Chem Start

Pre-Course Workbook

Name…………………......

Please complete the exercises in the booklet. This will need to be handed in during your **Second lesson** in A Level Chemistry

Equipment needed for the course:

- Black, Red and Green Pens
- A4 Notebook – lined paper, 2 or 4 hole punched
- A4 ring binder or similar for use in lessons
- A4 lever arch file – for storing notes at home
- Scientific Calculator
- 30 cm ruler
- Pencil and sharpener

Introduction

Firstly, welcome to Chemistry at Wyke.

This booklet has been prepared to help you make the transition from GCSE to A-level. There are summary notes for the topics at GCSE which will be key to A-level study and short exercises with answers provided at the back. These cover all parts from the AQA Combined Science: Trilogy [double award], as well as the Separate Chemistry course [part of the triple award]. We recognise that you will come from a variety of Science backgrounds and we have plenty of support available to help you all to have a successful time at Wyke. You might find this site useful too, http://www.chemguide.co.uk, it explains some things very well and may help you with unfamiliar sections.

Exercise 10 is a short exercise based on the work in the Wyke Start "Shapes" lesson. There is also an online version of this lesson available at https://www.youtube.com/watch?v=QLLCJAOO_i4&t=6s. Answers are not provided for this exercise as this section will be marked during your first week at Wyke.

At the end of the booklet is a set of GCSE exam questions and a mark scheme. When you have finished the booklet you should complete these questions and then mark them using the mark scheme. Record your mark in the space below.

You should bring this booklet to your second lesson. In this lesson you will have an assessment based on the work you did at GCSE. This is to allow you (and us) to find out what you can remember and what you may have forgotten over the summer. We have weekly support sessions in place to assist with any areas where you may need help.

We look forward to seeing you at Wyke.

Have a good summer.

Paul, Sarah, Laura and Jo.

Quotes from Students

'The progress I have made from GCSE to A Level in Chemistry is more than I could have imagined and thanks to the Chemistry Department at Wyke they have made it an easy and fun transition.'

Connor - Heading to Cambridge University to study Natural Sciences

'I have enjoyed my time studying Chemistry at Wyke, it is a challenging subject that requires a lot of time and effort but gives a great deal of satisfaction upon completion.'

Dan - Heading to Bangor University to study Zoology

Mark for exam question section
/ 71

Atomic Structure and Bonding

Atoms, Molecules and Ions.

AN ATOM is the smallest particle of an element. They cannot be split into smaller particles in chemical reactions. Iron is made of iron atoms (Fe). Sulphur is made of sulphur atoms (S)

A MOLECULE is a small group of atoms joined together.
The atoms may be the same (e.g. O_2) or different (e.g. H_2O). The chemical formula shows the number and type of atoms present. Non-metal compounds are made of molecules:

Carbon dioxide contains CO_2 molecules
Methane (natural gas) contains CH_4 molecules

AN ION is an atom or group of atoms with an electrical charge (+ or -). Metal compounds such as sodium chloride or copper sulphate contain ions.

Sodium chloride is made of Na^+ and Cl^- ions
Magnesium Oxide is made of Mg^{2+} and O^{2-} ions
Note that metals form positive ions while non-metals form negative ions.

A solid is represented by (s). e.g. $H_2O_{(s)}$ is ice.
A liquid is represented by (l) e.g. $Fe_{(l)}$ is molten iron.
A gas is represented by (g) e.g. $H_2O_{(g)}$ is steam.
A solution in water is represented by (aq). Salt dissolved in water is $NaCl_{(aq)}$.

You should remember that the common gases are diatomic (have 2 atoms in each molecule). These are Oxygen O_2; Hydrogen H_2; Nitrogen N_2; and the halogens.

Elementary Particles

Atoms are made up of smaller particles called protons, neutrons and electrons.
The protons and neutrons cluster together in a small nucleus at the centre of the atom while the electrons orbit the nucleus.

The main properties of the particles are:

Particle	Mass	Charge
PROTON	1	+1
NEUTRON	1	0
ELECTRON	Very Small	-1

Every element has an atomic number, which is the number of protons in the nucleus.
Atoms are neutral, so that the number of electrons is the same as the number of protons.
The mass of an atom is almost entirely made up of protons and neutrons, which have the same mass as each other (the mass of electrons can be ignored).

23.0 ← Atomic Mass

Na

Chemical Symbol →

Sodium
11 ← Atomic Number
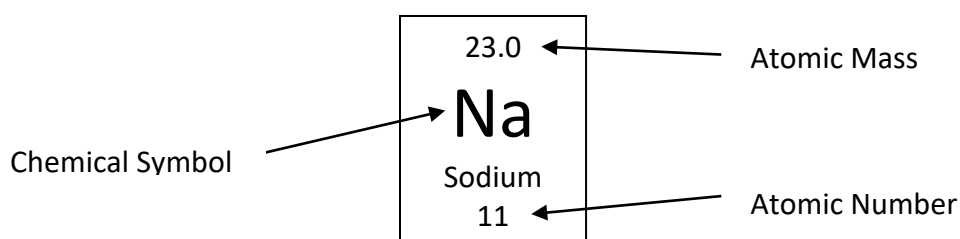
Electron Structure

The electrons orbit the nucleus in 'shells'. These can hold the following numbers of electrons:
The innermost shell can contain up to 2 electrons
The next shell can contain up to 8 electrons
The next shell can contain up to 8 electrons (although this can be expanded up to 18)
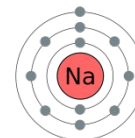
11: Sodium   2,8,1

Fluorine has atomic number 9. Its electronic structure is 2.7
Sodium has atomic number 11. Its electronic structure is 2.8.1
Calcium has atomic number 20. Its electronic structure is 2.8.8.2

Ionic and Covalent Bonding

Elements have a tendency to change their electronic structures to become more like noble gases and therefore more stable. They can do this by losing, gaining or sharing electrons.

Ionic Bonding

1. Ionic bonding takes place between a metal and a non-metal.
2. The metal atoms lose their outer shell electrons to form positive ions.
3. The non-metal atoms gain these electrons to fill their outer shells and form negative ions
4. The positive and negative ions attract each other in a lattice

Covalent Bonding

1. Covalent bonds are formed between 2 non-metallic elements.
2. The atoms share electrons in order to complete their outer shells.
3. The atoms all attain noble gas structure (complete outer shells).
4. The new particles formed are neutral molecules.

Electron is given away

Atom with spare electron   Needs an electron to become stable

Shared Electrons
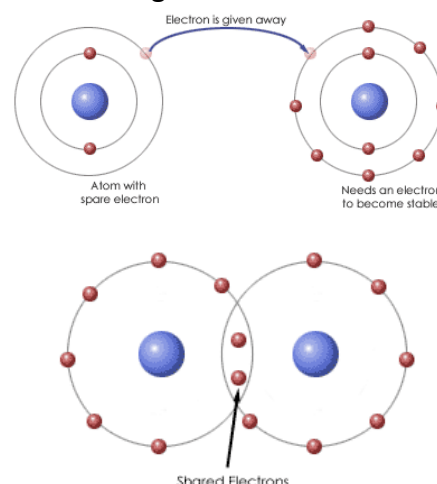
Exercise 1 - Atomic Structure and Bonding

1. Complete the following table:

Particle	Mass	Charge
PROTON		
NEUTRON		
ELECTRON		

2. An element appears in the periodic table as:

27.0

Al

Aluminium
13

a) What is the mass number of this element?   _____

b) How many electrons does this element have?   _____

c) How many neutrons does this element have?   _____

d) What is the electronic structure of this element?   _____

Structures of Substances

There are 4 main structures which substances can have. These are known as:
SIMPLE MOLECULAR, GIANT COVALENT, GIANT IONIC and GIANT METALLIC

Simple Molecular

Simple molecular substances have small molecules, such as H_2O or CO_2 . The atoms in these molecules are held together by strong forces called covalent bonds, but there are only very weak forces between the molecules. This means:
    1) They have low melting and boiling points (many are liquids or gases).
    2) They tend to be soft and/or have little strength.
    3) They do not conduct electricity
Simple molecular substances are nearly always non-metallic elements or their compounds.
e.g. Water (H_2O), Iodine (I_2), Carbon dioxide (CO_2), Sugar ($C_{12}H_{22}O_{11}$).

Giant Covalent Substances

In these substances, strong covalent bonds join atoms together in large numbers to make giant structures. Sand (silicon dioxide), diamond and graphite (both forms of carbon) are examples.
Diamond has a 3 dimensional structure where each carbon is bonded to 4 others. Diamond is extremely hard, does not dissolve and does not conduct electricity.
Graphite has a layer structure. In each layer the carbons are bonded to 3 other carbon atoms. The layers can slip over each other making graphite soft and slippery (it is used in pencil leads)
Silicon Dioxide is similar to diamond in the arrangement of its atoms.

