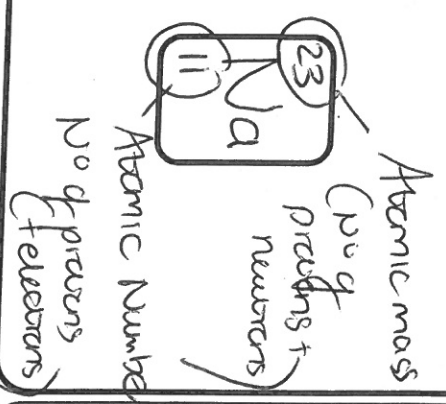


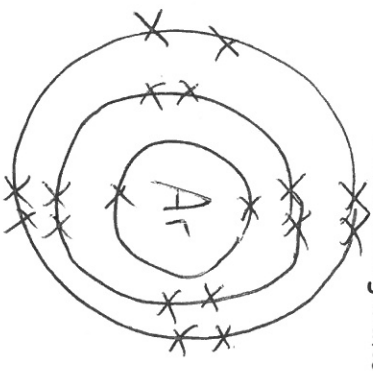
Draw the symbol for sodium include its atomic mass and atomic number (what do they tell us?)



Why do atoms contain equal number of protons and electrons?

Because atoms have no overall charge so the No of protons + electrons cancel each other out  
 Where are electrons and neutrons and protons found in an atom?  
 Electrons - shells around nucleus  
 Protons + Neutrons - in the nucleus.

Draw the electronic configuration for argon



How has the Dalton model of the atom changed over time?  
 Dalton - Solid spheres - couldn't be broken down.  
 -> Then discovered subatomic particles

Calculate the number of protons, neutrons and electrons these atoms have:

**Be**<sup>9</sup><sub>4</sub>      P = 4  
                   E = 4  
                   N = 5

**K**<sup>39</sup><sub>19</sub>      P = 19  
                   E = 19  
                   N = 20

What are the charges and masses of electrons, protons and neutrons

	Charge	Mass
Proton	+1	1
Neutron	0	1
Electron	-1	1/1835 (6)

[H] Chlorine has 2 isotopes. 75% is Cl<sup>35</sup><sub>17</sub> and 25% is Cl<sup>37</sup><sub>17</sub>. Calculate the relative atomic mass of Chlorine. Give your answer to 1dp.

$$\begin{aligned}
 & 100 \\
 & = \frac{75 \times 35}{100} + \frac{25 \times 37}{100} \\
 & = 2,625 + 925 \\
 & = 35.5 = \text{relative atomic mass.}
 \end{aligned}$$

Draw and label the nuclear model of the atom

mostly empty space  
 nucleus containing the protons + neutrons  
 electrons in shells

