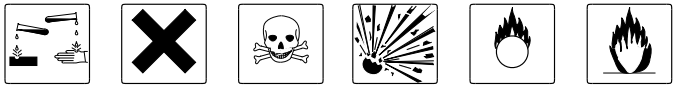
All you need to know about ... OCR 21st Century Science

Module C6

CHEMICAL SYNTHESIS - making new substances

- some chemicals are made on a large scale - sulphuric acid
- some are made in laboratories on a small scale - special drugs
- care must always be taken, whatever the scale of manufacture
- the time taken to make a chemical is very important
- the following steps are involved
  - choosing the correct reaction
  - carrying out a risk assessment
  - working out the quantities of reactants to use
  - using suitable apparatus
  - using the right conditions (temperature, pressure)
  - separating and purifying the product
  - measuring the yield of the product
  - checking the purity of the product



PRACTICAL TECHNIQUES

DISSOLVING	a solute dissolves in a solvent
CRYSTALLISATION	purifies a solid by dissolving it in hot solvent and allowing it to cool until crystal form
FILTRATION	separates an insoluble solid from a liquid
EVAPORATION	warming to drive off a liquid

"Acids contain aqueous hydrogen H^+ ions"

- the hydrogen ions can be replaced by other positive ions
- reacting acids with :-

metals	gives a	**salt + hydrogen**
oxides of metals		**salt + water**
hydroxides of metals		**salt + water**
carbonates		**salt + water + carbon dioxide**

"Alkalis contain aqueous hydroxide OH^- ions"

- hydroxide ions combine with hydrogen ions to give water
- the hydroxides of sodium, potassium and calcium are alkalis

FORMULAE TO LEARN

chlorine gas	Cl_2	nitrogen gas	N_2
oxygen gas	O_2	hydrogen gas	H_2
hydrochloric acid	HCl	nitric acid	HNO_3
sulphuric acid	H_2SO_4	sodium hydroxide	NaOH
sodium chloride	NaCl	sodium carbonate	Na_2CO_3
potassium chloride	KCl	magnesium oxide	MgO
magnesium hydroxide	$Mg(OH)_2$	magnesium carbonate	$MgCO_3$
magnesium sulphate	$MgSO_4$	calcium carbonate	$CaCO_3$
calcium chloride	$CaCl_2$		

You can calculate the formulae of salts by balancing the positive and negative charges on ions

potassium	K^+	chloride	Cl^-
sodium	Na^+	bromide	Br^-
magnesium	Mg^{2+}	sulphate	SO_4^{2-}

potassium chloride	KCl	(one - balances one +)
magnesium chloride	$MgCl_2$	(two -'s balance one 2+)
magnesium sulphate	$MgSO_4$	(one 2- balances one 2+)
sodium sulphate	Na_2SO_4	(one 2- balances two +'s)

ACIDS AND ALKALIS

- solutions may be acidic, alkaline or neutral
- water is neutral
- indicators can show what a solution is by colour
- pH meters or universal indicator can measure the pH

pH scale

- used to show how acidic or alkaline a solution is
- acidic pH less than 7
- neutral pH = 7
- alkaline pH more than 7

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RED		ORANGE		YELLOW		GREEN			BLUE		INDIGO		VIOLET	
strong acid			weak acid			neutral			weak alkali				strong alkali	

NEUTRALISATION

acid + alkali ——> salt + water

ionically $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$

SALT formed **depends on** the **METAL** in the alkali and the **ACID**

- **hydrochloric acid** produces a **chloride**
- **nitric acid** produces a **nitrate**
- **sulphuric acid** produces a **sulphate**

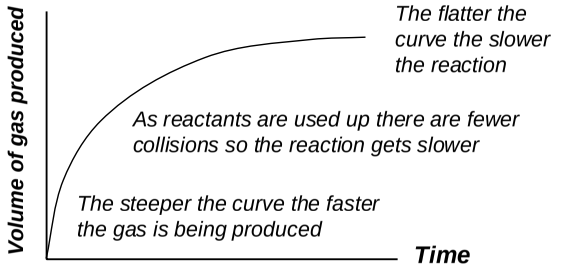
RATE OF REACTION

- this is a measure of how fast a reaction is going
- reaction rate must be controlled for safety and economy
- for a reaction to occur, reactants molecules must collide

COLLISION THEORY

Particles must collide before a reaction can take place
Reactants must also have a minimum amount of energy

- TO **INCREASE** THE RATE OF A REACTION ...
  - **Increase the concentrations** *more collisions*
  - **Increase the temperature** *more energy*
  - **Reduce size of solid particles** *more collisions*
  - **Add a catalyst** *less energy required*
- TO **FOLLOW** THE RATE OF A REACTION...
  - weigh the reaction mixture and note any change in mass
  - observe the formation of a precipitate
  - observe the formation or disappearance of a colour
  - collect a gas and measure its volume (see graph below)



CATALYSTS

- **speed up chemical reactions** BUT are **not used up**
- examples ammonia manufacture **iron**
  sulphuric acid manufacture **vanadium(V) oxide**

Calculations

Relative atomic mass	The mass of an atom relative to the masses of other atoms
Relative formula mass	Sum of the relative atomic masses of all the atoms in a compound
YIELD	The mass of product obtained
PERCENTAGE YIELD	The mass you get as a percentage of what you ought to get (percentage yield)