Metals

Metals have atoms in layers. These layers can slide over each other so that metals can be bent or shaped. Metals are also strong and hard. Metallic bonding involves positive ions in a sea of delocalised electrons.

Giant Ionic Structures

Compounds of metals, such as sodium chloride (NaCl) or copper sulphate ($CuSO_4$) are made up of positive metal ions (e.g. Na^+) and negative non-metal ions (e.g. Cl^-).
The ions are arranged in a regular lattice so positive and negative ions are arranged alternately in 3 dimensions.
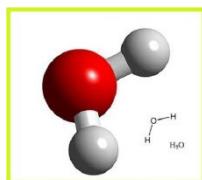   1) They have high melting and boiling points.
    2) They are hard but brittle (shatter easily)
    3) They conduct electricity *only when melted or dissolved in water.*
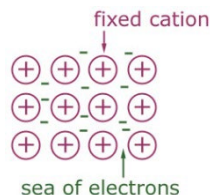   4) Many ionic substances are soluble in water.

Exercise 2 - Bonding

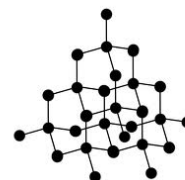What type of bonding is represented by the following diagrams:
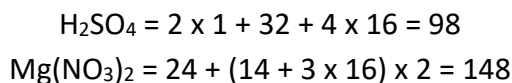
a) _____   b) _____   c) _____   d) _____

Calculations Summary
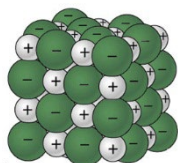
Formula masses (A_r and M_r)

The A_r is the relative atomic mass from the periodic table. The A_r values of the atoms in a formula are added to get the formula mass or M_r

$$H_2SO_4 = 2 \times 1 + 32 + 4 \times 16 = 98$$
$$Mg(NO_3)_2 = 24 + (14 + 3 \times 16) \times 2 = 148$$

Percentage Calculations

If you need to find the percentage of an element E in a compound, you use formula

$$Percentage\ of\ E = \frac{A_r\ of\ E\ \times No.of\ atoms\ of\ E}{M_r\ of\ compound} \times 100$$

e.g. Find the percentage of nitrogen in ammonium nitrate (NH_4NO_3)

a) M_r of N = 14
b) No. of N atoms = 2
c) M_r of ammonium nitrate = 14 + 4 x 1 + 14 + 3 x 16 = 80

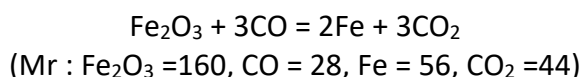$$Percentage\ of\ N = \frac{14\ \times 2}{80} \times 100 = 35\%$$

Atom Economy

This is given as:

$$Atom\ Economy = \frac{Mass\ of\ all\ molecules\ of\ Useful\ Product}{Mass\ of\ all\ molecules\ of\ reactants} \times 100$$

Eg. Atom economy for making iron from the equation

$$Fe_2O_3 + 3CO = 2Fe + 3CO_2$$
$$(Mr : Fe_2O_3 = 160, CO = 28, Fe = 56, CO_2 = 44)$$

Mass of useful product (iron atoms) = 2 x 56 = 112
Mass of all reactants = 160 + (3x28) = 244

$$Atom\ Economy = \frac{112}{244} \times 100 = 45.9\%$$

Percentage Yield

To find the percentage yield, divide the mass obtained in an experiment by the maximum mass which could have been obtained and multiply by 100.

e.g. the maximum mass of alcohol which could be obtained by fermenting some sugar is 4.6g of alcohol. The actual mass obtained in an experiment was 3.5g. Find the % yield.

$$\%Yield = \frac{3.5}{4.6} \times 100 = 76\%$$

Exercise 3 - Calculations

1. Use a periodic table to calculate the relative atomic mass, M_r, of the following:

a) H_2O _____

b) HNO_3 _____

c) $Mg(OH)_2$ _____

c) $(NH_4)_2SO_4$ _____

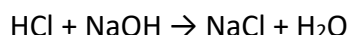2. Use a periodic table to calculate the following percentages:
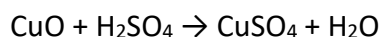
a) N in NH_3 _____

b) C in CH_3COOH _____

c) O in $Ba(OH)_2$ _____

d) Fe in $Fe_2(SO_4)_3$ _____

3. Calculate the atom economy for the production of sodium chloride in the following reaction:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

_____

_____

_____

_____

4. Calculate the atom economy for the production of copper sulphate in the following reaction:

$$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$$

_____

_____

_____

_____

5. The expected mass in a synthesis of aspirin was 2.61g. The actual mass produced was 1.03g. Calculate the percentage yield.

_____

_____

_____

Rates of Reaction

There are 4 main ways of controlling the rate of a reaction:

Catalysts

Catalysts are substances which increase the rate of chemical reactions without being chemically changed. They do this by providing a different route for the reaction with a lower activation energy. Enzymes are biological catalysts.

Examples of catalysts are:

NAME	PURPOSE
Aluminium Oxide	Cracking of Oil
Iron	Manufacture of ammonia

Catalysts are very valuable in chemical industry, since they can be reused and they provide a much cheaper way of speeding up a reaction than heating, so providing cheaper goods.

Temperature

Another way of controlling the rate of a reaction is by temperature. A rise of $10^{\circ}C$ will roughly double the rate of a reaction. This is because at higher temperature, the particles move faster, they therefore collide more often and with more energy. This makes the reaction faster.
Cooling down a reaction will make it slower, this means that food will deteriorate more slowly at low temperatures (e.g. in a fridge or freezer)
Remember that raising temperature does not make any difference to the amount produced, only to the speed of the reaction.

Concentration

The concentration of a solution is the amount of substance dissolved in a solution..
Reactions happen more quickly when concentrated solutions are used because the particles are closer and so are more likely to collide and react.

Pressure

When gases are at high pressure, their particles are closer, and so are more likely to collide and react.

Surface Area

Solids in powder form will react much more quickly than those in lump form. This is because the powder particles have much more surface area exposed to the other reactant. If a lump is used, only the outside of that lump can react.

Summary

If we take a reaction such as the reaction between zinc an sulphuric acid:

ZINC + SULPHURIC ACID → ZINC SULPHATE + HYDROGEN

The rate of this reaction can be measured by seeing how much hydrogen gas is given off in one minute. This rate can be increased by:

1) Raising the temperature of the reaction.
2) Using more concentrated sulphuric acid.
3) Using powdered zinc rather than lumps.
4) Adding some copper, which acts as a catalyst.

The rate of a reaction can be measured and followed on a graph, e.g.
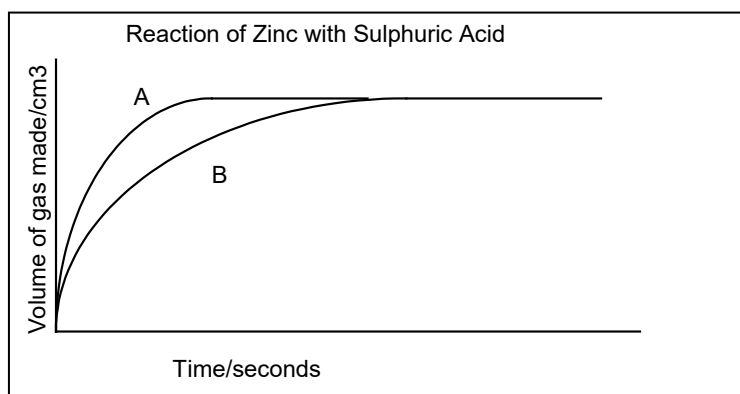
Curve A represents a reaction between powdered zinc and sulphuric acid, while curve B represents a reaction between lumps of zinc and the same amount of sulphuric acid. You should note:

a) That a steeper curve (A) represents a faster reaction.
b) That the curves start steeply, but then level off. This is because the concentration of the acid is high at the start of the reaction, but gets less as the acid is used up and eventually stops.
c) That the amount of gas made by the end of the reaction is the same as long as the amounts of reactants are the same. The rate of a reaction does not affect the final amount of product made.

Measuring the Rate of a Reaction

The rate of a reaction is defined as:

$$Rate = \frac{Amount\ of\ reactant\ used\ up\ \textbf{or}\ Amount\ of\ product\ formed}{Time\ taken}$$

A reaction can be followed in various ways, e.g. by seeing how much mass is lost in a certain time, or how much gas is produced in a certain time.

For instance, a number of similar experiments can be done under similar conditions, e.g. when reacting limestone with hydrochloric acid, different concentrations of hydrochloric acid could be used and the time taken to collect a boiling-tube of gas ($50cm^3$) could be compared.

