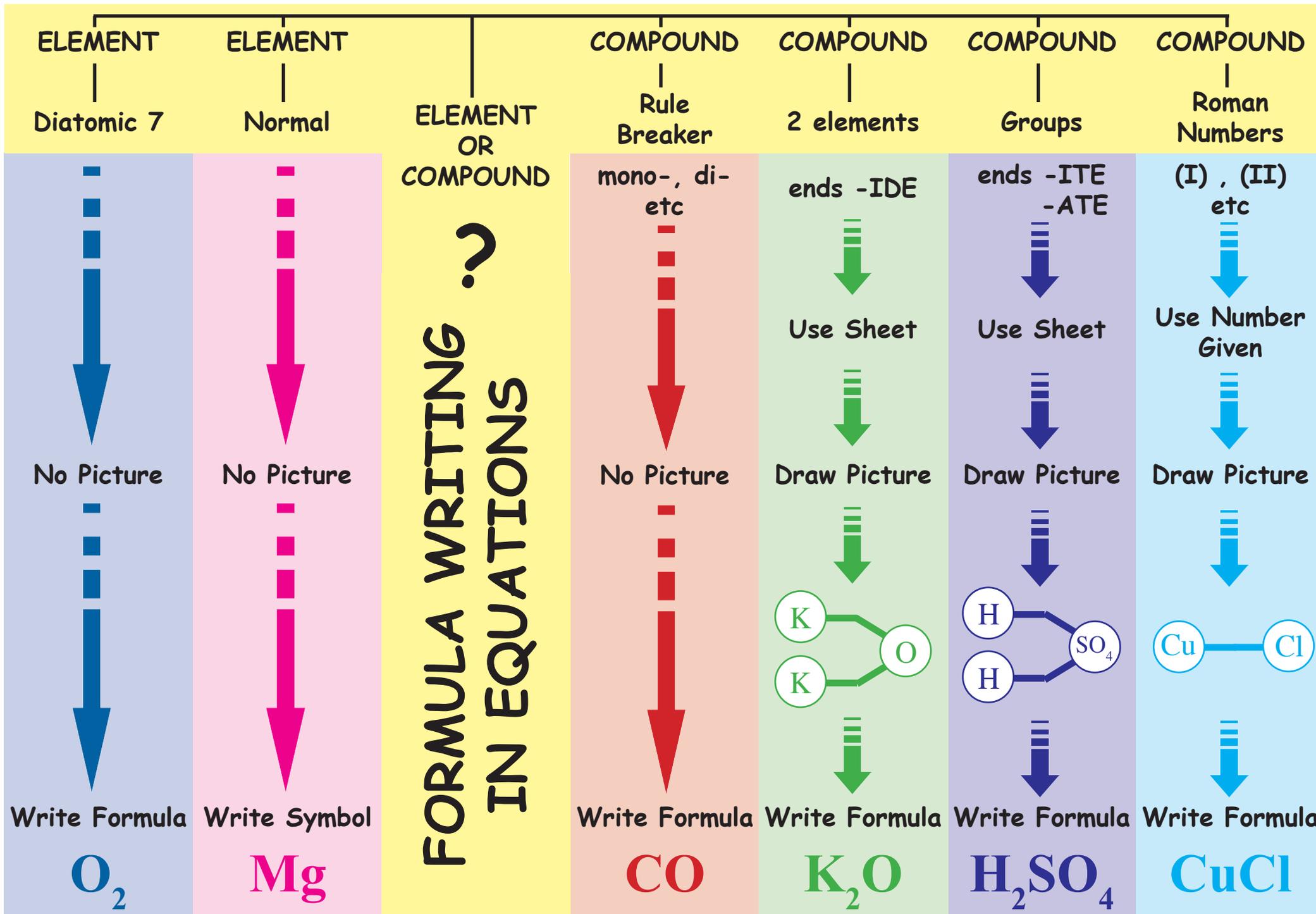
Equations are *balanced* by *increasing the amount* of some of the chemicals.



