Chemistry Unit 3: Chemistry in action		
1.1 1.2	• What is the difference between **quantitative** and **qualitative** chemical analysis? **(2)** • Explain why the test for any **ion** must be unique **(1)**	• **Qualitative** only tells you which chemical is present **(1) Quantitative** tells you how much of the chemical is present (the quantity) **(1)** • To avoid confusion between results and to allow one chemical to be clearly identified **(1)**
1.3	Describe the test for the following **ions** in solids or solution: a) **Aluminium ion, Al^{3+}** **(1)** b) **Calcium ion, Ca^{2+}** **(1)** c) **Copper, Cu^{2+}** **(1)** d) **Iron, (ii) Fe^{2+}** **(1)** e) **Iron (iii), Fe^{3+}** **(1)** f) **Ammonium NH_4^+** **(1)**	**a)** Add **sodium hydroxide** solution, a **white precipitate** forms, when excess sodium hydroxide is added the precipitate disappears. **(1)** **b)** Add **sodium hydroxide** solution, a **white precipitate** forms. **(1)** **c)** Add **sodium hydroxide** solution, a **blue precipitate** forms. **(1)** **d)** Add **sodium hydroxide** solution, a **green precipitate** forms. **(1)** **e)** Add **sodium hydroxide** solution, a **brown precipitate** forms. **(1)** **f)** Add **sodium hydroxide** solution, warm over a Bunsen flame **(1)** the gas given off turns damp **red litmus** paper blue **(1)**
1.4	Describe the test for the halide ions: a) **Chloride, Cl^-** **(1)** b) **Bromide, Br^-** **(1)** c) **Iodide, I^-** **(1)** You also need to know the tests from unit 2; flame tests for Sodium Na^+, Potassium K^+, Calcium Ca^{2+}, Copper Cu^{2+}. Also tests for sulfate $SO_4^{2-}$and carbonate CO_3^{2-} ions.	a) Add **silver nitrate** solution and **nitric acid**, a white **precipitate** is formed. **(1)** b) Add **silver nitrate** solution and **nitric acid**, a cream **precipitate** is formed. **(1)** c) Add **silver nitrate** solution and **nitric acid**, a yellow **precipitate** is formed. **(1)** Flame tests; Na^+ yellow, K^+ lilac Ca^{2+} red, Cu^{2+} blue- green. Sulfate- barium chloride and hydrochloric acid = white precipitate. Carbonate, add any acid, fizzes giving off carbon dioxide that turns lime water cloudy.
1.5	Give two examples of where these tests for **ions** are used **(2)**	To test the **purity** of drinking water **(1)**, to identify chemicals present in blood **(1)**

2.1	Calculate the **concentration** of a solution in **g/dm^3**. a) 20g dissolved in 100cm^3 of water **(1)** b) 0.5g dissolved in 100cm^3 of water **(1)** c) 0.2g dissolved in 50cm^3 of water **(1)**	First convert **cm^3** into **dm^3**, then: Concentration = mass/ volume in **dm^3** a) 100/1000 = 0.1**dm^3**,20/0.1 = **200g dm^{-3}** b) 100/1000 = 0.1**dm^3**,0.5/0.1 = **5g dm^{-3}** c) 50/1000 = 0.05**dm^3**,0.2/0.05 = **4g dm^{-3}**
2.6 Higher	*Describe how to calculate the* ***mass of solute*** *in a solution*	Measure mass of solution **(1)**, heat solution gently in an **evaporating basin** until it is dry **(1)** allow to cool and measure mass of solid residue **(1)**, divide mass of **residue** by mass of solute **(1)**
2.7 Higher	*a) Recall 3 units for measuring* ***concentration****. (1)*	*a) Grams per deci metre cubed,* ***g dm^{-3} (1)****, moles per deci metre cubed* ***mol dm^{-3} (1)****, number of particles per deci metre cubed* ***(1)***
2.8 Higher	*Convert the* ***mass*** *of a chemical into the* ***number of moles*** *of a chemical.* *a) 20g of calcium (Ar for Ca = 40)* *b) 200g of $CaCO_3$ (Ar of Ca = 40, C = 12, O = 16)* *c) 5g of $CuSO_4$ (Ar of Cu = 63.5, S = 32, O = 16)*	***Number of moles = mass (g)/ Mr or Ar (Mr is the relative mass of a formula, Ar is the relative atomic mass of an element.)*** *a) 20/40 = 0.5 moles* *b) Mr of = 40 + 12 + (3 X16) = 100 moles = 200/100 = 2* *c) Mr of = 63.5 + 32 + (4 x 16) = 159.5 moles = 5/159.5*