Also, the rate of a reaction changes as it proceeds. When the reaction starts, the reactants are quite concentrated, but as it goes on, the reactants become less concentrated, and the reaction slows down and eventually stops.

The following reaction shows the thermal decomposition of Copper Carbonate:

$$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$$

1) Give two ways in which the rate of this reaction could be speeded up.

_____

_____

2) For each way of speeding up the reaction explain why the reactions would speed up.

_____

_____

_____

3) Describe how you would measure the rate of this reaction.

_____

_____

_____

Energy changes in reactions

Reactions which give out energy are called **Exothermic**. They cause the temperature to rise. Many reactions are exothermic, including all burning (combustion) reactions

$$e.g. \ 2Mg + O_2 \rightarrow 2MgO$$
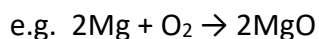
Reactions which take in energy are called **Endothermic**. They may cause the temperature to fall. Thermal decompositions are always endothermic

$$e.g. \ CaCO_3 \rightarrow CaO + CO_2$$
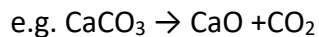
Some reactions require an initial input of energy to start the reaction (called the activation energy) but are exothermic. E.g. the match to light the fire.

Exothermic reaction

Endothermic reaction

Reversible reactions
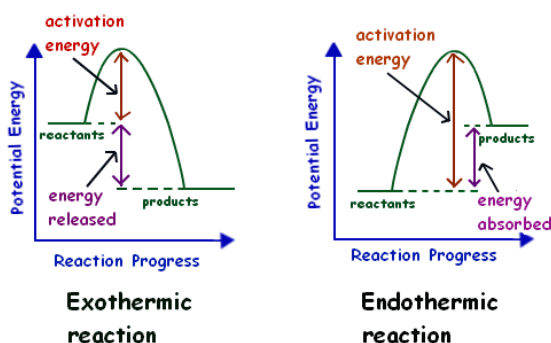
If a reaction is exothermic in one direction, it will be endothermic in the other direction and the amount of heat given out by the exothermic reaction will be equal to the amount of heat taken in by the endothermic reaction.

e.g. HYDRATED COPPER SULPHATE ↔ ANHYDROUS COPPER SULPHATE + WATER
(Blue)   (White)
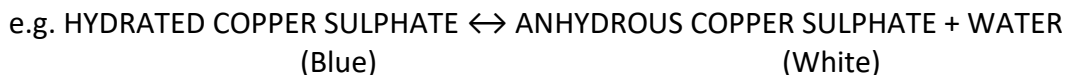
If the hydrated copper sulphate is heated, it turns white as the water is given off. This requires energy so the forward reaction is endothermic.

When water is added to anhydrous copper sulphate, it turns blue and heat is given out so the reverse reaction is exothermic. This reaction is sometimes used as a test for water.

In any industrial process it is necessary to minimise the amount of energy used. This makes the process cheaper, and does less harm to the environment. In general non-vigorous conditions should be used.

Energy Calculations

The energy produced by a reaction can be used to heat water. The energy gained by the water is the same as the energy given out by the reaction. We can calculate the energy gained by the water using the following equation:

$$Q = mc\Delta T$$

Q = the energy gained by the water
m = the mass of the water
c = the specific heat capacity of the water (usually taken as 4.2 J g^{-1} K^{-1})
ΔT = the temperature change of the water

e.g. A methanol burner is used to heat 50g of water. The temperature of the water raises by 20°C. The energy gained by the water can be calculated as follows.

$$Q = mc\Delta T = 50 \times 4.2 \times 20 = 4200\, J$$

The energy changes for a reaction are usually given per mole and have the symbol ΔH. We can calculate ΔH using the following equation when n is the number of moles:

$$\Delta H = \frac{-Q}{n}$$

Note the negative sign is used so that if Q is positive (i.e. the water has gained energy) then ΔH would be negative (the reaction is exothermic and has given out energy) and vice versa.

e.g. If in the example above 0.006 moles of methanol was burnt then the energy change per mole could be calculated by:

$$\Delta H = \frac{-Q}{n} = \frac{-4200}{0.006} = -700000\, J\, mol^{-1} = -700\, kJ\, mol^{-1}$$

Exercise 5 - Energy Calculations

1) A propane burner is used to heat 100g of water. The water temperature rises by 50⁰C.

a) Calculate the energy gained by the water.

b) If 0.01 moles of propane have been burnt what is the energy change per mole?

2) 200g of water are heated by 0.02 mol of ethanol. The temperature of the water rises by 28⁰C.

a) Calculate the energy gained by the water.

b) Calculate the energy change per mole of ethanol.

Electrochemistry

Conductors

Metals and graphite are the only solids which conduct electricity, but no chemical change is involved. Liquid (melted) metals also conduct, but again there is no chemical change.

Electrolytes

These are liquids which conduct electricity, and are decomposed by it. They are ionic substances which are dissolved in water or have been melted. This includes all acids and metal compounds.

Examples: Copper sulphate solution, iron chloride solution, molten sodium chloride, dilute sulphuric acid. Non-electrolytes are covalent substances, e.g. pure water, sugar solution, alcohol, petrol.
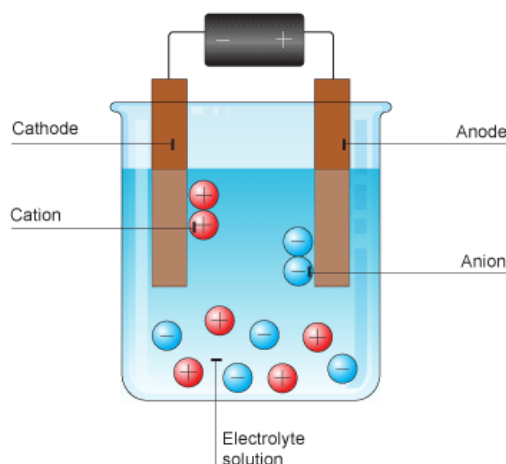
Electrolysis

This is when an electric current passes through an electrolyte.

Electrons enter the solution through the negative electrode (cathode), cause a chemical change and leave by the positive electrode (anode).

Molten electrolytes are split into their elements by electrolysis.
The metal is produced at the cathode (-),
while the non-metal is produced at the anode (+)

e.g.   Lead Bromide (molten) → Lead (at the cathode) + Bromine (at the anode)
           Aluminium Oxide (molten) → Aluminium (cathode) + Oxygen (anode)

With aqueous electrolytes, the electrolyte is also split up, but if the metal is reactive, then hydrogen from the water is produced at the cathode in place of the metal.

e.g.   Copper chloride (aq) = Copper (at the cathode) + Chlorine (at the anode)
           Sodium chloride (aq) = Hydrogen (at the cathode) + Chlorine (at the anode)

The lower in the reactivity table a metal is (including hydrogen), the more likely it is to be released at the cathode.

Electrolysis of Sodium Chloride Solution

When sodium chloride solution is electrolysed a number of useful products are formed.

1) Hydrogen is given off at the cathode. (cathode is -, hydrogen ions are +)
   (**Not** sodium as reactive metals cannot be released when solutions are electrolysed)
2) Chlorine is given off at the anode (anode is + chloride ions are -)
3) Sodium hydroxide is left in solution

Acids and alkalis

Acids

1) They are corrosive.
2) They have a pH of less than 7
3) They react with and neutralise bases.
4) They produce hydrogen (H^+) ions in water.

Examples:
Sulphuric acid	H_2SO_4
Hydrochloric acid	HCl
Nitric acid	HNO_3

Bases

1) Bases react with and neutralise acids.
2) Metal oxides and metal hydroxides are bases
3) ALKALIS are soluble bases
4) Alkalis produce OH^- ions in water.