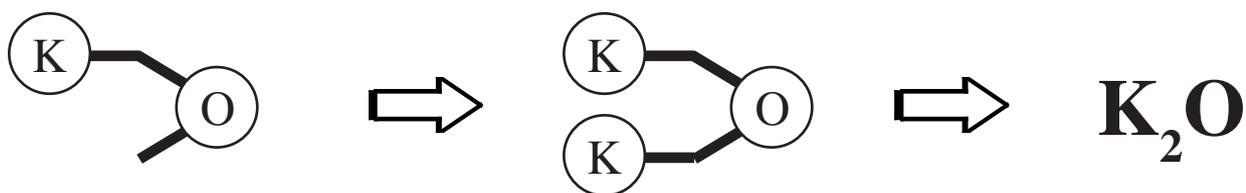
Test Yourself

Balance each of the equations shown below.





Formula Writing & Chemical Equations



Balanced Equations

Formula Equations

Word Equations

Transition Metals

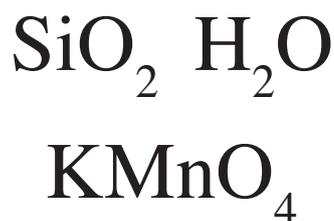
Using Brackets

Awkward Customers

More than 2 Elements

2 Elements Only

Using the Name Only



These sheets belong to _____

What is a Formula ?

The **formula** of a **compound** tells you two things about the **compound** :-



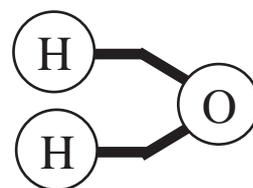
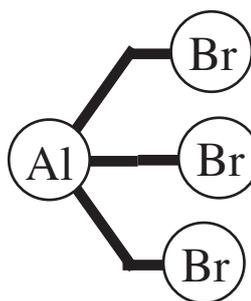
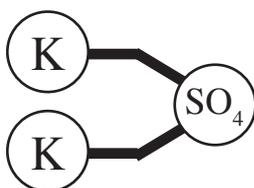
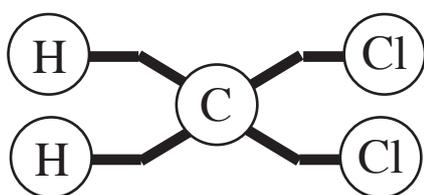
and

i) **which elements** are in the compound using **symbols**,

ii) **how many** atoms of each **element** are in the compound using **numbers**.

Test Yourself

What would be the formula for each of the following?



Using the Name Only

Some **compounds** have extra information in their **names** that allow people to work out and write the correct **formula**.

The **names** of the elements appear as usual but this time the **number** of each type of atom is included using

carbon **monoxide** CO

carbon **dioxide** CO_2

dinitrogen tetroxide N_2O_4

mono- = 1 **di-** = 2 **tri-** = 3 **tetra-** = 4

Test Yourself

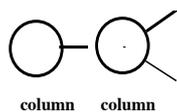
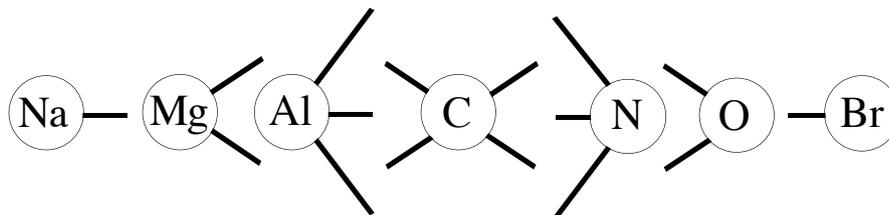
What would be the formula for each of the following?

1. sulphur trioxide
2. silicon tetrafluoride
3. dinitrogen oxide
4. phosphorus trichloride
5. dinitrogen tetroxide
6. nitrogen monoxide
7. nitrogen dioxide
8. tin dibromide
9. sulphur dioxide

Valency Numbers

Apart from the *Noble Gases* (column 8), all **atoms** can form **bonds** and join to other atoms in **compounds**.

The **number of bonds** an atom can form is called its **Valency**.



lithium \Leftarrow *Name*

column 1	column 2
Li 1	Be 2
Na 1	Mg 2
K 1	Ca 2

Li \Leftarrow *Symbol*



Li \Leftarrow *Valency Picture*

To begin with, you will be given a special **Periodic Table** which you can use to find the **Valency Number** of an **Element**.

