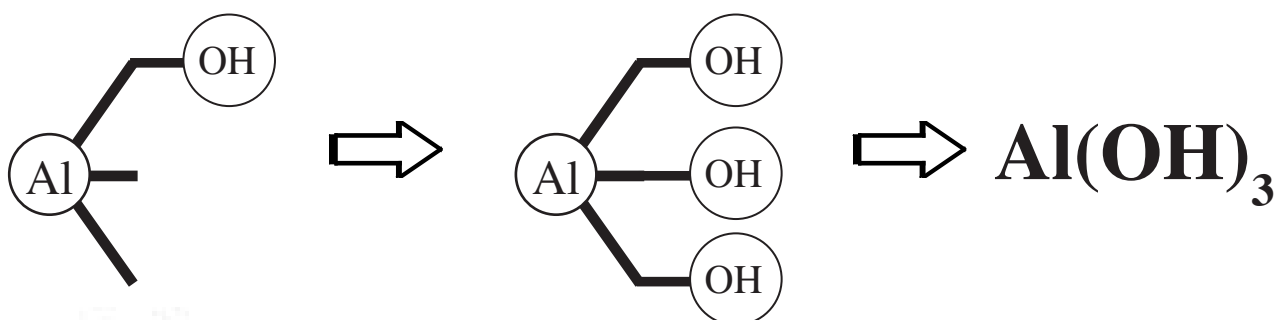


Formula & Equation Writing

Book 2



Ionic Equations

Ionic Formulae

Balanced Equations

Formula Equations

Word Equations

Transition Metals

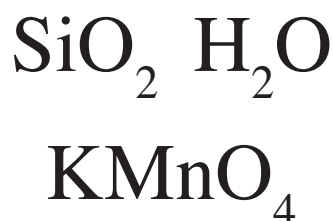
Using Brackets

Awkward Customers

More than 2 Elements

2 Elements Only

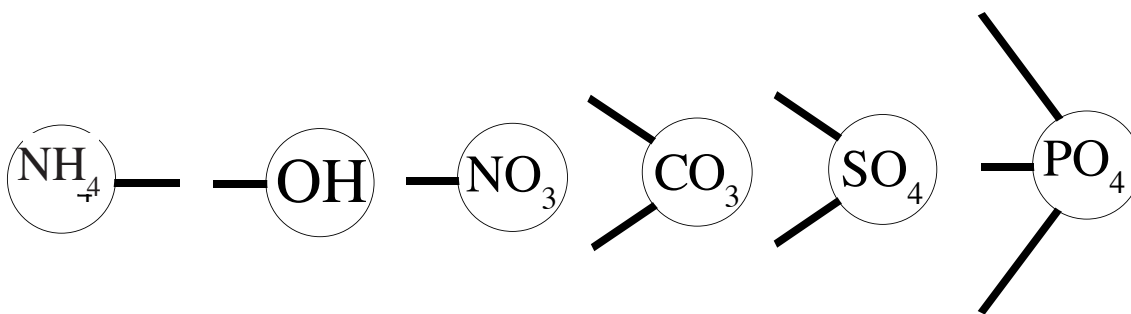
Using the Name Only



These sheets belong to _____

Group Valencies

At often join together to form "**Groups**" - *fixed numbers of at* with a certain number of *spare bo* still available - an overall **group valency**.



To begin with, you may have found your **Group** on the other side of the special "**Periodic Table**" that you may have been given originally.

Name ⇒ carbonate

Symbol ⇒

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

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

Valency ⇒ **Picture**

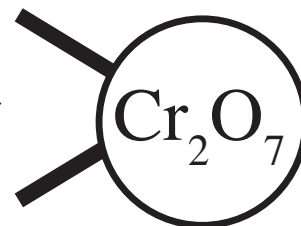
Formulae of Selected Ions containing more than one kind of Atom

one positive		one negative		two negative		three negative	
Ion	Formula	Ion	Formula	Ion	Formula	Ion	Formula
ammonium	NH ₄ ⁺	ethanoate	CH ₃ COO ⁻	carbonate	CO ₃ ²⁻	phosphate	PO ₄ ³⁻
		hydrogencarbonate	HCO ₃ ⁻	chromate	CrO ₄ ²⁻		
		hydrogensulfate	HSO ₄ ⁻	dichromate	Cr ₂ O ₇ ²⁻		
		hydrogensulfite	HSO ₃ ⁻	sulfate	SO ₄ ²⁻		
		hydroxide	OH ⁻	sulfite	SO ₃ ²⁻		
		nitrate	NO ₃ ⁻	thiosulfate	S ₂ O ₃ ²⁻		
		permanganate	MnO ₄ ⁻				

During exams you will be expected to use the Table above, which will be in the **Data Book** supplied.