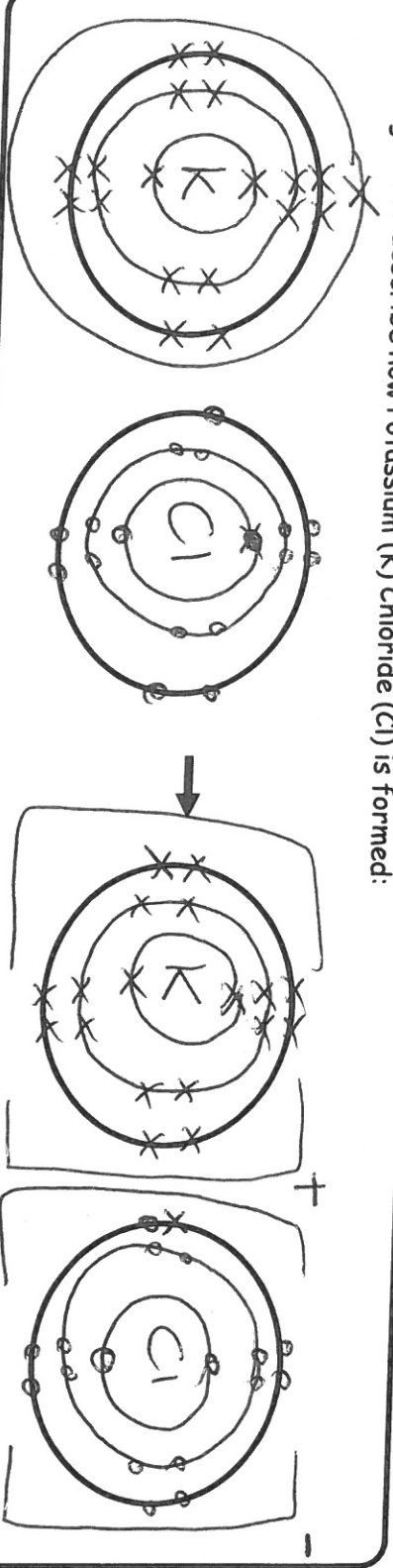


# IONIC BONDING

CCS

pg 83 - 84

Use a diagram to describe how Potassium (K) Chloride (Cl) is formed:



Give the electronic arrangement and charge of:

- a) A Sodium ion  $Na^+ [2, 8]^+$
- b) A Chloride ion  $Cl^- [2, 8, 8]^-$
- c) An Oxide ion  $O^{2-} [2, 8]^{2-}$
- d) A Boron ion  $B^{3+} [2]^{3+}$

Describe what happens when Oxygen and Magnesium react to form an ionic bond

Magnesium loses 2 electrons  $\rightarrow Mg^{2+}$   
 Oxygen atom gains 2 electrons to form an oxide ion  $O^{2-}$   
 $MgO$

What is an ionic bond and how is it formed?

The transfer of electrons between atoms to produce cations + anions

Explain why a Calcium ion has a charge of 2+

It is in group 2 - so has 2 outer electrons. It needs to lose these 2 electrons to get a full outer shell.

Complete the table by giving the name and formula of the ionic compound formed

Cations	Anions		
	Chloride $Cl^-$	Oxide $O^{2-}$	Iodide $I^-$
Sodium $Na^+$	NaCl Sodium Chloride	$Na_2O$ Sodium oxide	NaI Sodium iodide
Barium $Ba^{2+}$	$BaCl_2$ Barium Chloride	BaO Barium oxide	$BaI_2$ Barium iodide
Calcium $Ca^{2+}$	$CaCl_2$ Calcium chloride	CaO Calcium oxide	CaI <sub>2</sub> Calcium iodide
Aluminium $Al^{3+}$	Aluminium chloride $AlCl_3$	Aluminium oxide $Al_2O_3$	Aluminium iodide $AlI_3$
			Hydroxide $OH^-$
			NaOH Sodium hydroxide
			$Ba(OH)_2$ Barium hydroxide
			Calcium hydroxide $Ca(OH)_2$
			Aluminium hydroxide $Al(OH)_3$

What is an ion?

An atom with a positive or negative charge

How many protons, neutrons and electrons do the following ions have?

- $Li^+$  P=3, E=2, N=4  $\rightarrow$  lost 1
- $F^-$  P=9, E=10, N=10  $\rightarrow$  gained 1
- $O^{2-}$  P=8, E=10, N=8  $\rightarrow$  gained 2
- $Al^{3+}$  P=13, E=10, N=14  $\rightarrow$  lost 3

# IONIC COMPOUNDS

CCS Pg 85

Which types of elements carry out ionic bonding?

metals + non-metal elements

Compound	Melting point (°C)	Soluble in water?	Conducts electricity when molten
A	2072	No	Yes <i>metals</i>
B	191	No	No
C	782	Yes	Yes
D	605	Yes	Yes
E	150	Yes	No

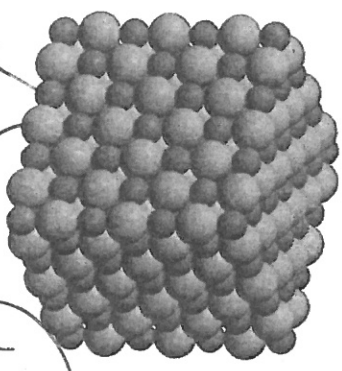
Identify the compounds from the table that have ionic bonding and explain your reasoning

C + D - soluble in water + conducts when molten

How do you know the other compounds do not have ionic bonding?

They do not dissolve in water + cannot conduct when molten

Label the ions in this giant ionic lattice of Sodium Chloride (NaCl). Include which is the anion and cation and the charge on each ion



Why do ionic compounds have high melting and boiling points?

- Strong electrostatic forces (+/-) of attraction which require large amounts of energy to break.

What forces of attraction hold the ions together in a giant ionic lattice?