Use the **Name** of the **Element** to find its **Symbol** and then draw the correct **Valency Picture**

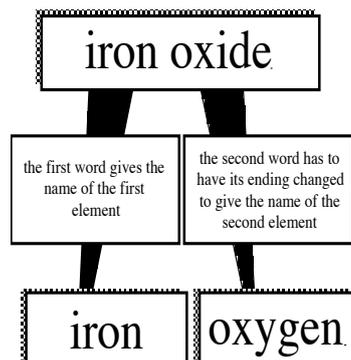
Test Yourself

Draw the Valency Picture for each of these Elements.

- | | | | |
|--------------|------------|-------------|--------------|
| 1. beryllium | 2. boron | 3. nitrogen | 4. fluorine |
| 5. sodium | 6. silicon | 7. sulphur | 8. calcium |
| 9. chromium | 10. cobalt | 11. arsenic | 12. selenium |

2 Elements Only

The name of a 2-element **compound** usually lists **both** the **elements** in the compound.

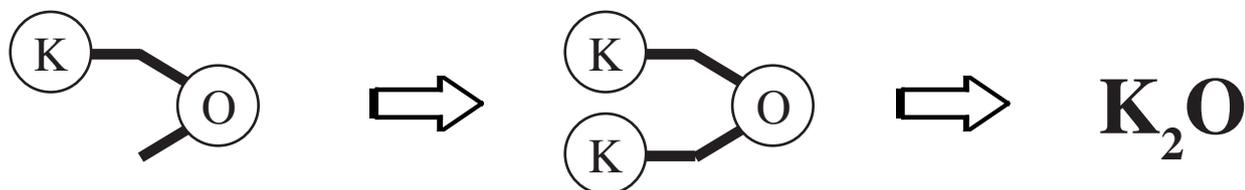


-ide endings are used to emphasise that there are **only two elements** in the compound.

exceptions: compounds ending **hydroxide** or **cyanide** have **more** than 2 elements in them

Writing a **correct formula** is all about looking up the **correct symbol**, identifying the **correct valency number** and then **balancing** the two halves of the **compound**. This is easier if you use **Valency Pictures**.

For example, to work out the formula for **potassium oxide**.



1. Draw the Valency Pictures for atoms of **potassium** and **oxygen**.
2. Draw them as shown. This valency picture is not complete.
3. Draw another **potassium** atom to complete the picture.
4. Now write the correct formula for **potassium oxide**.

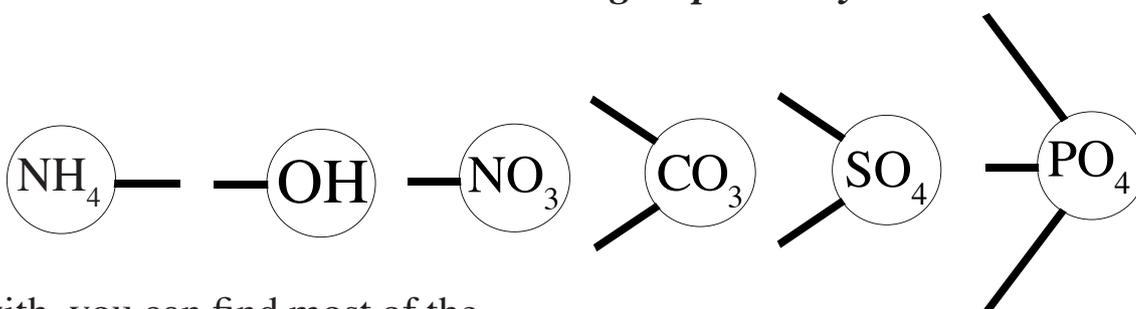
Test Yourself

Work out the formula for each of these compounds.

1. hydrogen oxide
2. sodium bromide
3. phosphorus fluoride
4. magnesium oxide
5. sulphur chloride
6. aluminium sulphide
7. silicon oxide
8. calcium sulphide
9. nitrogen iodide

Group Valencies

Atoms often join together to form "**Groups**" - fixed numbers of **atoms** with a certain number of **spare bonds** still available - a **group valency**.



To begin with, you can find most of the **Groups** on the other side of the special "**Periodic Table**".

This will show you the **Symbol** and the **Valency Number** for most of the **Groups** you will need.