Name ⇒ **dichromate**

Valency picture ⇒



Symbol ⇒ **Cr₂O₇²⁻**

Valency number ⇒ **same as the amount of charge**

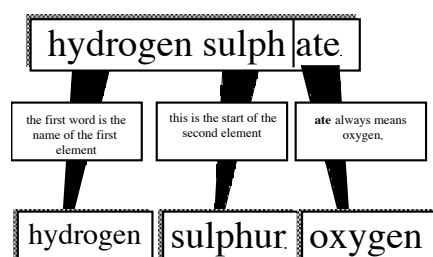
⇒ **2**

Test Yourself 6

Draw the valency picture for each of these Groups.

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

More than 2 Elements

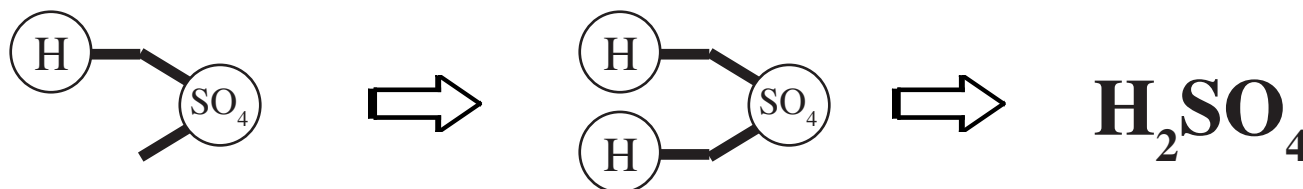


-ite endings are used to warn that there are *more than two elements* in the compound.

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 sulfate*.



1. Draw the Valency Pictures for an atom of **hydrogen** and the **sulfate 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 sulfate**.

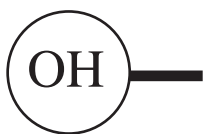
Test Yourself 7

Work out the formula for each of these compounds.

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

Awkward Customers

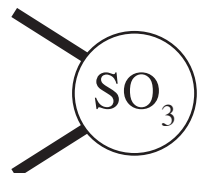
Some *Gro* are particularly *awkward* and you need to watch out for them.



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**.



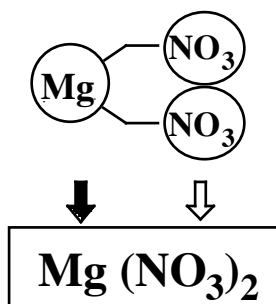
The *Sulfite Gro* is particularly *awkward* because it is very similar to the *Sulfate Group*, SO_4 .



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 8

Work out the formula for each of these compounds.

- | | | |
|------------------------|------------------------|----------------------------|
| 1. lithium nitrate | 6. barium carbonate | 11. magnesium sulfite |
| 2. sodium carbonate | 7. gallium hydroxide | 12. sodium nitrite |
| 3. magnesium sulfate | 8. potassium phosphate | 13. potassium permanganate |
| 4. calcium hydroxide | 9. strontium nitrate | 14. sodium dichromate |
| 5. aluminium phosphate | 10. rubidium sulfate | 15. lithium chromate |

Transition Metals

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

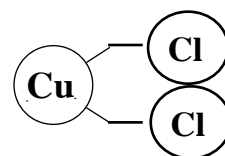
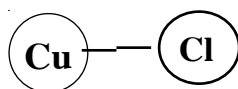
This problem is solved by including the **valency number** in the name of the compound.

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.

