

USEFUL TERMS - complete the table of definitions.

Element	
Atom	
Molecule	
Compound	
Ion	
Formula	
Ionic bonding (A level standard definition)	
Covalent bonding (A level standard definition)	
Metallic bonding (A level standard definition)	
Isotope	
Relative atomic mass	

NAMES & FORMULAE OF COMMON IONS

You must know the formula of the **polyatomic ions (in bold)**. Learn these over the summer.

	Positive Ions +		Negative Ions -	
1	hydrogen	H ⁺	chloride	Cl ⁻
	sodium	Na ⁺	bromide	Br ⁻
	potassium	K ⁺	iodide	I ⁻
	lithium	Li ⁺	hydroxide	OH⁻
	copper(I)	Cu ⁺	nitrate	NO₃⁻
	<u>silver</u>	Ag ⁺	hydrogen carbonate	HCO₃⁻
	ammonium	NH₄⁺		
2	calcium	Ca ²⁺	sulphate	SO₄²⁻
	barium	Ba ²⁺	sulphide	S ²⁻
	magnesium	Mg ²⁺	oxide	O ²⁻
	<u>zinc</u>	Zn ²⁺	carbonate	CO₃²⁻
	lead(II)	Pb ²⁺		
	iron(II)	Fe ²⁺		
3	copper(II)	Cu ²⁺		
	aluminium	Al ³⁺	phosphate	PO₄³⁻
	iron(III)	Fe ³⁺	nitride	N ³⁻

Many elements, particularly transition metals (e.g. iron) have more than one charge. To indicate which charge the element has, a Roman numeral appears after the name e.g. iron(III).

Questions

1. Name the following ions and indicate their charge.
- | |
|------------------|
| Sn^{2+} |
| Sn^{4+} |
| Sb^{3+} |
2. Give the symbol of the following ions.
- | |
|---------------|
| lead(II) |
| scandium(III) |
| manganese(II) |
3. What charge are all of the ions in:

Group 1?

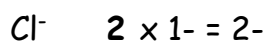
Group 2?

Group 7?

CONSTRUCTION OF FORMULAE**Worked Example**

To work out the formula for magnesium chloride:

1. Write the ions out and their charges Mg^{2+} Cl^{-}
2. Balance the number of ionic charges. The positive and negative charges need to cancel out to zero as compounds are electrically neutral (no overall charge).



so $MgCl_2$

Questions

Write the formulae for the following

- | | |
|-----------------------|------------------------|
| 1. potassium chloride | 6. magnesium nitrate |
| 2. iron(II) sulphate | 7. calcium nitride |
| 3. lithium sulphate | 8. aluminium carbonate |
| 4. sodium sulphide | 9. iron(III) sulphate |
| 5. sodium oxide | |

Complete the formulae for the following!

Common acids hydrochloric acid sulphuric acid nitric acid



Common gases ammonia carbon dioxide carbon monoxide



sulphur dioxide methane nitrogen dioxide

Hydrocarbons ethane propane butane



ethene propene butene

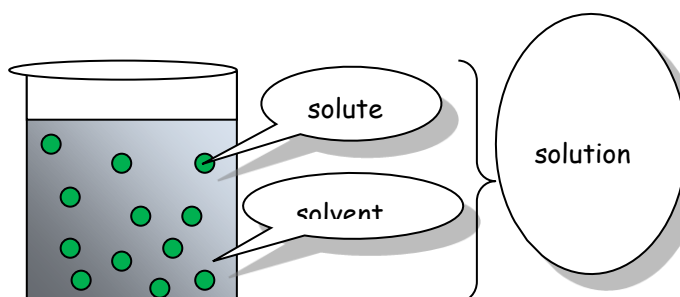
BALANCING EQUATIONS

Construct balanced chemical equations for reactions studied and for unfamiliar reactions given reactants and products