Strong electrostatic forces of attraction

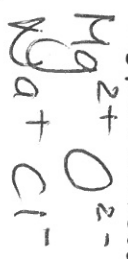
Why can a solid ionic compound not conduct electricity?

The ions cannot move so cannot carry the charge

Why can a molten or dissolved ionic compound conduct electricity?

The ions are free to move and carry the charge.

[H] Why does Magnesium Oxide (MgO) have a higher melting and boiling point than Sodium Chloride (NaCl)?



Stronger electrostatic forces of attraction with  $\text{Mg}^{2+} \text{O}^{2-}$

Difficult, compound, gaining, ionic, losing, new, noble

When two different elements react together they make a new substance called a compound. It is difficult to separate the elements after the reaction. Some atoms react by losing or gaining electrons. We call this ionic bonding. When atoms react in this way they get the electronic structure of a noble gas.

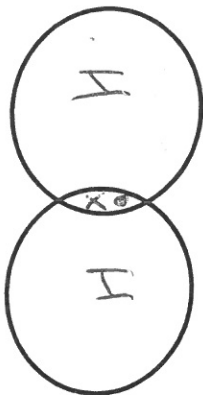
# COVALENT BONDING AND SIMPLE COVALENT MOLECULES

pg 50

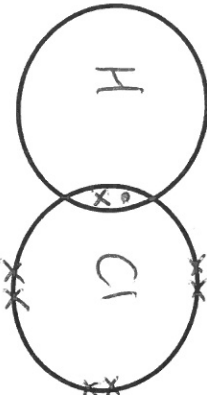
CC6 / CC7

Complete the electron shell diagrams to represent the bonding in the following molecules:

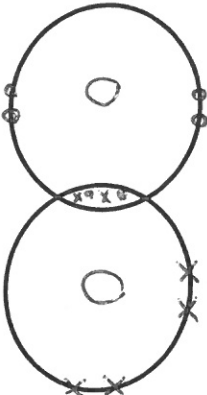
Hydrogen ( $H_2$ )



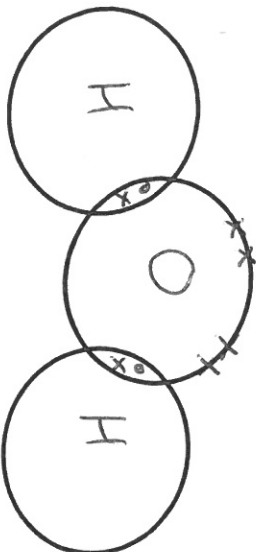
Hydrogen Chloride ( $HCl$ )



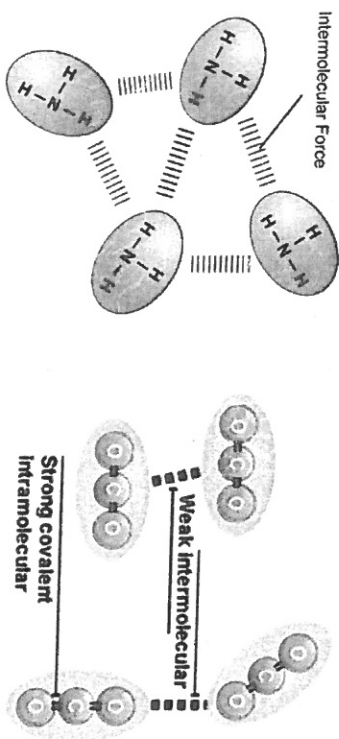
Oxygen ( $O_2$ )



Water ( $H_2O$ )



The majority of covalent molecules are simple covalent molecules like the ones of the left hand side between simple covalent molecules



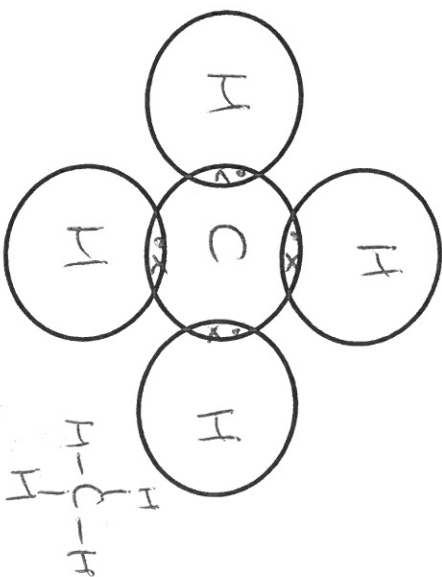
Explain in terms of intermolecular forces why simple covalent molecules have low melting and boiling points

*Weak intermolecular forces between the molecules which are easily overcome*

Explain why simple covalent molecules do not conduct electricity

*No charges - no free electrons or ions*

Complete the electron shell diagram to represent the bonding in methane ( $CH_4$ )



Do you think methane is a solid, liquid or gas at room temperature?