Examples:

1) These are soluble and are therefore alkalis as well as bases:

Sodium hydroxide	NaOH
Calcium hydroxide	$Ca(OH)_2$
Ammonia	NH_3

2) These bases are insoluble:

|	
Magnesium oxide	MgO
Copper oxide	CuO

Salts

These are crystalline substances, generally compounds of metals. They are formed when an acid neutralises a base. The salt is formed when hydrogen in an acid is replaced by metal atoms.
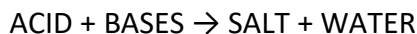
Sodium chloride	NaCl (A salt of hydrochloric acid, HCl)
Copper sulphate	$CuSO_4$ (A salt of sulphuric acid H_2SO_4)
Potassium nitrate	KNO_3 (A salt of nitric acid HNO_3)

The pH Scale
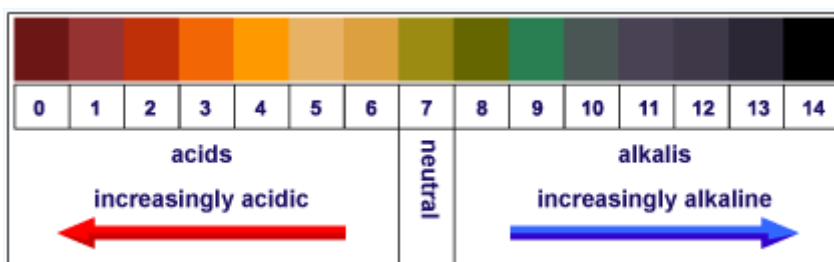
Reactions of acids

1) Acids react with and neutralise bases

$$ACID + BASES \rightarrow SALT + WATER$$

The name of the salt comes from the metal in the base and a word derived from the acid

- Sulphuric acid gives sulphates
- Nitric acid gives nitrates
- Hydrochloric acid gives chlorides

e.g. Sodium hydroxide + sulphuric acid $\rightarrow$ sodium sulphate + water

Ammonia reacts with acids to give ammonium salts such as ammonium nitrate. These are valuable fertilisers

2) Acids react with metals (except for the unreactive metals such as copper, silver and gold)

$$ACID + METAL \rightarrow SALT + HYDROGEN$$
e.g. Zinc + sulphuric acid $\rightarrow$ zinc sulphate + hydrogen

Neutralisation

To find out the neutralisation point for an acid-alkali reaction, various techniques can be used:

1) When Universal Indicator becomes pale green (pH7)
2) When a pH meter indicates that the pH is 7

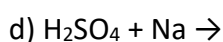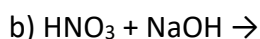Therefore when an acid reacts with an alkali, H+ ions from the acid react with OH- ions from the alkali to make water

$$H^+ + OH^- \rightarrow H_2O$$
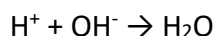
Exercise 6 - Acids and Bases

1) Would the following be above, below or equal to 7 on the pH scale?

a) H_2SO_4 _____   b) Water _____   c) KOH _____

d) NaO _____   e) NaCl _____

2) Complete the following reactions:

a) $HCl + KOH \rightarrow$

b) $HNO_3 + NaOH \rightarrow$

c) $HCl + Mg(OH)_2 \rightarrow$

d) $H_2SO_4 + Na \rightarrow$
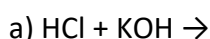
Titration

Concentration, volume and moles are linked by the following equation:

$$n = CV$$

n = number of moles
C = concentration (in mol dm^{-3})
V = volume (dm^3)

Remember that 1 dm^3 = 1000 cm^3

So to work out the number of moles in a 250 cm^3 solution of concentration 0.1 mol dm^{-3}:

$$n = CV = 0.1 \times \frac{250}{1000} = 0.025 mol$$

An unknown concentration of an acid or alkali can be determined by titration. An indicator is used to determine at which point neutralisation has been reached. Suitable indicators you may have come across are:

| Indicator	Colour in Acids	Colour in Alkalis
Methyl Orange	*Red*	*Orange*
Phenolphthalein	*Colourless*	*Pink*

Titration Calculations

The unknown concentration is worked out by titrating with a solution of known concentration. The following is an example question and answer.

25 cm^3 of sodium hydroxide solution requires 20 cm^3 of 0.1 mol dm^{-3} hydrochloric acid for neutralisation. What is the concentration of the sodium hydroxide?

Firstly work out the number of moles of acid added (remember volume should be in dm^3):

$$n = CV = 0.1 \times \frac{20}{1000} = 0.0020 mol$$

Next look at the balanced chemical equation:

$$HCl + NaOH \rightarrow NaCl + H_2O$$
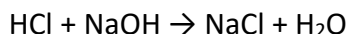
This tell us that 1 mol of HCl reacts with 1 mol of NaOH, so if 0.0020 mol of HCl was used then there must have been 0.0020 mol of NaOH.

Now the concentration of the sodium hydroxide can be worked out:

$$C = \frac{n}{V} = \frac{0.0020}{25/1000} = 0.08 mol$$
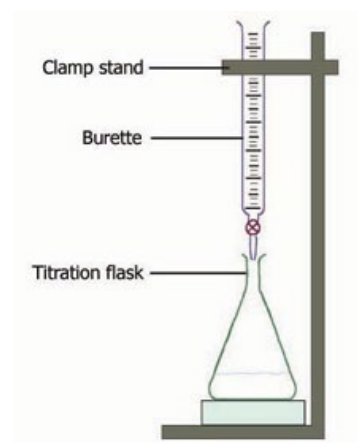
Exercise 7 - Titration Calculations

1) How many moles are there in 200 cm^3 of a 0.2 mol dm^{-3} solution.

2) If a 50 cm^3 solution contains 0.004 moles what is the concentration?

3) 25 cm^3 of sodium hydroxide solution requires 15 cm^3 of 0.2 mol dm^{-3} hydrochloric acid for neutralisation. What is the concentration of the sodium hydroxide?
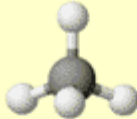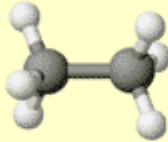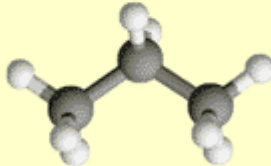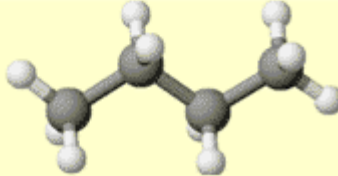
4) 20 cm^3 of potassium hydroxide solution requires 22.6 cm^3 of 0.1 mol dm^{-3} hydrochloric acid for neutralisation. What is the concentration of the potassium hydroxide?

5) 25 cm^3 of sodium hydroxide solution requires 10 cm^3 of 0.1 mol dm^{-3} sulphuric acid for neutralisation. What is the concentration of the sodium hydroxide? (Careful with balancing the equation here)

Organic Chemistry

Organic chemistry concerns molecules containing carbon. The carbon atoms are usually joined together in rings or chains and each carbon atom has four bonds.
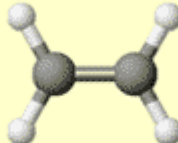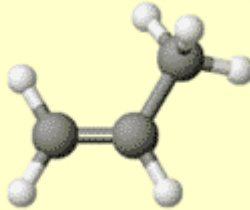
Alkanes

Alkanes just contain chains of carbon with the remaining bonds being to hydrogen atoms. Their names end with the letters -ane. The first part of the name depends on how many carbons are in the chain.

methane CH_4	H−C−H with H above and H below	(ball-and-stick model)
ethane C_2H_6	H−C−C−H with H atoms	(ball-and-stick model)
propane C_3H_8	H−C−C−C−H with H atoms	(ball-and-stick model)
butane C_4H_{10}	H−C−C−C−C−H with H atoms	(ball-and-stick model)

Alkenes

Alkenes are like alkanes but they contain a double bond so they are known as unsaturated hydrocarbons. Their names end with the letters -ene. Again, the first part of the name depends on how many carbons are in the chain.

ethene C_2H_4	C=C with H atoms	(ball-and-stick model)
propene C_3H_6	C=C with CH$_3$ group and H atoms	(ball-and-stick model)

Alcohols

Alcohols are organic molecules which contain an -OH group attached to the chain. Their names end with the letters -ol. The molecule shown below is propanol.
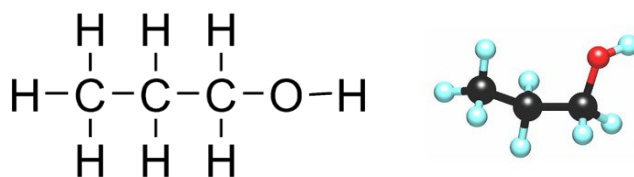
Carboxylic Acids

Carboxylic acids contain the functional group -COOH. Their names end with the letters -oic acid. The molecule shown below is ethanoic acid which is found in vinegar.
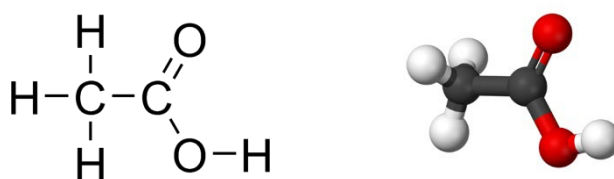
Exercise 8 - Organic molecules

Complete the following table (an example is given):

Name	'Family'	Displayed formula
Propane	Alkane	
Ethanol		
Propanoic acid		

Maths Skills

There are a number of maths skills that are required during the A Level Chemistry course. These include graph skills, use of logarithms, use of standard form, etc. To help you prepare for this the next pages and exercise covers 3 important skills: Use of significant figures, Converting units and Rearranging equations.

Use of significant figures

Significant figures are the number of digits included in a number from the first digit that is not a zero. The more significant figures, the more precise the number. This is important in Chemistry as we often need to know the precision of equipment used, and then record answers to a suitable precision.