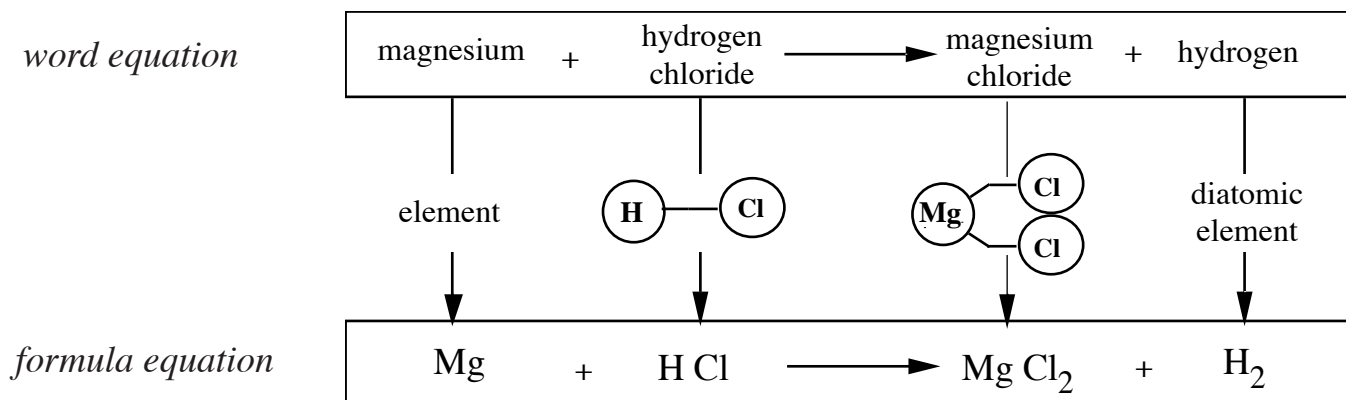
Test Yourself 9

Work out the formula for each of these compounds.

- | | |
|--------------------------|----------------------------|
| 1. silver (I) hydroxide | 10. iron (III) phosphate |
| 2. copper (II) chromate | 11. nickel (II) chloride |
| 3. zinc (II) carbonate | 12. lead (II) nitrate |
| 4. iron (II) hydroxide | 13. iron (III) oxide |
| 5. copper (I) oxide | 14. copper (II) sulfate |
| 6. copper (II) oxide | 15. gold (III) iodide |
| 7. lead (IV) oxide | 16. nickel (II) sulfate |
| 8. silver (I) nitrate | 17. chromium (III) nitrate |
| 9. mercury (II) chloride | 18. chromium (III) oxide |

Formula Equation

You should already know how to write a *word equation* and then replace all the *na* of chemicals with their *form*, ie write a *Formula Equation*. e.g.

**Test Yourself 10**

1. Pentane (C₅H₁₂) burns in oxygen to form water and carbon dioxide.
2. Ammonia (NH₃) burns in oxygen to form water and nitrogen.
3. Zinc (II) oxide and nitric acid (HNO₃) react to form zinc (II) nitrate and water.
4. Iron (III) oxide and carbon monoxide react to give iron and carbon dioxide.
5. Potassium reacts with water to produce potassium hydroxide and hydrogen.
6. Ammonium dichromate (NH₄)₂Cr₂O₇ decomposes on heating to form chromium (III) oxide, water and nitrogen.
7. Phosphorus (V) oxide is formed by heating the elements together.
8. Water and carbon dioxide are produced as well as copper (II) nitrate when copper (II) carbonate reacts with nitric acid (HNO₃).
9. Ethanol (C₂H₅OH) burns in oxygen to form water and carbon dioxide.
10. Nitric acid (HNO₃) and calcium hydroxide react to give water and calcium nitrate.