2.9 Higher	*Convert* ***concentration*** *in g dm^{-3} into mol dm^{-3}* *a) 20g dm^{-3} of calcium hydroxide $Ca(OH)_2$ (Ca =40, o =16, H = 1)* *b) 282g of sodium carbonate Na_2CO_3 (Na =23, C=12, O=16)* *Convert concentration in mol dm^{-3} into g dm^{-3}* *c) 0.5 mol dm^{-3} of methane CH_4 (C=12, H=1)* *d) 2 mol dm^{-3} of sulphuric acid H_2SO_4 (H=1, S = 32, O =16)*	***Number of moles = mass (g)/ Mr or Ar*** *a) Mr of $Ca(OH)_2$ = 40 + 2(1 +16) =74 moles = mass/Mr = 20/74 = 0.27 mol dm^{-3}* *b) Mr of Na_2CO_3 = (2x23)+12+(3x12)= 94 moles = mass/Mr = 282/94 = 3 mol dm^{-3}* *mass in grams = No. of moles X Mr or Ar* *c) Mr of CH_4 = 12 + (4 x 1) = 16 mass = 0.5 X 16 = 8 g of methane CH_4 g dm^{-3}* *d) Mr of H_2SO_4 = 1x2 + 32 = (4 x 16) = 98 mass = 2 X 98 = 196 g dm^{-3}*
2.10	Describe how to prepare a **soluble salt** from an acid and an	Add excess solid **reactant** (to ensure all the acid is used up) **(1)**, filter to remove

	insoluble reactant (3)	unreacted solid reactant**(1)**, the remaining solution is the new salt and water **(1)**
2.11	Describe how to prepare a **soluble salt** from an acid and a **soluble reactant (3)**	**Titration** is used to work out the exact **volume** of **reactant** needed to react with the acid **(1),** the exact volume of acid and reactant are added together **(1),** the remaining solution is the new **salt** and **water (1)**
2.12	a) Name the two **ions** involved in an **acid - base titration reaction (2)** b) Describe what happens to the **ions** in an acid base **titration** reaction **(1)**	a) **hydrogen ions, H^+ (1) and hydroxide ions, OH^- (1)** b) The **hydrogen ions** are **neutralised** by the **hydroxide ions (1)** water H_2O is formed **(1)**
2.13	Describe how to carry out an acid – base **titration**, include names and uses of equipment **(6)**	Fill a **burette** with acid **(1)**, use a **pipette** to measure a set volume (eg $20cm^3$) of alkali (of known concentration) and add to a **conical flask (1)**, add a few drops of an **indicator**, like phenolphthalein (pink in alkali and colourless in acid) or methyl orange (yellow in alkali and red in acid) **(1)** place a white tile underneath the conical flask **(1)**, add the acid and swirl the flask, keep going until the indicator changes colour**(1)** **repeat** to test reliability**(1)**
2.15 Higher	*For the **neutralisation** reaction:* $HCl + NaOH \rightarrow NaCl + H_2O$ *Calculate the **concentration** of acid in the following examples.* *a) $20cm^3$ of 0.5M alkali is neutralised by $24cm^3$ of acid.**(3)*** *b) $25cm^3$ of 2M alkali is neutralised by $15cm^3$ of acid.**(3)***	*a) **Convert cm^3 into dm^3 by dividing by 1000.*** *Vol of alkali = 20/1000 = $0.02dm^3$* *Vol of acid = 24/1000 = $0.024dm^3$ **(1)*** *Calc no moles of alkali in $0.02dm^3$ of solution.* ***No of moles = conc X vol*** *= 0.5 X 0.02* *= 0.01 mol **(1)*** *The equation shows a ratio of 1:1 for the number of moles of acid and alkali, so there must be 0.01 mols of acid in $0.024dm^3$ of solution.* ***Conc = no moles/ volume*** *= 0.01 / 0.024* *= 0.42 mol dm^3 **(1)*** *b) **Convert cm^3 into dm^3 by dividing by 1000.*** *Vol of alkali = 25/1000 = $0.025dm^3$* *Vol of acid = 15/1000 = $0.015dm^3$ **(1)*** ***No of moles = conc X vol***

		= 2 X 0.025 *= 0.05 mol* ***(1)*** *The equation shows a ratio of 1:1 for the number of moles of acid and alkali, so there must be 0.05 mols of acid in 0.015dm^3 of solution.* *Conc of acid = no moles/ volume* *= 0.05 / 0.015* *= 3.33 mol dm^3* ***(1)***