Below are some examples:

Number	Number of significant figures (s.f.)	Explanation
26.4	3	This is fairly straightforward. The first non-zero is the 2 and counting from there there are 3 digits. (2, 6 and 4)
0.0473	3	This is also 3 s.f. The first non zero is the 4 and then there are 3 digits (4, 7 and 3)
0.2094	4	For this one the first non zero is the 2. Note that we count the zero after the 2 as a significant figure.
250.0	4	In this case, because the 1st decimal place has been reported we know that measurements were made to this precision and we count up to this digit.
21000	2	This is a tricky one. Since there is no decimal place we make the assumption that the zeros are not significant figures.
2.7×10^{-8}	2	The method works the same way when numbers are written in standard form.
8.70×10^{4}	3	In standard form if a zero is recorded we would count this as a significant figure.
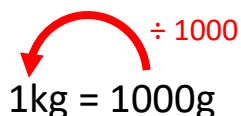
Converting Units

Most of the unit conversions at A level involve multiplying or dividing by 1000. For example, converting 382g to kg.

Start with what you know about g and kg:

$$1kg = 1000g$$

Add an arrow in the direction you want to convert and look at what has happened to the numbers:

$\div 1000$

$$1kg = 1000g$$

We can see from this we need to divide by 1000.

$$\frac{382}{1000} = 0.382 \, kg$$

Rearranging equations

For A Level Chemistry you will be expected to rearrange equations using addition, subtraction, multiplication, division, square and square root.

For addition equations you can move the addition by subtracting from the other side, e.g.:

$$A + B = C$$

becomes

$$B = C - A$$

For subtraction it is a similar process, e.g.:

$$A - B = C$$

becomes

$$A = B + C$$

The trickier ones are where you want to make the subtracted term the subject. The easiest way to do this is to first move the subtracted term, then make it the subject, e.g.:

$$A - B = C$$

first becomes

$$A = B + C$$

then

$$A - C = B$$

When multiplication is involved, these can be rearranged by dividing, e.g.:

$$A \times B = C$$

becomes

$$A = \frac{C}{B}$$

Again this is similar if division is used, e.g.:

$$\frac{A}{B} = C$$

becomes

$$A = B \times C$$

As with subtraction, this can be trickier when we want the denominator as the subject.
Again, a two step process by first multiplying and then dividing makes it easier, e.g.:

$$\frac{A}{B} = C$$

first becomes

$$A = B \times C$$

then

$$\frac{A}{C} = B$$

Squares and square roots are also inverses of each other, e.g.:

$$A^2 = B$$

becomes

$$A = \sqrt{B}$$

and vice versa

Some equations may involve multiple operations. In these cases we need to be careful to move everything in the correct order, e.g.:

$$A = B + \frac{C}{D}$$

first move B

$$A - B = \frac{C}{D}$$

then move D

$$D \times (A - B) = C$$

Another example:

$$A = \sqrt{\frac{B}{C}}$$

first move the square root

$$A^2 = \frac{B}{C}$$

then move C

$$C \times A^2 = B$$

Exercise 9 – Mathematics

1. How any significant figures have been used in each of the following?

Number	Sig figs	Number	Sig figs	Number	Sig figs
67		0.0045		1385	
67.0		0.00300		283000	
60.7		0.02060		1000.6	

2. Write the following numbers to the number of significant figures given:

a) 2.4883 (3s.f.)
b) 373.22 (2s.f.)
c) 8734 (3s.f.)
d) 0.00238 (2s.f.)
e) 2.6679×10^6 (3s.f.)

3. Convert the following

a) 1376 g to kg
b) 22.6 kg to g
c) 138000 Pa to MPa (N.B.1 MPa = 1000000 Pa)
d) 25 cm³ to dm³ (N.B. 1 dm³ = 1000 cm³)
e) 0.2 dm³ to cm³

4. Make x the subject of the following equations:

a) $y = x + 1$ b) $y = x - 4$ c) $y = 1 - x$ d) $y = 2x$

e) $y = 2x + 1$ f) $y = 3x - 1$ g) $y = \frac{x-2}{4}$ h) $y = \frac{x}{2} + 5$

i) $y = x^2 + 5$ j) $y = 2x^2$ k) $y = \sqrt{x + 2}$ l) $y = \sqrt{2x} + 4$

Exercise 10 - Shapes from Wyke Start

The following questions build on the work you did at Wyke Start. Use what you have learnt and the internet to help you answer these questions. Note there are no answers to these questions in this booklet.

1) (a) The shape of the molecule BCl_3 and that of the unstable molecule CCl_2 are shown below.
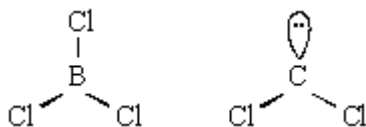
(i) Why is each bond angle exactly 120° in BCl_3?

....

....

(ii) Predict the bond angle in CCl_2 and explain why this angle is different from that in BCl_3

Predicted bond angle ....

Explanation ....

....

(5)

(b) Give the name which describes the shape of molecules having bond angles of 109.5°. Give an example of one such molecule.

Name of shape ....

Example ....

(2)

(c) The shape of the XeF_4 molecule is shown below.
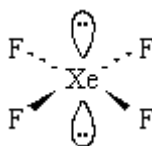
(i) State the bond angle in XeF_4

....

(ii) Suggest why the lone pairs of electrons are opposite each other in this molecule.

....

....

(iii) Name the shape of this molecule, given that the shape describes the positions of the Xe and F atoms only.

....

(4)
(Total 11 marks)

What else can I do now that would help prepare me for A Level Chemistry

Chemistry is an academically challenging course and most students do find the start of their A level study demanding. The key to success is, as ever, good preparation. How can you prepare? You need to be comfortable with the basic Chemistry from your GCSE course, most importantly: 'Bonding and Structure', 'Periodicity', 'Chemical Formulae', 'Moles and Chemistry Calculations' and 'Balancing Equations'. Now that you have attended our WykeStart sessions over the summer you need to complete the induction materials to help prepare you but you should also take time to a look at these websites (particularly Chemguide)

http://www.gcsechemistry.co.uk	Some good free resources here
http://www.bbc.co.uk/schools/gcsebitesize/chemistry	Good basic material see GCSE AQA core and additional.
http://www.docbrown.info/page19/AQAchemistryAS.htm	Excellent revision material for all levels 'Dr Brown's site' (but you have to rummage a bit)
http://www.webelements.com http://www.chemsoc.org/viselements/	Useful sources of information on each of the elements.
http://www.chemguide.co.uk	The best A-Level site very thorough and quite easy to navigate

There are also many revision guides on the market. They all offer similar help, but their efficacy is probably determined by what works for you.

Your first few weeks of the course are very important and we will carefully monitor your progress and offer support and advice where necessary. Above all, you must be honest with yourself and undertake additional work/come to support sessions as appropriate.

Most important of all: enjoy your study of chemistry!

Exercise 1

1.

Particle	Mass	Charge
PROTON	1	+1
NEUTRON	1	0
ELECTRON	Very Small	-1

2. a) 27.0   b) 13   c) 14   d) 2.8.3

Exercise 2

a) Ionic   b) Simple molecular c) Metallic   d) Giant Covalent

Exercise 3

1. a) 18   b) 63   c) 58.3   d) 132.1
2. a) 82.3%   b) 40%   c) 18.7%   d) 27.9%
3. 76.5%   4. 89.9%   5. 39.5%

Exercise 4

1. Any two of: Use powdered $CuCO_3$
                         Increase the temperature
                         Use a catalyst

2. Use powdered $CuCO_3$ - Increases surface area for reaction
    Increase temperature - particles have more energy
    Use a catalyst - Lowers activation energy

3. Either: Measure the amount of CO_2 produced in a set time
    Or: Measure the change in mass of the $CuCO_3$

Exercise 5

1. a) 21 000 J   b) 2 100 kJ mol^{-1} c) 23 570 J   d) 1 176 kJ mol^{-1}

Exercise 6

1. a) Below   b) Equal   c) Above   d) Above   e) Above
2. a) $HCl + KOH \rightarrow KCl + H_2O$
    b) $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$
    c) $2HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2H_2O$
    d) $H_2SO_4 + 2Na \rightarrow Na_2SO_4 + H_2$

Exercise 7

1) 0.04 mol   2) 0.08 mol dm^{-3} 3) 0.12 mol dm^{-3} 4) 0.113 mol dm^{-3} 5) 0.08 mol dm^{-3}

Exercise 8

Name	'Family'	Displayed formula
Propane	Alkane	
Ethanol	Alcohol	
Ethene	Alkene	
Butane	Alkane	
Propanoic acid	Carboxylic Acid	

Exercise 9

1.