Valency \Rightarrow

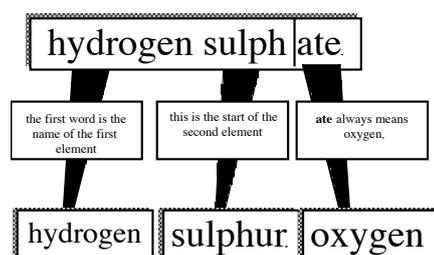
1		2	
name	formula	name	formula
ammonium	NH ₄	carbonate	CO ₃
cyanide	CN	chromate	CrO ₄
hydroxide	OH	sulphate	SO ₄
nitrate	NO ₃	sulphite	SO ₃

Test Yourself

Draw the valency picture for each of these Groups.

- | | | | |
|--------------|--------------|-------------|----------------------|
| 1. hydroxide | 2. sulphate | 3. ammonium | 4. permanganate |
| 5. silicate | 6. phosphate | 7. sulphite | 8. hydrogencarbonate |
| 9. carbonate | 10. chromate | 11. nitrate | 12. thiosulphate |

More than 2 Elements

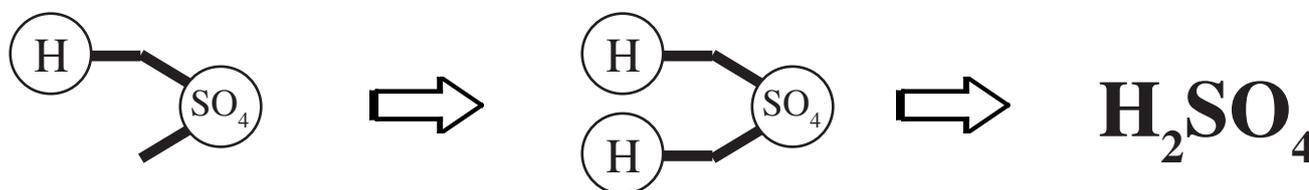


-ite **-ate** endings are used to warn that there are *more than two elements* in the compound.

exceptions: none

Compounds may have *more than 2 elements*, but they will still only involve *two parts* :- one of which is a **Group**.

For example, to work out the formula for *hydrogen sulphate*.



1. Draw the Valency Pictures for an atom of **hydrogen** and the **sulphate group**.
2. Draw them as shown. This valency picture is not complete.
3. Draw another **hydrogen** atom to complete the picture.
4. Now write the correct formula for **hydrogen sulphate**.

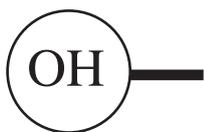
Test Yourself

Work out the formula for each of these compounds.

- | | | |
|---------------------|------------------------|----------------------|
| 1. ammonium nitrate | 2. potassium hydroxide | 3. calcium sulphate |
| 4. sodium carbonate | 5. ammonium chloride | 6. lithium phosphate |
| 7. copper chromate | 8. sodium sulphate | 9. caesium nitrate |

Awkward Customers

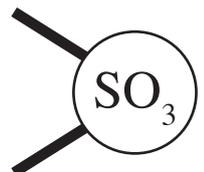
Some **Groups** are particularly *awkward* and you need to watch out for them.



The **Hydroxide Groups** is particularly *awkward* because it *contains two elements* but ends in **-IDE**.



The **Cyanide Groups** is particularly *awkward* because it *contains two elements* but ends in **-IDE**.



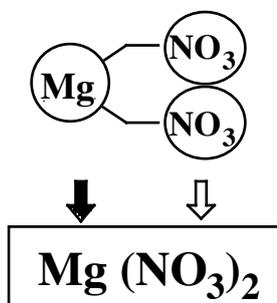
The **Sulphite Groups** is particularly *awkward* because it is very similar to the **Sulphate Group**, SO_4 .



The **Ammonium Groups** is particularly *awkward* because it *comes at the beginning* of the compounds name.

Using Brackets

Whenever *two or more* of a **group** appears in a **formula**, **brackets** must be used to avoid confusion.



Wrong because it means 1Mg, 1N and 32 O atoms.



Better, but we lose the fact that we have NO_3 groups.



Ideal. We can see the nitrate group present, and tell how many

Test Yourself

Work out the formula for each of these compounds.