*gas*

*Why? Low boiling point due to weak intermolecular forces between molecules*

*Covalent, difficult, compound, new, noble*  
When two different elements react together they make a *new* substance called a *compound*. It is *difficult* to separate the elements after the reaction. Some atoms react by sharing electrons. We call this *covalent* bonding. When atoms react in this way they get the electronic structure of a *noble* gas.

# Graphene covalent substance ALLOTROPES OF CARBON

CC7

pg 87

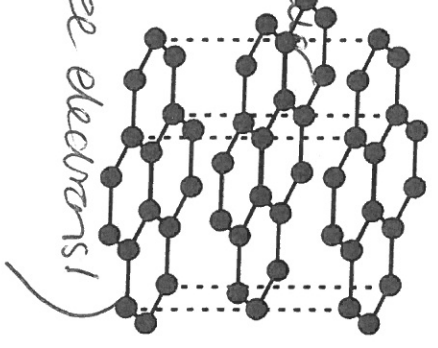
The diagram below shows the structure of graphite

Describe the structure of graphite

- 3 covalent bonds
- layers with weak intermolecular forces between them

Why is graphite used to make electrodes?

Graphite can conduct (free electrons)



Why is graphite used to make lubricants?

Weak intermolecular forces so layers can slide easily over one another.

How are diamond and graphite similar?

Both giant covalent substances, strong covalent bonds, high m.p./boiling points, not soluble in water.

How are diamond and graphite different?

Diamond - 4 covalent bonds  
Graphite - 3 covalent bonds - can conduct electricity

Describe the structure of a polymer

Made of covalently bonded carbon chains eg poly(ethene) monomers join together to form a polymer.

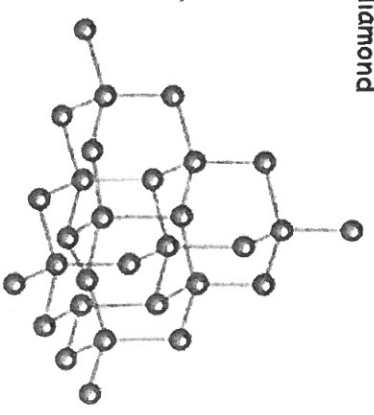
The diagram below shows the structure of diamond

Describe the structure of diamond

- 4 covalent bonds
- rigid lattice structure
- hard

Why is diamond used in cutting tools?

Hard - 4 v. strong covalent bonds



Describe the differences between simple covalent molecules and giant covalent molecules

Simple - carbon only a few atoms - low m.p./b.p. / don't conduct  
Giant - much bigger - high m.p./b.p. - graphite can conduct

Describe the structure of graphene

A type of fullerene - one layer of graphite. Sheets of carbon atoms joined together in hexagons are carbon made - making it a

Describe the structure of a fullerene

molecules of carbon / closed tubes or hollow balls.  
C60 - sphere of carbon atoms / used for drug delivery / large surface area.

# CALCULATIONS INCLUDING MASSES

CC9 pg 89 - 95

Calculate the relative formula mass ( $M_r$ ) of:

Copper oxide (CuO).

Relative atomic masses: O = 16, Cu = 64

$$64 + 16 = 80$$

Sulfuric acid ( $H_2SO_4$ ).

Relative atomic masses: H = 1, S = 32, O = 16

$$(2 \times 1) + 32 + (4 \times 16)$$

Ammonia ( $NH_3$ ).