Number	Sig figs	Number	Sig figs	Number	Sig figs
67	2	0.0045	2	1385	4
67.0	3	0.00300	3	283000	3
60.7	3	0.02060	4	1000.6	5

2. a) 2.49   b) 370   c) 8730   d) 0.0024   e) 2.67×10^6

3. a) 1.376 kg   b) 22600 g   c) 0.138 MPa   d) 0.025 dm^3 e) 200 cm^3

4. a) $x = y - 1$ b) $x = y + 4$ c) $x = 1 - y$ d) $x = \frac{y}{2}$

e) $x = \frac{y-1}{2}$ f) $x = \frac{y+1}{3}$ g) $x = 4y + 2$ h) $x = 2(y - 5)$

i) $x = \sqrt{y - 5}$ j) $x = \sqrt{\frac{y}{2}}$ k) $x = y^2 - 2$ l) $x = \frac{(y-4)^2}{2}$

~ 27 ~

The remaining pages contain some typical GCSE exam questions that link with the work covered in this booklet. You should complete these questions, mark them using the mark scheme at the end and record your score at the front of the booklet.

You should use any marks you don't get to highlight where extra work is needed and use the booklet and the internet to practice those topics.

Q1 This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of _____

(1)

(ii) The mass number of an atom is the number of _____

_____

(1)

(b) Explain why an atom has no overall charge.

Use the relative electrical charges of sub-atomic particles in your explanation.

_____

_____

_____

_____

(2)

(c) Explain why fluorine and chlorine are in the same group of the periodic table.

Give the electronic structures of fluorine and chlorine in your explanation.

_____

_____

_____

_____

(2)

(d)   The diagram shows the electronic structure of an atom of a non-metal.
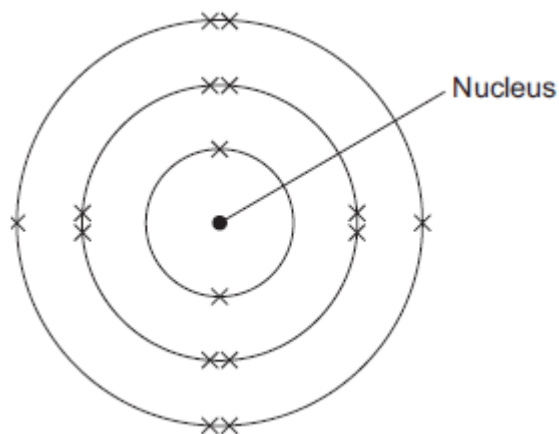
What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar ☐

O   ☐

S   ☐

Si ☐

(1)

(e)   When elements react, their atoms join with other atoms to form compounds.

Complete the sentences.

(i)   Compounds formed when non-metals react with metals consist of

particles called _____ .

(1)

(ii)   Compounds formed from only non-metals consist of

particles called _____ .

(1)
(Total 9 marks)

Q2 This question is about calcium.

(a) What type of compound is calcium oxide?

Tick **one** box.

An acid ☐

A base ☐

A carbonate ☐

A salt ☐

(1)

(b) Ionic compounds, such as calcium oxide, have high melting points.

Complete the sentences. Use words from the box.

bonds	forces	ions	layers

Calcium oxide has a giant ionic lattice in which there are strong electrostatic

_____ of attraction in all directions.

(1)

(c) The figure below shows the electronic structure of an oxygen atom and a calcium atom.
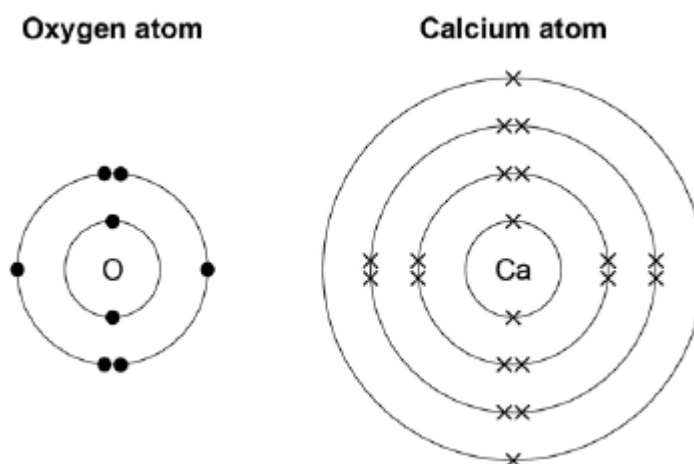
Describe how the calcium atom and the oxygen atom forms calcium oxide.

You should give the charge on each ion formed.

_____

_____

_____

_____

(4)
(Total 6 marks)

Q3 The hydrogen halides (hydrogen fluoride, hydrogen chloride, hydrogen bromide and hydrogen iodide) are important chemicals.

The diagram below represents a molecule of hydrogen chloride.
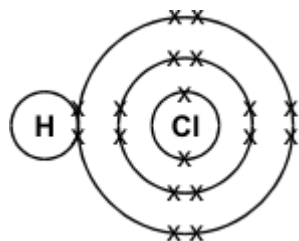
(i)   What type of particles are represented by the crosses (X)?

_____

(1)

(ii)   What type of chemical bond holds the atoms in this molecule together?

_____

(1)

(iii)   Would you expect hydrogen chloride to be a gas, a liquid or a solid, at room temperature and pressure? Explain your answer.

_____

_____

_____

(3)
(Total 5 marks)

Q4 Aqamed is a medicine for children.

(a)   The medicine is a formulation.

What is meant by a formulation?

_____

_____

(1)

(b)   Children often do not like taking medicine.

Suggest a substance that could be added to Aqamed to increase the desire for children to take it.

Give a reason for your suggestion.

Substance _____

Reason _____

_____

(2)

(c) The main ingredient in Aqamed is a painkiller called paracetamol.

The figure below represents a molecule of paracetamol.
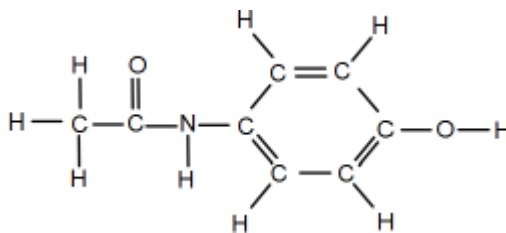
Give the molecular formula of paracetamol.

Calculate its relative formula mass (M_r).

Relative atomic masses (A_r): H = 1; C = 12; N = 14; O = 16

Molecular formula _____

Relative formula mass _____

_____

M_r = _____

(2)

(d) Aspirin is a medicine for use by adults.

An aspirin tablet contains 300 mg of acetylsalicylic acid.

Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.

Give your answer in standard form to three significant figures.

Relative formula mass (M_r) of aspirin = 180

_____

_____

_____

_____

_____

_____

Number of moles = _____

(4)

(Total 9 marks)

Q5 A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

The student used the apparatus shown in **Figure 1**.

Figure 1
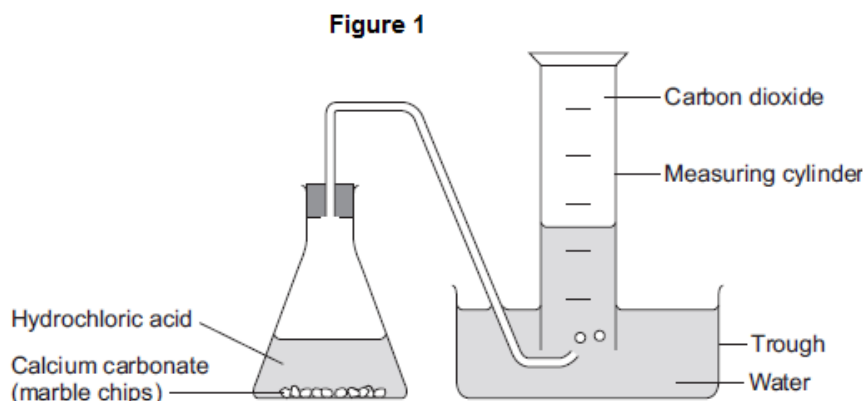
The student:
* recorded the volume of gas collected every 5 seconds
* repeated the experiment using hydrochloric acid at different temperatures.

The equation for the reaction is:

$$CaCO_3(s) + 2\ HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$
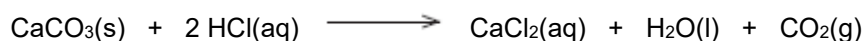
(a) The student plotted results for the hydrochloric acid at 20 °C and 40 °C on a graph.