- | | | |
|------------------------|------------------------------|----------------------|
| 1. aluminium nitrate | 2. calcium hydrogencarbonate | 3. ammonium sulphate |
| 4. magnesium hydroxide | 5. sodium chloride | 6. carbon monoxide |
| 7. magnesium sulphate | 8. cobalt nitrate | 9. potassium oxide |
| 10. lithium carbonate | 11. magnesium cyanide | 12. copper carbonate |

Transition Metals

The **Transition Metals** are awkward because they can **change the number of bonds they use** from **compound** to **compound**.

This problem is solved by including the **valency number** in the name of the compound.

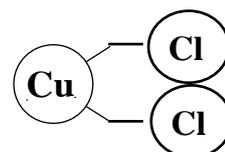
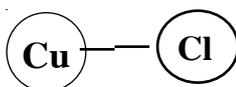
Roman numerals are used

(**I** = one, **II** = two, **III** = three and **IV** = four).



<i>name</i>	copper (I) chloride	copper (II) chloride
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picture



formula



Remember that the **Roman numeral** tells you the **number of bonds**, it does not tell you how many atoms should be in the formula.

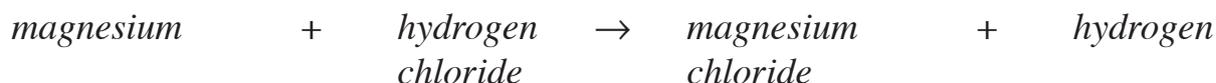
Test Yourself

Work out the formula for each of these compounds.

- | | | |
|---------------------------|-------------------------|------------------------|
| 1. copper (II) chromate | 2. lead (II) nitrate | 3. barium permanganate |
| 4. silver (I) hydroxide | 5. iron (III) phosphate | 6. lead (IV) oxide |
| 7. chromium (III) nitrate | 8. nickel (II) sulphate | 9. sodium bromide |

Word Equations

We write a “**Word Equation**” to describe the **changes** that take place during a **chemical reaction**.



- The + sign means **and**.
- The → sign means **change into**.
- The chemicals which react are called the **Reactants** and are written on the **left**.
- The chemicals which are produced are called the **Products** and are written on the **right**.

Test Yourself

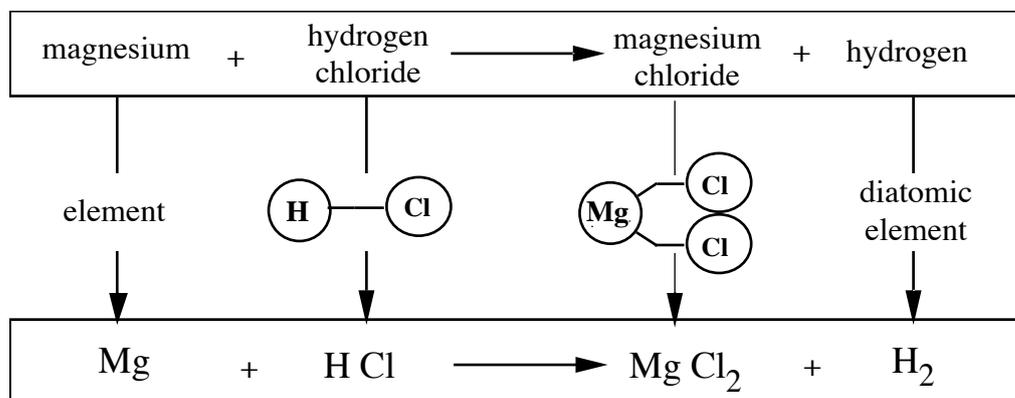
Write a **Word Equation** for each of the reactions described below.

- When magnesium metal burns, it reacts with oxygen in the air to form magnesium oxide, a white powder.
- In the Blast Furnace, iron is made by reacting iron (III) oxide with carbon monoxide gas. Carbon dioxide gas is also produced.
- In our bodies, starch, which we get from our food, reacts with water and breaks down to form glucose.
- When calcium metal is added to water, a gas is given off and calcium hydroxide solution is formed. When tested with a burning splint, the gas burns with a "pop".

Formula Equation

The next stage is to replace all the **names** of chemicals with their **formulae**, ie write a **Formula Equation**. e.g.

word equation



formula equation

Elements in Equations

Most *elements* are easy. They are simply represented by their *symbol*.



There are, however, **7 elements** which are made up of *molecules*, each with **2 atoms**. This needs to be shown in their *formulae*, such as H_2 for *hydrogen*.