Relative atomic masses: N = 14, H = 1

$$14 + (3 \times 1) = 17$$

Calculate the concentration in  $g/dm^3$  for:

1. 50 g of sodium chloride in 2.5  $dm^3$  of water

$$conc = \frac{mass}{vol} = \frac{50}{2.5} = 20 g/dm^3$$

2. 1.8g of sodium carbonate in 862  $cm^3$  of water

$$conc = \frac{1.8}{0.862} = 2.1 g/dm^3$$

Calculate the mass of potassium bromide (KBr) dissolved in 200  $cm^3$  of water with a concentration of 1.5g/ $dm^3$

$$mass = conc \times vol$$

$$= 1.5 \times 0.2 dm^3$$

$$= 0.3 g$$

14.3g of an oxide of copper contained 12.7g of copper  
Calculate the empirical formula of this oxide  
Relative atomic masses: Cu = 63.5, O = 16



Mass:	12.7g	1.6g
Mr:	63.5	16
Moles:	$\frac{12.7}{63.5} = 0.2$	$\frac{1.6}{16} = 0.1$
Ratio:	$\frac{0.2}{0.1} = 2$	$\frac{0.1}{0.1} = 1$
Empirical formula:		

In an experiment to determine the empirical formula of magnesium oxide, 0.63g of magnesium combined with 0.42g of oxygen.  
Calculate the empirical formula of the magnesium oxide.  
Relative atomic masses: Mg = 24, O = 16



Mg	O
0.63g	0.42g
$\frac{0.63}{24} = 0.02625$	$\frac{0.42}{16} = 0.02625$
1	1

When calcium carbonate is heated it thermally decomposes into calcium oxide and carbon dioxide.



Calculate the maximum mass of calcium oxide that could be formed from 1.5g of calcium carbonate.

(relative masses: Ca = 40, C = 12, O = 16)

$$1.5g$$

$$SF \frac{1.5}{100} = 0.015$$

$$\frac{40 + 12 + (16 \times 3)}{100g} \rightarrow 40 + 16$$

$$= 56g$$

$$0.84g$$

0.50g of sodium chloride is mixed with water to make 25  $cm^3$  of solution.  
Calculate the mass of sodium chloride in 10  $cm^3$  of solution

$$0.5g \rightarrow 25 cm^3$$

$$0.02g \rightarrow 10 cm^3$$

[H] 34.5g of nitrogen dioxide is provided in a sample.  
Calculate the number of nitrogen dioxide molecules,  $NO_2$ , in this sample.

(relative atomic masses: O = 16.0, N = 14.0)  
Avogadro constant =  $6.02 \times 10^{23} mol^{-1}$

no of molecules = moles x avogadro

$$moles = \frac{mass}{Mr}$$

$$= \frac{34.5g}{46}$$

$$= 0.75$$

$$= 0.75 \times 6.02 \times 10^{23}$$

Complete and balance the following chemical equations and state what has been oxidised and what has been reduced:

A more reactive halogen will displace a less reactive one



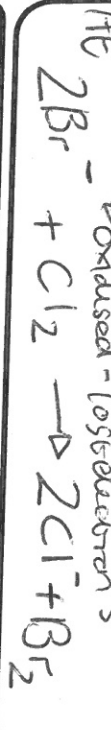
oxidation → reduction  
The more reactive halogens



B-  $\text{no color change observed}$



At  $2\text{Br}^- + \text{Cl}_2 \rightarrow 2\text{Br}^- + \text{Cl}_2$



Explain in terms of electronic structure why Fluorine is the most reactive element in group 7

As you go down the group the elements are less reactive because it is harder to attract the extra electron as the atomic radius is bigger

Explain in terms of electronic structure why Francium is the most reactive element in group 1

As you go down the group - the more reactive the metal. They are bigger and so lose their outer electrons more easily as the distance from the nucleus is less. The halogen gains electrons / The halide ion loses electrons

Describe the chemical test for Chlorine gas

Damp blue litmus paper goes white (may get red first)

Describe the properties of halogen halides

low m.p + b.p (increase as you go down the group)  
Reactivity decreases

Group 0: Describe the physical properties:

b.p + m.p + density all increase as you go down the group  
non-flammable  
Describe and explain the chemical properties:

Inert, colorless gases  
no atomic full outer shell of electrons

Group 1: Describe the properties:

Soft low m.p  
reactivity increases as you go down the group  
Describe the reactions with water:  
Lithium + water → lithium hydroxide + hydrogen  
 $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$   
friz + K ignites

Group 7: Describe the physical properties:

Chlorine - green gas  
Bromine - red brown liquid  
Iodine - dark grey solid  
The Halogens can react with metals + hydrogen

As you go down the group.