Figure 2 shows the student's graph.
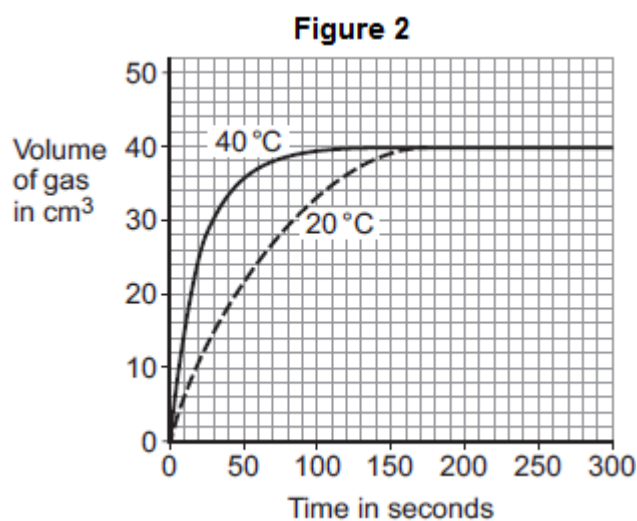
Figure 2

Use information from **Figure 2** to answer these questions.

(i) State **one** conclusion the student could make about the effect of temperature on the rate of the reaction.

_____

_____

(1)

(ii) Give **one** reason why the student could make this conclusion.

_____

_____

(1)

(iii)   For the hydrochloric acid at 60 °C the student had collected 30 cm^3 after 15 seconds.

Calculate the average rate of reaction from 0 to 15 seconds.

_____

_____

Rate of reaction = _____ cm^3 per second

(1)

(b)   The student then investigated how the surface area of marble chips affected the rate of reaction.

(i)   Which **two** variables should the student keep constant?

Tick (✓) **two** boxes.

Amount of water in the trough ☐

Concentration of acid ☐

Mass of marble chips ☐

Size of marble chips ☐

Volume of measuring cylinder ☐

(2)

(ii)   Explain, in terms of particles and collisions, the effect that increasing the surface area of the marble chips has on the rate of reaction.

_____

_____

_____

_____

(2)

(c)   Calcium carbonate is a catalyst for the industrial production of biodiesel.

Give **one** reason why using a catalyst reduces costs.

_____

_____

(1)
(Total 8 marks)

Q6 This question is about energy changes in chemical reactions.

(a)   Balance the chemical equation for the combustion of methane.

$$CH_4 \quad + \quad O_2 \quad \longrightarrow \quad CO_2 \quad + \quad H_2O$$
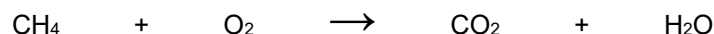
(1)

(b)   Alcohols are used as fuels.

A group of students investigated the amount of energy released when an alcohol was burned. The students used the apparatus shown in the diagram below.
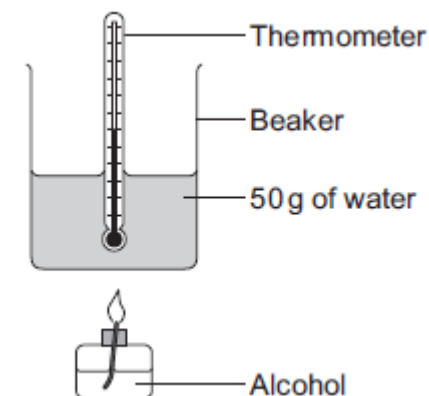
In one experiment the temperature of 50 g of water increased from 22.0 °C to 38.4 °C. The mass of alcohol burned was 0.8 g.

Calculate the heat energy (Q) in joules, released by burning 0.8 g of the alcohol.
Use the equation:

$$Q = m \times c \times \Delta T$$

Specific heat capacity (c) = 4.2 J / g / °C

_____

_____

_____

_____

Heat energy (Q) = _____ J

(3)

(c)   The chemical equation for the combustion of ethanol is:

$$C_2H_5OH \ + \ 3O_2 \ \longrightarrow \ 2CO_2 \ + \ 3H_2O$$
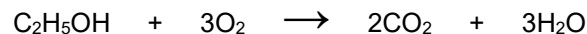
(i)   The equation for the reaction can be shown as:
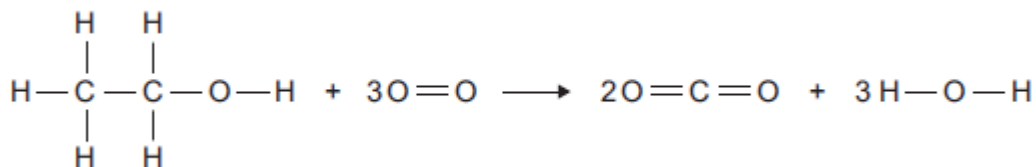
Bond	Bond energy in kJ per mole
C — H	413
C — C	347
C — O	358
C = O	799
O — H	467
O = O	495

Use the bond energies to calculate the overall energy change for this reaction.

_____

_____

_____

_____

_____

_____

Overall energy change = _____ kJ per mole

(3)

(ii)   The reaction is exothermic.
       Explain why, in terms of bonds broken and bonds formed.

_____

_____

_____

_____

(2)

(iii)   Complete the energy level diagram for the combustion of ethanol.

On the completed diagram, label:

•   activation energy
•   overall energy change.

Energy
$C_2H_5OH + 3O_2$
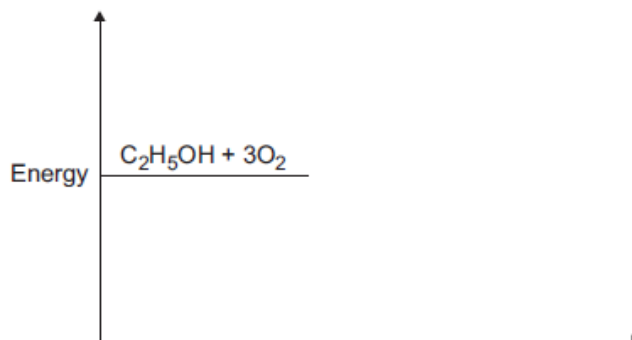
(3)
(Total 12 marks)

Q7 The salt sodium hydrogen phosphate (Na_2HPO_4) is used as a softening agent in processed cheese.
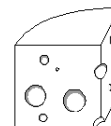
It can be made by reacting phosphoric acid (H_3PO_4) with an alkali.

(a)   Complete the name of an alkali that could react with phosphoric acid to make sodium hydrogen phosphate.

_____ hydroxide

(1)

(b)   What is the name given to a reaction in which an acid reacts with an alkali to make a salt?

_____

(1)

(c)   How would the pH change when alkali is added to the phosphoric acid solution?

_____

_____

(1)

(d)   What ions are present when any acid is dissolved in water?

_____

(1)

(e)   What ions are present when any alkali is dissolved in water?

_____

(1)

(f)   Write a chemical equation for the reaction which takes place between the ions you have named in (e) and (f).

_____

(1)
(Total 6 marks)

Q8 The table shows some information about acids and alkalis.

Name of acid or alkali	Type	Ions produced in solution		pH	Effect on Universal Indicator
Hydrochloric acid	Strong acid	H^+	Cl^-	1	Goes red
Sodium hydroxide	Strong alkali	Na^+	OH^-	13	Goes purple

Use the information in the table to help you answer parts **(a)** and **(b)**.

(a)   Draw a ring around the correct answer to complete each sentence.

(i)   Hydrochloric acid is acidic.

This is because it contains

Cl^-
H^+ ions
OH^-

(1)

(ii)   Sodium hydroxide solution is alkaline.

This is because it contains

H^+
Na^+ ions
OH^-

(1)

(iii)   The pH of acids is

higher than
lower than   the pH of alkalis.
the same as

(1)

(b)   Ethanoic acid is a weak acid.

Universal Indicator can be used to show that hydrochloric acid is a stronger acid than ethanoic acid of the same concentration.

Explain how.

_____

_____

_____

_____

(2)

(c)   Draw a ring around the correct answer to complete this sentence.

Strong acids and strong alkalis are

completely
not
partially

ionised in water.

(1)

(d)   The diagram shows the apparatus used to find the volume of hydrochloric acid that reacts with 25.0 cm³ of sodium hydroxide solution.