											H_2												He				
																						B	C	N_2	O_2	F_2	Ne
																						Al	Si	P	S	Cl_2	Ar
Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br_2	Kr																	
Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I_2	Xe																	
Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																	

“The Diatomic 7”

hydrogen
nitrogen
oxygen
fluorine
chlorine
bromine
iodine

Test Yourself

Write a *Formula Equation* for each of the reactions describe by the *Word Equations* shown below.

1. When magnesium metal burns, it reacts with oxygen in the air to form magnesium oxide, a white powder.
2. In the Blast Furnace, iron is made by reacting iron (III) oxide with carbon monoxide gas. Carbon dioxide gas is also produced.
3. In our bodies, starch, which we get from our food, reacts with water and breaks down to form glucose.
4. When calcium metal is added to water, a gas is given off and calcium hydroxide solution is formed. When tested with a burning splint, the gas burns with a "pop".
5. Black copper oxide powder and carbon dioxide are made when green copper carbonate powder is heated.

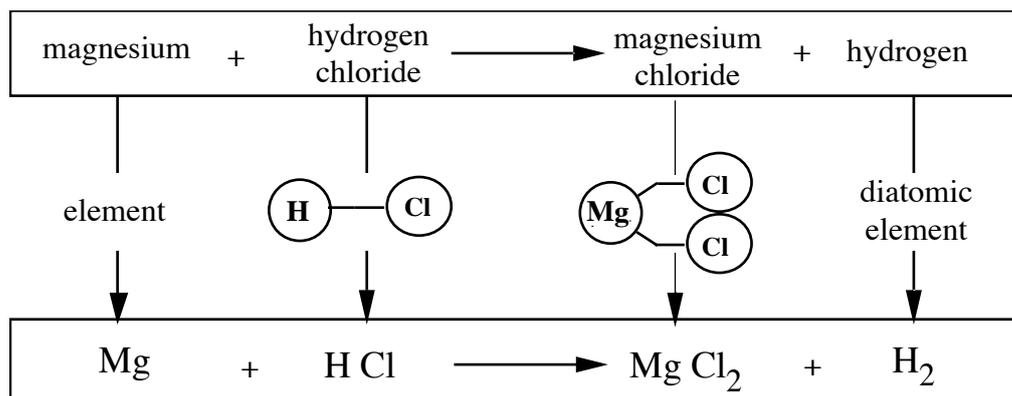
Balancing Equations



A **balanced equation** has the **same number** of each **type of atom** in the **Reactants** & **Products**.

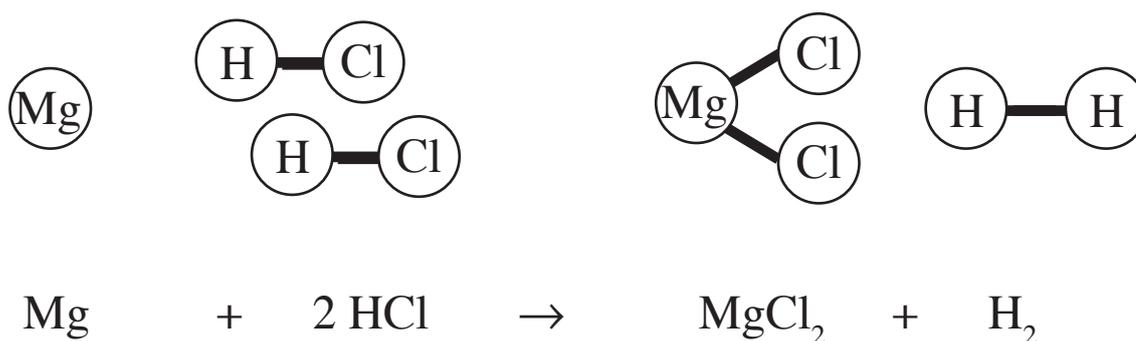
In other words, *all the atoms that are there at the beginning of a reaction (Reactants) must still be there at the end (Products).*

If we look at our earlier example,



This is an **unbalanced** reaction, *there is 1 H on the left but 2 on the right*
there is 1 Cl on the left but 2 on the right

Equations are **balanced** by **increasing the amount** of some of the chemicals.



Test Yourself

Balance each of the equations shown below.