1. Word equation for the reaction
2. Write the correct formula for each species and include state symbols if necessary
3. Balance the number of atoms on the left with the number of atoms on the right, by adding **BIG** numbers in front of any formula if more than one is required.
4. Check that the equation balances

State symbols

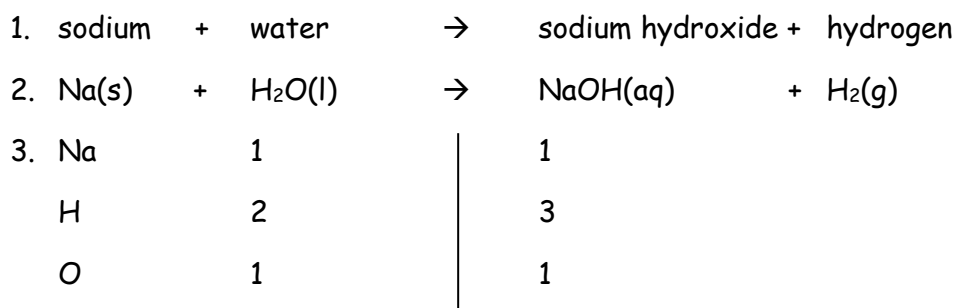
(s)	solid
(l)	liquid
(g)	gas
(aq)	substance dissolved in water



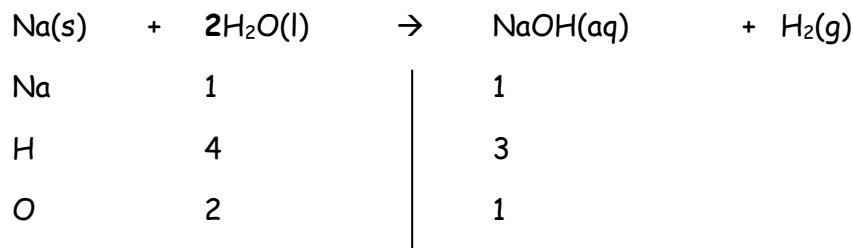
How to work out what state something is:

- **Common gases** = H_2 , O_2 , N_2 , F_2 , Cl_2 , NH_3 , CO_2 , alkanes and alkenes with 3 or less carbons
- Acids, hydroxides and ionic substances tend to be **aqueous solutions**
- Water and hydrocarbons that have more than four carbons are **liquid**
- Oxides, carbonates, metals are **solids**

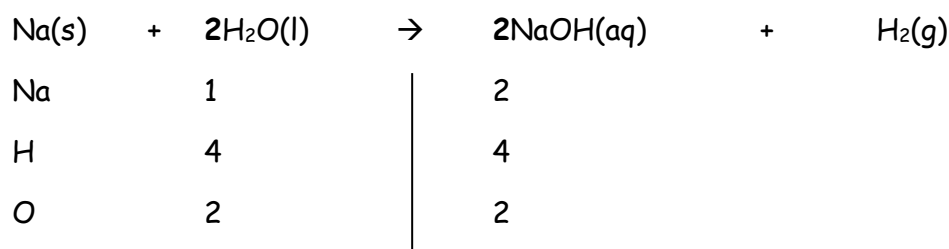
Worked example



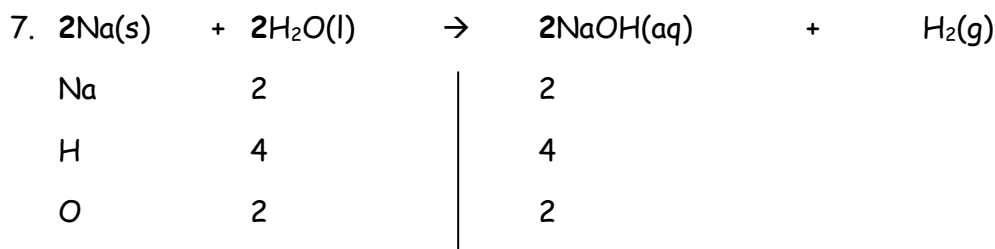
4. Add H₂O to increase H atoms.