3.1	Describe what an **electrolyte** is **(1)**	An **ionic** substance in the **molten** state (melted) or as a **solution (1)**
3.2	a) What name is given to positively charged ions? **(1)** b) What name is given to negatively ions? **(1)** c) Describe the movement of positive ions during **electrolysis (2)**	a) **Cations (1)** b) **Anions (1)** c) Positively charged **cations** attract to the negatively charged **cathode (1)**. Negatively charged **anions** attract to the positively charged **anode (1)**
3.3	a) Define **oxidation (1)** b) Define **reduction (1)**	loss of electrons **(1)** Gain of electrons **(1)** **(OIL- oxidation is loss of electrons. RIG- reduction is gain of electrons)**
3.4	a) Name the **electrode** where **reduction** takes place- and explain why **(2)** b) Name the **electrode** where **oxidation** takes place- and explain why **(2)**	a) **Cathode (1)** as positive **cations** are **discharged** by gaining **electrons** at the negative **cathode (1)** b) **Anode (1)** as negative **anions** are **discharged** by losing **electrons** at the positive **anode (1)**
3.5 Higher	*Write* ***ionic half equations*** *for the reactions at the* ***electrodes*** *in the following* ***electrolysis cells****:* *a)* ***Molten*** *sodium chloride NaCl (l)* ***(2)*** *b)* ***Aqueous*** *sodium chloride NaCl (aq)* ***(2)*** *c)* ***Molten*** *lead bromide PbBr (l)* ***(2)*** *d)* ***Aqueous*** *copper sulfate $CuSO_4$ (aq)* ***(2)***	*a) Anode: $Na^+ + e^- \rightarrow Na$* **(1)** *Cathode: $2Cl^- \rightarrow Cl_2 + 2e^-$* **(1)** *b) Anode: $2H^+ + 2e^- \rightarrow H_2$* **(1)** *Cathode: $2Cl^- \rightarrow Cl_2 + 2e^-$* **(1)** *c) Anode: $Pb^{2+} + 2e^- \rightarrow Pb$* **(1)** *Cathode: $2Br^- \rightarrow Br_2 + 2e^-$* **(1)** *d) Anode: $Cu^{2+} + 2e^- \rightarrow Cu$* **(1)** *Cathode: $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$* **(1)**
3.6	Describe how **sodium** is manufactured	**Electrolysis** of **molten sodium chloride (1)**
3.7	Name two uses for sodium **(2)**	Street lights **(1)**, coolant in some nuclear reactors **(1)**
3.8	Name the products formed during the **electrolysis** of **aqueous** sodium	Hydrogen gas (at cathode) **(1)**, chlorine gas (at anode) **(1)**, and sodium hydroxide solution

	chloride **(3)**	**(1)**
3.9	Explain why these products are formed **(4)**	Both sodium and hydrogen **cations** attract to the **cathode (1)**, the **least reactive ion** - hydrogen is **discharged** forming hydrogen gas.**(1)** Both hydroxide and chloride **anions** are attracted to the **anode (1).** Chloride ion is **discharged** forming chlorine gas **(1).** Sodium and hydroxide ions are left in solution as sodium hydroxide **(1).**
3.10	a) Recall the rules that determine which **cation** is **reduced** at the **cathode (1).** b) Recall the rules that determine which **anion** is **oxidised** at the **anode (1).**	a) The least reactive **cation** is **discharged** and **reduced** – gains electron/s **(1).** (most-least reactive Na^+, Cu^+, H^+) b) The order for discharge goes -halide ions (forms halogen gas), hydroxide ion (forms oxygen gas and water), sulfate ions **(1).**
3.12	a) Explain the change in mass of the copper electrodes during the electrolysis of copper sulphate **(1).** b) Describe how copper is **purified** and explain what happens at each copper electrode. **(6)** c) Why is pure copper needed? **(1)**	The **anode** decreases in mass and the **cathode** increases in mass. **(1)** b) Impure copper as the anode & pure copper as cathode **(1),** electrolyte is copper sulfate **(1).** A direct current is passed through the electrodes **(1),**copper atoms in the anode are oxidised to copper ions by losing 2 electrons **(1)** copper cations in electrolyte are attracted to the cathode**(1),** they're reduced to copper atoms by gaining 2 electrons **(1)** c) Pure copper is a better **conductor** of electricity & in high demand **(1)**