# RATES OF REACTION

CC 14

pg 128-133

What do we mean by 'rate of reaction'?

a measure of how fast the reaction happens

What factors affect the rate of a reaction?

1. Temperature
2. Concentration
3. Surface area
4. Pressure
5. Catalyst

What must happen for a reaction to occur?

1. Particles must collide

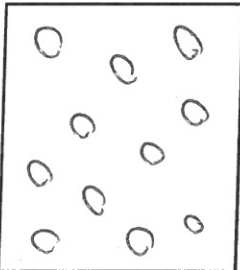
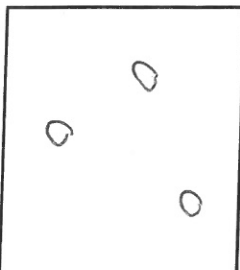
2. With at least the activation energy  
What is the smallest amount of energy that must be overcome for a reaction to occur?

activation energy

Explain the effect of concentration on the rate of reaction

The higher the concentration the faster the rate of reaction. There are more particles in the same volume resulting in increased frequency of collisions

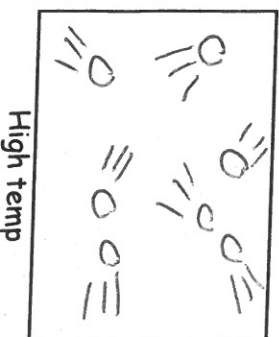
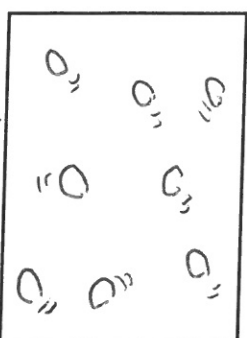
Draw diagrams to represent it:



Explain the effect of temperature on the rate of reaction

The hotter it is the faster the rate of reaction. Particles have more energy + speed resulting in more successful collisions

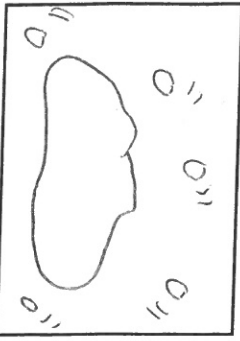
Draw diagrams to represent it:



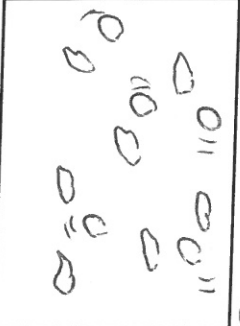
Explain the effect of surface area on the rate of reaction

Having a large s.a to volume ratio increases the rate of reaction as the particles around it will have more area to work on so the frequency of collisions increases

Draw diagrams to represent it:



Small surface area



Large surface area

Why does increasing the pressure increase the rate of reaction?

The higher the pressure, the faster the rate of reaction. There are more particles in the same volume resulting in increased frequency of collisions

What do catalysts do?

Increase the rate of a reaction (without being used up). They decrease the activation energy. What happens to them during a reaction? They aren't using up or chemically changed

frequency of collisions  
Energy of activation collide frequently minimum

Particles can react with each other only when they collide with sufficient energy.

Reaction rates increase when collisions are more energetic and/or happen more frequently. The

minimum amount of energy needed for particles to react is known as the activation energy.

# HEAT ENERGY CHANGES IN CHEMICAL REACTIONS

CC15 pg 134

What is an exothermic change?

gives out energy to the surroundings (rise in temperature)  
What is an endothermic change?

takes in energy from the surroundings (fall in temperature)  
Breaking bonds is endothermic

Making bonds is exothermic

Overall a heat energy change for a reaction is exothermic if:

it is a negative energy change

Overall a heat energy change for a reaction is endothermic if:

it is a positive energy change

The energies of some bonds are shown in Figure 13.

bond	energy of bond / kJ mol <sup>-1</sup>
H-H	436
Cl-Cl	243
H-Cl	432

Figure 13

Hydrogen reacts with chlorine to form hydrogen chloride.  
Energy in - energy out



Calculate the energy change, in kJ mol<sup>-1</sup>, for the reaction of 1 mol of hydrogen gas, H<sub>2</sub>, with 1 mol of chlorine gas, Cl<sub>2</sub>, to form 2 mol of hydrogen chloride gas, HCl.