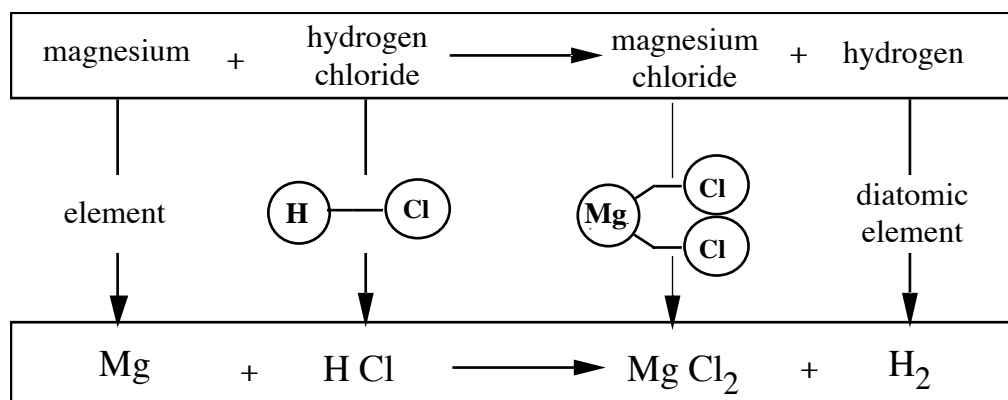
Balancing Equations



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

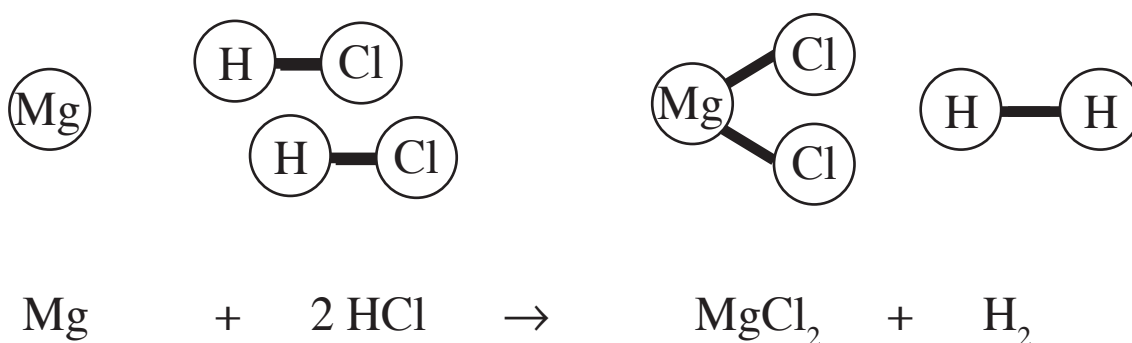
In other words, *all the atoms that are there at the beginning of a reaction (Reactants) must still be there at the end (Products)*.

If we look at an example from Book 1,



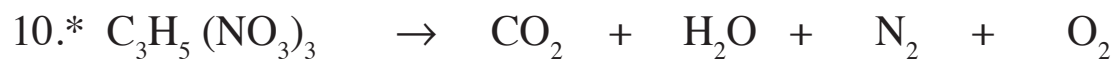
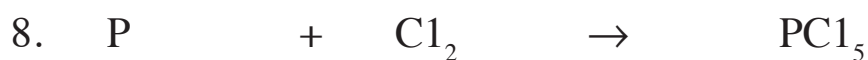
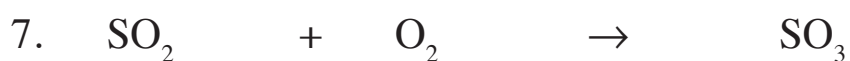
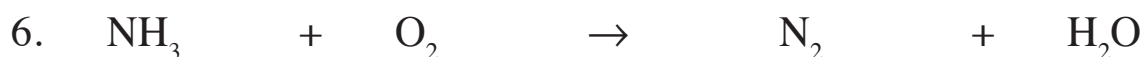
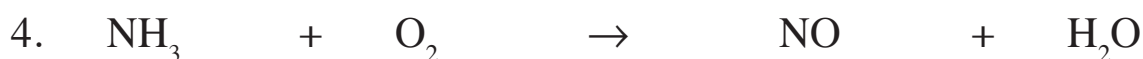
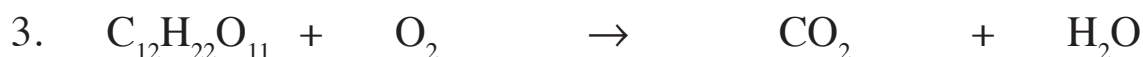
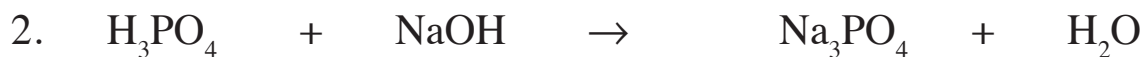
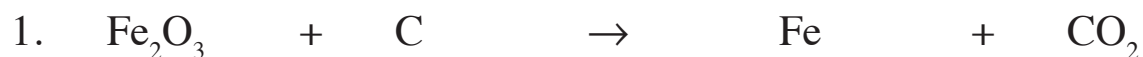
This is an *unbalanced* reaction, *there is 1 H on the left but 2 on the right*
there is 1 Cl on the left but 2 on the right