3.14	a) Explain how a metal is **electroplated (4)** b) Describe two uses for electroplating metals **(2)**	a) The item to be plated is connected as the **cathode (1)**, the **electrolyte** contains ions of the metal to be plated – eg gold, silver or zinc **(1)**. A direct current is passed through the cell **(1).** A layer of metal builds up on the cathode **(1)** b) Gold plated jewellery, stays looking good, but is lower in cost **(1)**. Galvanising-covering in zinc reduces corrosion. **(1)**
4.1 Higher	*Recall the volume occupied by 1 mole of any gas at standard temperature and pressure.* **(1)**	*$24dm^3$* **(1)** *standard temperature and pressure (room temp. and 1 atm. pressure)*
4.2 Higher	*a) Use the* ***balanced equation*** *below to work out the volume of oxygen gas needed to react*	*a) The equation shows ratio of hydrogen to oxygen is 2:1, so 2 moles of hydrogen react with 1 mole of oxygen.* ***No. moles of gas = volume of gas/24***

	completely with 12dm³ of hydrogen gas. **(2)** *$2H_2 + O_2 \rightarrow 2H_2O$* *b) Calculate the volume taken up by 11g of carbon dioxide (Ar of C = 12, O = 16)* **(2)**	*No. moles of H_2 = 12/24 = 0.5* **(1)** *0.5 mol of H_2 reacts with 0.25 mol of O_2.* ***Volume of gas = No moles X 24*** *= 0.25 x 24 = 6dm³* **(1)** *b) Mr of CO_2 = 12 + (2x16) = 44* ***No moles = mass in g/ Mr*** *= 11/44 = 0.25* **(1)** ***Volume of gas = No moles X 24*** *= 0.25 x 24 = 6dm³* **(1)**
4.4	What is the main use of **ammonia**? **(1)**	As a **fertiliser** promoting plant growth (due to high nitrogen content) **(1)**
4.5	a) What environmental problem is caused by the over use of **fertilisers**? **(1)** b) Explain how the **fertilisers** cause this problem **(4)**	a) **Eutrophication (1)** b) **Fertiliser** washes into lakes and streams **(1)**, **algae** grows quickly blocking sunlight reaching plants below the surface **(1)**, plants under water die (as can't **photosynthesise**), **bacteria decompose** plant material and use up **oxygen** in water during **respiration (1)**, fish and other aquatic **suffocate** due to lack of oxygen in water **(1)**
4.6	a) What is meant by a **reversible** reaction? **(1)** b) Write the symbol for a reversible reaction **(1)** c) Write the word equation for the production of ammonia **(1)** d) Write a **balanced symbol equation** for the production of ammonia **(1)** e) Where do the **reactants** to make **ammonia** come from? **(2)**	a) A reaction where the reactants react to form products, but also the products break down to form the reactants again**(1)** b) $\rightleftharpoons$ **(1)** c) Nitrogen + hydrogen $\rightleftharpoons$ ammonia **(1)** d) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ **(1)** e) Nitrogen comes from the air (remember 78% of air is nitrogen) **(1).** Hydrogen comes from natural gas- methane **(1)**
4.7 Higher	*Explain what is meant by* ***dynamic equilibrium*** **(2)**	*A* ***reversible*** *reaction where the forward reaction takes place at the exact same rate as the reverse reaction.* **(1)** *Overall there is no change in the ratio of reactants to products.* **(1)**
4.8 Higher	*a) How does an increase in temperature affect the* ***equilibrium position*** *of the reversible reaction below where the forward reaction is*	*a) Increase in temperature favours an* ***endothermic reaction*** **(1)***, as the forward reaction is* ***exothermic*** *the reverse reaction must be* ***endothermic*** **(1)***. The reverse reaction is* ***favoured*** *and* ***equilibrium shifts*** *to the left, reducing the* ***yield*** *of product*