5. Add NaOH to increase H and O atoms.



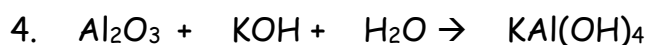
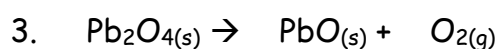
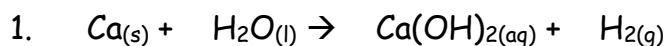
6. Add Na to increase Na atoms.

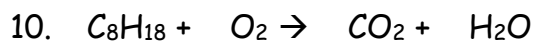
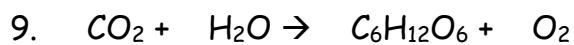
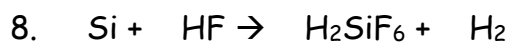
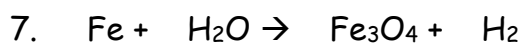
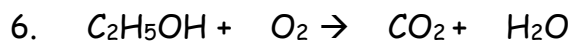


Balanced!

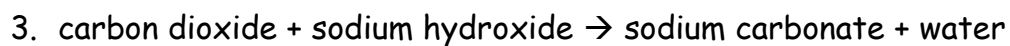
Questions

a) Balance the following and b) include state symbols (the first three state symbols have been done for you)





Balance the following word equations. Write the formulae first, then balance, then state symbols.



FUNDAMENTALS - SUMMARY QUESTIONS

Answer these questions to check your knowledge of what you've already covered

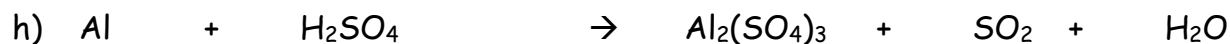
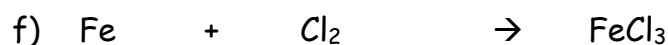
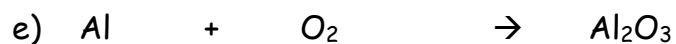
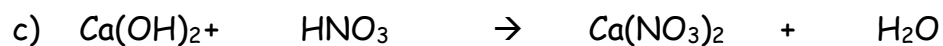
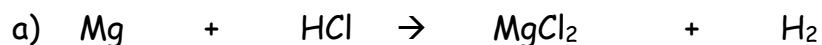
1. Write out the correct formula for each of the following compounds.

- | | |
|------------------------------|-----------------------|
| a) sodium chloride | b) magnesium sulphate |
| c) sodium hydrogen carbonate | d) calcium chloride |
| e) copper(II) nitrate | f) potassium sulphate |
| g) manganese(IV) oxide | h) zinc carbonate |
| i) aluminium oxide | j) aluminium sulphate |
| k) silver nitrate | l) calcium hydroxide |

2. How many atoms of each type are in the following?

- | | | | | |
|--|-----|-----|------|----------|
| a) H_2O | H = | O = | | |
| b) H_2SO_4 | H = | O = | S = | |
| c) $(\text{NH}_4)_2\text{SO}_4$ | H = | O = | S = | N = |
| d) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ | H = | O = | S = | Cu = |
| e) 2NaOH | H = | O = | Na = | |
| f) $3\text{Ca}(\text{OH})_2$ | H = | O = | Ca = | |
| g) $2\text{Na}_2\text{HPO}_4$ | H = | O = | Na = | P = |
| h) $2\text{NH}_4\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ | H = | N = | O = | Al = S = |