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



Test Yourself 11

Balance each of the equations shown below.

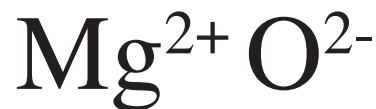
* *If you can do this one you can certainly balance equations!!*

Ionic Formulae

There are many occasions when we want to show the *charges* present in *ionic compounds* - write *ionic formulae*.



metals such as *magnesium*
 ⇒ will *lose electrons* to form
positive ions

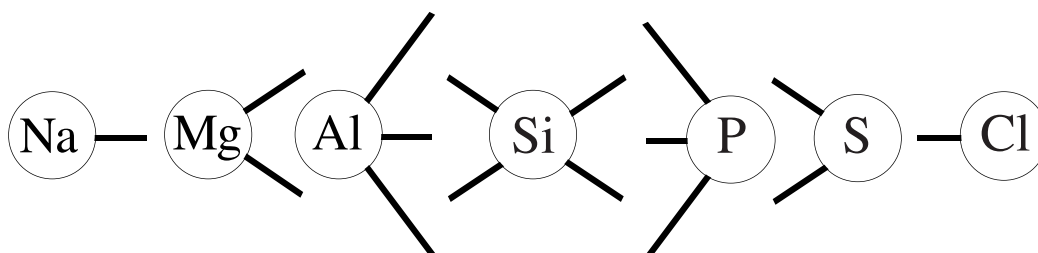


non-metals such as *oxygen*
 ⇒ will *gain electrons* to form
negative ions

Exactly like its *Valency*, the *charge on an ion* depends on which *Group* in the Periodic Table an atom belongs to.

<i>Group</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
<i>Valency No.</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>3</i>	<i>2</i>	<i>1</i>

Valency Pictures



Charge on the ion

<i>1+</i>	<i>2+</i>	<i>3+</i>	<i>unlikely to form a simple ion</i>	<i>3-</i>	<i>2-</i>	<i>1-</i>
-----------	-----------	-----------	--------------------------------------	-----------	-----------	-----------

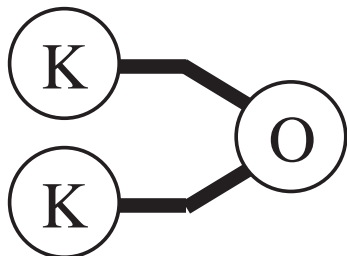
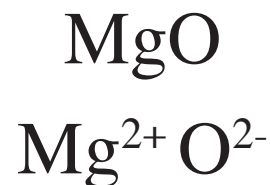
Group ions already have their *charges* shown in the *Data Book*.

Formulae of Selected Ions containing more than one kind of Atom

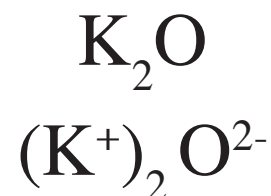
one positive		one negative		two negative		three negative	
Ion	Formula	Ion	Formula	Ion	Formula	Ion	Formula
ammonium	NH ₄ ⁺	ethanoate	CH ₃ COO ⁻	carbonate	CO ₃ ²⁻	phosphate	PO ₄ ³⁻
		hydrogencarbonate	HCO ₃ ⁻	chromate	CrO ₄ ²⁻		
		hydrogensulfate	HSO ₄ ⁻	dichromate	Cr ₂ O ₇ ²⁻		
		hydrogensulfite	HSO ₃ ⁻	sulfate	SO ₄ ²⁻		
		hydroxide	OH ⁻	sulfite	SO ₃ ²⁻		
		nitrate	NO ₃ ⁻	thiosulfate	S ₂ O ₃ ²⁻		
		permanganate	MnO ₄ ⁻				