	exothermic? **(3)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$ *b) How does an increase in pressure affect the* ***equilibrium position*** *of the above reaction?* **(3)**	*(ammonia).* **(1)** *b) An increase in pressure favours a reduction in pressure* **(1)** *caused by a reduction in the number of gas molecules.* **(1)** *There are 4 molecules on the left and 2 on the right of the equation, so the forward reaction reduces pressure and so the* ***equilibrium position*** *moves to the right, increasing the* ***yield*** *of ammonia* **(1)**
4.9 Higher	*a) Recall how an increase in pressure affects the* ***rate of a reaction (1)*** *b) Recall how an increase in temperature affects the rate of a reaction* ***(1)*** *c) Recall how a catalyst affects the rate of a reaction* ***(1)*** *(Note these conditions increase the speed of a reaction, but may reduce the yield- often a compromise of conditions is needed.)*	*a) Increase in pressure increases the reaction rate* ***(1)*** *(more particles in same volume,* ***increases frequency of successful collisions****)* *b) Increase in temperature increases the rate of reaction* ***(1)*** *(particles have more* ***energy****, move faster,* ***increases frequency of successful collisions****)* *c) Catalyst speeds up reaction rate by* ***lowering the activation energy****- but is not used up in the reaction.* ***(1)***
4.10 Higher	*Explain why the reaction conditions in the* ***Haber process*** *are set at 450°C, 200 atm and with an iron catalyst with a honeycomb structure* ***(4)***	*Fast rate of reaction favoured by high temperature and pressure* ***(1)****, but high yield favoured by low temperature and high pressure* ***(1)****. Compromise of conditions to favour fast reaction rate and high yield.* ***(1)*** *Iron acts as a catalyst, honey comb increases it's surface area, both increase the rate of reaction.****(1)***
5.1	a) Describe the conditions needed to produce **ethanol** from plants ***(3)*** b) What name is given to this reaction? ***(1)*** c) Write a word equation for this reaction ***(1)*** d) Write a balanced symbol equation for the reaction **(3)**	a) Plants high in sugary carbohydrates are pulped and mixed with yeast***(1)***, kept warm ***(1)*** and anaerobic (lacking in oxygen) ***(1)***. b) Fermentation reaction ***(1)*** c) Glucose → ethanol + carbon dioxide ***(1)*** d) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ ***(3)***
5.2	Describe how to prepare a solution of **ethanol** ***(4)***	Sterilise a conical flask, add warm water (30-40°C) ***(1)***, sugar (or plant material-

		maize, wheat, potatoes) ***(1)***, yeast, and leave for a few days***(1)***, preventing oxygen getting to reaction mixture. ***(1)***
5.3	Recall the approximate % of alcohol in the following drinks: a) Beer, lager, cider ***(1)*** b) Wine ***(1)*** c) Spirits like vodka & whiskey ***(1)***	a) 3-5% ***(1)*** b) 9-13% ***(1)*** c) 40% ***(1)***
5.4	a) Describe some problems caused by over use of alcoholic drinks **(2)** b) Give a use for **ethanol** (other than as a drink) **(1)**	Family break down, violence, liver cirrhosis, cancer of mouth, throat & stomach **(1 mark per point)** b) As a fuel, it can be used in place of petrol as it releases a lot of energy when burnt **(1)**
5.5	a) Name the technique used to purify ethanol from a solution. **(1)** b) Describe how the process works **(3)**	a) Fractional distillation **(1)** b) Heat solution to 78°C in a flask attached to a condenser **(1)**, ethanol evaporates and vapour passes through condenser and cools, condensing to give liquid ethanol **(1)**. Water doesn't boil until 100°C so is left behind in the flask. **(1)**