3. Balance the following equations and include state symbols.



4. Balance the following word equations, write the formulae first and then balance to complete.

a) carbon dioxide + sodium hydroxide \rightarrow sodium carbonate + water

b) lithium carbonate + nitric acid \rightarrow lithium nitrate + carbon dioxide + water

c) magnesium nitrate \rightarrow magnesium oxide + nitrogen dioxide + oxygen

5. Write the formulae of the following covalent compounds, include state symbols.

	Name	Formula
1.	water (liquid)	
2.	methane (gas)	
3.	hydrogen (gas)	
4.	nitrogen (gas)	
5.	oxygen (gas)	
6.	chlorine (gas)	
7.	bromine (liquid)	
8.	iodine (solid)	
9.	ammonia (gas)	
10.	carbon dioxide (gas)	
11.	carbon monoxide (gas)	
12.	fluorine (gas)	
13.	sulphur dioxide (gas)	
14.	sulphur trioxide (gas)	
15.	hydrogen chloride (gas)	
16.	hydrogen bromide (gas)	
17.	hydrogen iodide (gas)	
18.	hydrogen sulphide (gas)	
19.	tetrachloromethane (gas)	
20.	boron trifluoride (gas)	

STRUCTURE AND BONDING

Draw dot-and-cross diagrams for the following. Remember you need to decide whether it is ionic bonding or covalent bonding first.

Sodium Fluoride

Calcium Oxide

Lithium Sulphide

Carbon Dioxide

Methane

Water

Properties of substances

1. Why do ionic substances...
 - a. Have high melting points?

 - b. Conduct electricity when molten or dissolved, but not when solid?

2. Why do simple covalent substances...
 - a. Have low melting points?

 - b. Have melting points that increase as the size of the molecule increases?

3. Why...
 - a. Is diamond hard?

 - b. Doesn't diamond conduct electricity?

 - c. Is graphite soft?

 - d. Does graphite conduct electricity?

4. Why do metallic substances...
 - a. Conduct electricity?

 - b. Bend easily?

5. Why are alloys harder than pure metals?

QUANTITATIVE CHEMISTRY

1. Calculate the Mr of:
 - a. NaCl
 - b. Fe₂O₃
 - c. Mg(OH)₂
 - d. CaCO₃
 - e. C₆H₁₂O₆
 - f. Mg₃(PO₄)₂

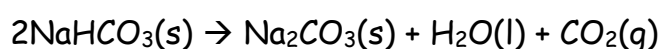
2. For each of the above compounds, calculate the percentage by mass of every element in the compound.

Reacting masses questions:

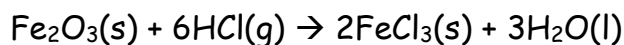
1. When calcium carbonate is heated it produces calcium oxide and carbon dioxide. What mass of calcium oxide would be produced by heating 75g calcium carbonate?



2. Calculate the mass of sodium hydrogencarbonate that must be heated to obtain 40g of sodium carbonate.



3. Iron (III) oxide reacts with hydrogen chloride to produce iron (III) chloride and water. What mass of iron (III) chloride would be produced by 20g of hydrogen chloride?



Limiting reactants questions:

In each example, one of the reactants is in excess. For each questions, work out:

- Which reagent is in excess and which is limiting
- How many moles of the product can be formed

<u>1</u>	CaO	+	H ₂ O	→	Ca(OH) ₂
a)	2 mol		3 mol		
b)	10 mol		8 mol		
c)	0.40 mol		0.50 mol		

<u>2</u>	2Ca	+	O ₂	→	2CaO
a)	2 mol		2 mol		
b)	10 mol		2 mol		
c)	0.50 mol		0.20 mol		

<u>3</u>	2Fe	+	3Cl ₂	→	2FeCl ₃
a)	3 mol		3 mol		
b)	12 mol		15 mol		
c)	20 mol		40 mol		

<u>4</u>	TiCl ₄	+	4Na	→	Ti	+	4NaCl
a)	4 mol		4 mol				
b)	2 mol		10 mol				
c)	0.5 mol		1 mol				

<u>5</u>	C ₂ H ₅ OH	+	3O ₂	→	2CO ₂	+	3H ₂ O
a)	15 mol		30 mol				
b)	0.25 mol		1 mol				
c)	3 mol		6 mol				

Find the empirical formula of each of the following substances:

1. N 82.4%, H 17.6%

2. C 1.24 g H 0.26 g

3. Al 52.9%, O 47.1%