- Burette
- Hydrochloric acid
- **A**
- Sodium hydroxide solution and a few drops of an indicator
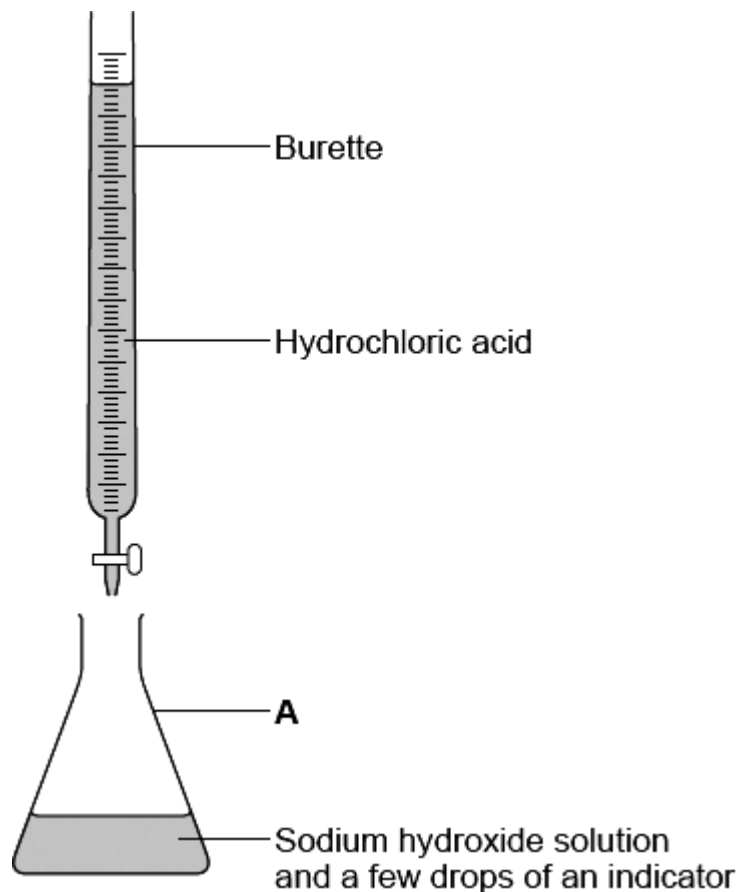
(i)   Which **one** of the following is the correct name for **A**?

Draw a ring around your answer.

beaker   **conical flask**   **pipette**

(1)

(ii)   Use the correct word from the box to complete the sentence.

distillation	**filtration**	**titration**

The method used to find the volume of acid that reacts with a known volume

of alkali is _____ .

(1)

(iii)   Suggest **one** way to make the results more reliable.

_____

(1)

(Total 9 marks)

Q9 Crude oil is a mixture of many *saturated hydrocarbons*. They can be separated into *fractions* by the process of fractional distillation.

State what is meant by:

(i) *hydrocarbon.* _____

_____

(2)

(ii) *saturated.* _____

_____

(1)

(iii) *fraction.* _____

_____

(1)
(Total 4 marks)

Q10 Crude oil is a complex mixture of hydrocarbons, mainly alkanes. The number of carbon atoms in the molecules ranges from 1 to over 100.

(a) How does the boiling point change as the number of carbon atoms in the molecules increases?

_____

_____

(1)

(b) Name the method used to separate petroleum into fractions.

_____

(1)

(c) The simplest hydrocarbon is methane, CH_4. Its structure can be represented:
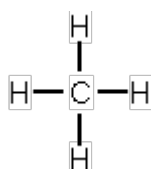
Draw the structure of ethane, C_2H_6.

(1)
(Total 3 marks)

Mark schemes

Q1.

(a) (i) protons

> *allow "protons or electrons", but do not allow "protons and electrons"*

1

(ii) protons plus / and neutrons

1

(b) (because the relative electrical charges are) −(1) for an electron and +(1) for a proton

> *allow electrons are negative and protons are positive*

1

and the number of electrons is equal to the number of protons

> *if no other mark awarded, allow 1 mark for the charges cancel out*

1

(c) (the electronic structure of) fluorine is 2,7 and chlorine is 2,8,7

> *allow diagrams for the first marking point*

1

(so fluorine and chlorine are in the same group) because they have the same number of or 7 electrons in their highest energy level or outer shell

> *if no other mark awarded, allow 1 mark for have the same / similar properties*

1

(d) S

1

(e) (i) ions

1

(ii) molecules

1

[9]

Q2.

(a) A base

1

(b) forces

1

(c) calcium loses electrons and oxygen gains electrons

> *max 3 for incorrect reference to atom / ion or to oxygen / oxide*

1

two electrons are transferred

1

calcium has a 2$^+$ charge

1

oxide has a 2$^-$ charge

1

[6]

~ 41 ~

Q3.

(i)   electrons   1

for 1 mark

(ii)   covalent   1

for 1 mark

(iii) made of small molecules:
usually gas or liquid   ) dependent on
have low melting points) having first
have low boiling points   ) point above
forces between molecules are weak

any 1 for 1 mark

3

[5]

Q4.

(a)   (medicine is) a mixture **and**

(designed as) a useful product

1

(b)   sugar / flavouring

1

to make it taste better

or

colouring

to make it look more attractive

1

(c) $C_8H_9NO_2$

any order of elements

1

151

1

(d)   mass of acetylsalicylic acid = 0.3 g

1

$= \dfrac{0.3}{100}$ (mol)

method mark – divide mass by M_r

1

= 0.00167 (mol)

allow 0.0016666(66)

1

1.67×10^{-3} (mol)

*correct answer with or without working scores **4** marks*
allow ecf from steps1, 2 and 3

1

[9]

~ 42 ~

Q5.

(a) (i) the higher the temperature, the greater the rate

or

at 40 °C rate is faster than at 20 °C

accept the higher the temperature, the faster the reaction

1

(ii) 40 °C curve is steeper

accept the 40 °C line becomes horizontal sooner

accept at higher temperatures the reaction finishes sooner

accept reaction finishes sooner at 40 °C

accept at higher temperatures the gas is produced faster

or

correct comparison of data from the graph

1

(iii) 2

1

(b) (i) Concentration of acid
Mass of marble chips

2

(ii) increases rate

incorrect reference to energy = max 1

1

(because of) more frequent collisions (between particles)

accept particles are more likely to collide

ignore more collisions

ignore more successful collisions

1

(c) any **one** from:

• increases rate of reaction

• reduces energy required

• lower temperature can be used

• catalyst is not used up.

1

[8]

Q6.

(a) CH_4 + $2O_2$ → CO_2 + $2H_2O$

allow multiples

1

(b) 3444 J

if answer incorrect:

one mark for temperature increase = 16.4 °C

one mark for mass of water = 50 g

ecf for one incorrect value gains two marks for correct calculation

no ecf for two incorrect values

3

(c)   (i)   1276 (kJ per mole)
              ignore + or -
              if answer incorrect:
              [(5 × 413) + 347 + 358 + 467] + [(3 × 495)] = 4722 (1 mark)
              [(4 × 799) + (6 × 467)] = 5998 (1 mark)
              correct subtraction of calculated energy values (1 mark)

                                                                                          3

       (ii)   because energy released when bonds form is greater than energy used when bonds broken
              allow converse
              if no mark awarded allow one mark for energy is used to break bonds
              or
              one mark for energy is released when bonds form

                                                                                          2

       (iii) products line lower than reactants

                                                                                          1

              activation energy labelled

                                                                                          1

              overall energy change labelled

                                                                                          1

                                                                                          [12]

Q7.

(a)   sodium

                                                                                          1

(b)   neutralisation

                                                                                          1

(c)   increase/inc. number

                                                                                          1

(d) H^+

                                                                                          1

(e) OH^-

                                                                                          1

(f) $H^+ + OH^- \rightarrow H_2O$

                                                                                          1

                                                                                          [6]

Q8.

(a)   (i) H^+

                                                                                          1

       (ii) OH^-

                                                                                          1

       (iii) lower than

                                                                                          1

(b)   with HCl:

UI goes red / pink
allow a comparison eg redder than ethanoic acid

1

has a pH 0 ,1 ,2 **or** 3
allow a comparison eg has pH less than ethanoic acid.
*do **not** accept an incorrect pH.*

or

with ethanoic acid:

UI goes orange / yellow (1)
allow a comparison with HCl

has a pH 4 / or above (but less than 7) (1)
allow a comparison with HCl

1

(c)   completely

1

(d)   (i)   conical flask

1

(ii)   titration

1

(iii)   repeat
allow compare with another students results

or

take average

1

[9]

Q9.

(i)   carbon and hydrogen
only **or** compound **of**
for 1 mark each

2

(ii)   single bonds only
or no double bonds etc
or contains maximum number of hydrogen atoms
for 1 mark

1

(iii)   molecules of similar chain length
similar boiling points
limited range of boiling points etc
any 1 for 1 mark

1

[4]

Q10.

(a) the more C atoms the higher the b.pt./temperature
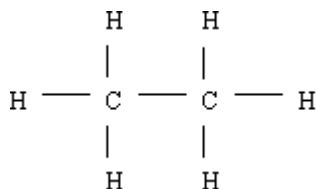**Allow** just higher. **Not** answer based on melting point
for 1 mark

1

(b) (fractional) distillation/fractionation
for 1 mark

1

(c)

```
        H       H
        |       |
  H —— C —— C —— H
        |       |
        H       H
```

must include H atoms and lines **not** $CH_3 - CH_3$
for 1 mark

1

[3]