⇒ *very little difference between the normal formula and the ionic formula*



⇒ *brackets, however, will be needed much more often to make clear the charge and number of ions*



Test Yourself 12

Write ionic formulae for the following ionic compounds

- | | | |
|-----------------------|---------------------|------------------------|
| 1. sodium chloride | 6. calcium sulfide | 11. aluminium iodide |
| 2. lithium iodide | 7. barium bromide | 12. aluminium oxide |
| 3. potassium fluoride | 8. magnesium iodide | 13. magnesium nitride |
| 4. rubidium bromide | 9. lithium sulfide | 14. strontium chloride |
| 5. beryllium oxide | 10. potassium oxide | 15. gallium sulfide |

Test Yourself 13

Write ionic formulae for the following ionic compounds

- | | | |
|------------------------|----------------------------|---------------------------|
| 1. lithium nitrate | 8. strontium nitrate | 15. zinc (II) carbonate |
| 2. sodium carbonate | 9. rubidium sulfate | 16. iron (II) hydroxide |
| 3. magnesium sulfate | 10. magnesium sulfite | 17. copper (I) oxide |
| 4. calcium hydroxide | 11. sodium nitrite | 18. copper (II) oxide |
| 5. aluminium phosphate | 12. potassium permanganate | 19. silver (I) nitrate |
| 6. barium carbonate | 13. sodium dichromate | 20. mercury (II) chloride |
| 7. potassium phosphate | 14. lithium chromate | 21. iron (III) oxide |

Ionic Equations

The main thing to remember when asked to write an ionic equation is that *not all compounds are ionic!*

Test Yourself 14

Write *balanced ionic equations* for the following

1. lead nitrate → lead (II) oxide + nitrogen dioxide
2. copper (II) carbonate → copper(II) oxide + carbon dioxide
3. sodium + water → sodium hydroxide + hydrogen
4. iron (II) chloride + chlorine → iron (III) chloride
5. silver + copper (II) → silver + copper (II)
nitrate chloride chloride nitrate

Going Further

You may be shown a series of videos demonstrating various reactions.

For each one, write a *Word Equation* and then try to write the correct *Ionic Formula Equation*. www.new.chemistry-teaching-resources.com/EquationWriting.html

'Further' Set 1 - charcoal with potassium nitrate

Word Equation:

Formula:

'Further' Set 2 - dichromate volcano

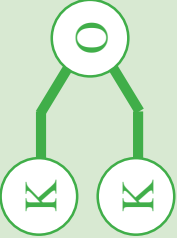
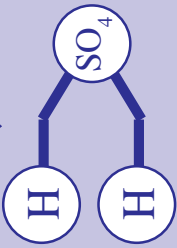

Word Equation:

Formula:

'Enthusiast' Set 2 - silver displacement

Word Equation:

Formula:

ELEMENT		ELEMENT OR COMPOUND		COMPOUND		COMPOUND		COMPOUND		COMPOUND	
Diatomic 7		Normal		Rule Breaker		2 elements		Groups		Roman Numbers	
<p>No Picture</p> <p>Write Formula</p> <p>O₂</p>		<p>No Picture</p> <p>Write Symbol</p> <p>Mg</p>		<p>mono-, di- etc</p> <p>No Picture</p> <p>Write Formula</p> <p>CO</p>		<p>ends -IDE</p> <p>Use Sheet</p> <p>Draw Picture</p>  <p>Write Formula</p> <p>K₂O</p>		<p>ends -ITE -ATE</p> <p>Use Sheet</p> <p>Draw Picture</p>  <p>Write Formula</p> <p>H₂SO₄</p>		<p>(I), (II) etc</p> <p>Use Number Given</p> <p>Draw Picture</p>  <p>Write Formula</p> <p>CuCl</p>	

**FORMULA WRITING
IN EQUATIONS**