more heat energy is released in forming bonds than breaking bonds

less heat energy is released in forming bonds than breaking bonds

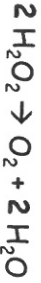
Bond Breaking  
436 + 243  
= 679 kJ/mol

679 kJ/mol

Bond making  
H-Cl  
H-Cl  
432 x 2  
= 864 kJ/mol

679 - 864  
= -185 kJ/mol

Hydrogen peroxide decomposes as shown:



Calculate the energy change for the reaction

Bond	Energy (kJ)
H-O	464
O-O	146
O=O	498

Bond breaking

$$464 \times 4 (1856)$$

$$+ 2 \times 146 (292)$$

$$= 2148 \text{ kJ/mol}$$

Bond making

$$498$$

$$+ 4 \times 464 (1856)$$

$$= 2354 \text{ kJ/mol}$$

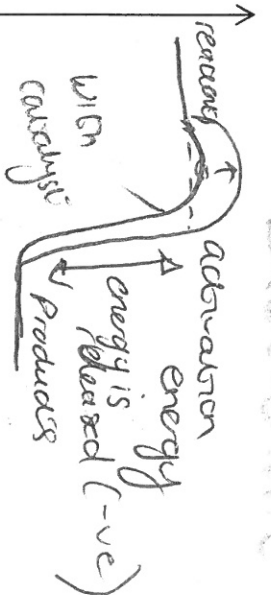
$$= \text{energy in} - \text{energy out}$$

$$= 2148 - 2354$$

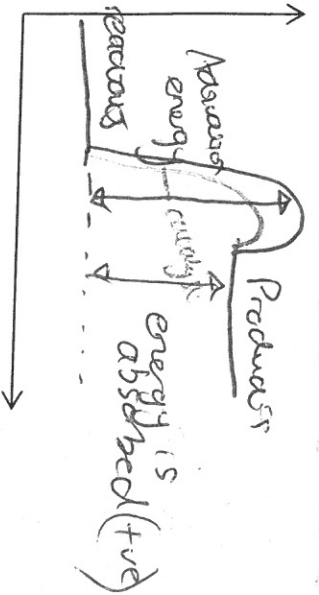
$$= -206 \text{ kJ mol}^{-1}$$

Sketch an energy change graph for each of the following and explain the energy changes taking place:

Endothermic



Exothermic:



On both diagrams

- Label the activation energy
- Draw and label the reaction pathway if a catalyst was used

Give an example of an exothermic reaction

displacement reactions + precipitation reactions

Give an example of an endothermic reaction

some neutralisation / some salt-dissolving in water



# EARTH AND ATMOSPHERIC SCIENCE

CC 17 pg 141 - 143

Gases produced by volcanic activity formed the early Earth's atmosphere.  
What was the composition of the Earth's early atmosphere?

Carbon dioxide  
Water vapour  
Methane  
Ammonia  
Hydrogen oxygen

How has the amount of carbon dioxide in the atmosphere reduced since the levels in the early atmosphere?

1. Photosynthesis -  $CO_2$  taken in
2. Trapped in sedimentary rocks as carbonates
3. Dissolved in the oceans

How have humans increased the levels of carbon dioxide and methane in the atmosphere?

↑ levels of  $CO_2$  + methane generated by human activity  
- burning fossil fuels  
- livestock farming  
- Base effects may be

What happened to the water vapour in the atmosphere as the Earth cooled?

Cooled + condensed to form oceans

What caused the levels of oxygen in the atmosphere to increase?

Plants used carbon dioxide + water to photosynthesise +  $O_2$  released oxygen.

Describe the chemical test for oxygen

relights a glowing splint

What evidence is there that humans have caused climate change?

- change in  $CO_2$  conc
- consumption of fossil fuels
- temperature change.

Why do some question the certainty of this?

caused by the location where measurements are taken + historical accuracy  
Go back for enough reference

Name the gases in the Earth's atmosphere that contribute to global warming

Carbon dioxide  
Methane  
water vapour

Explain what the greenhouse effect is and describe how these gases contribute to it

These gases absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm. This is known as the greenhouse effect.

Describe the potential effects on the climate of increased levels of carbon dioxide and methane

mitigation (lessen) - avoid, track, reduce, adapt, prepare, recover