5.6	*a) Describe another method used to produce ethanol* **(1)** *b) Write a word equation for the reaction* **(1)** *c) Write a balanced symbol equation for the reaction* **(2)**	*a) Reacting ethene (produced during cracking of crude oil fractions) with steam.* **(1)** *b) Ethene + steam → ethanol* **(1)** *c)* $C_2H_4 + H_2O \rightarrow C_2H_5OH$ **(2)**
5.7 Higher	*a)* ***Evaluate*** *when it is better to use* ***fermentation*** *to produce ethanol and when it is better to* ***react ethene with steam*** **(4)** *b) Describe two advantage of using* ***fermentation*** *to produce ethanol* **(1)** *c) Describe two disadvantage of using* ***fermentation*** *to produce ethanol* **(2)**	*a) Fermentation- best in countries which can't afford crude oil,* **(1)** *have a lot of land and suitable climate appropriate to grow crops eg sugar cane or sugar beet.* **(1)** *Reacting ethene with steam- best in countries that can afford crude oil* **(1)**, *have limited land to grow crops for fuel. Need a pure product.* **(1)** *b) Produced from a renewable source* **(1)**, *little energy needed to cause reaction.* **(1)** *c) Ethanol takes longer to be produced, as fermentation uses a batch process,* **(1)***also ethanol produced is not as pure as in the faster, continuous ethene reaction, carbon*

		dioxide is produced as a by product of the reaction **(1)**
5.8 Higher	*a) Describe how* ***ethene*** *can be produced from* ***ethanol*** **(1)** *b) Write a* ***word equation*** *for the reaction* **(1)** *c) Write a* ***balanced symbol equation*** *for the reaction* **(2)**	*a)* ***Ethanol*** *is* ***dehydrated*** *(water is removed) by passing over a hot* ***catalyst*** **(1)** *b) ethanol → ethene + water* **(1)** *c)* $C_2H_5OH \rightarrow C_2H_4 + H_2O$ **(1)**
5.9	Define the term **homologous series (2)**	A series of compounds which have the same **general formula (1)**, have similar chemical properties and reactions, show a gradual change in physical properties- like boiling point **(1)**
5.10	Name the following molecules: a) CH_4 **(1)** b) C_2H_6 **(1)** c) C_3H_8 **(1)** d) C_4H_{10} **(1)** e) C_2H_4 **(1)** f) C_3H_6 **(1)** *g)* CH_3OH *Higher only* **(1)** *h)* C_2H_5OH *Higher only* **(1)** *i)* C_3H_7OH *Higher only* **(1)** *j) COOH Higher only* **(1)** *k)* CH_3COOH *Higher only* **(1)** *l)* C_2H_5COOH *Higher only* **(1)**	a) Methane **(1)** b) Ethane **(1)** c) Propane **(1)** d) Butane **(1)** e) Ethene **(1)** f) Propene **(1)** *g) Methanol* **(1)** *h) Ethanol* **(1)** *i) Propanol* **(1)** *j) Methanoic acid* **(1)** *k) Ethanoic acid* **(1)** *l) Propanoic acid* **(1)**
5.11	Name the **homolgous series** that the following chemicals belong to: a) C_3H_7OH **(1)** b). *COOH* **(1)** c) C_4H_{10} **(1)** d) C_2H_4 **(1)**	a) Alcohol **(1)** b) Carboxylic acid **(1)** c) Alkane **(1)** d) Alkene **(1)**
5.12	a) Name the product formed when **ethanol** is **oxidised (1)** b) Explain why wine goes off when exposed to the air **(1)**	a) Ethanoic acid **(1)** b) The ethanol in the wine is **oxidised** (reacts with oxygen in the air) to form **ethanoic acid** (more commonly know as vinegar) which has a distinctive sour taste **(1)**
5.13	Describe two uses of vinegar **(2)**	As a **preservative (1)** (eg pickled onions), as a flavour **(1)** (eg in salad dressing)

5.14	Describe the reaction of ethanoic aicd with: a) Metals **(1)** b) Carbonates **(1)** c) Bases like oxides **(1)** d) Indicators **(1)**	a) Metal may fizz giving off hydrogen gas and producing a neutral salt **(1)** b) Carbonate may fizz, giving off carbon dioxide gas and producing a neutral salt c) Acid is neutralised (as in previous two reactions) forming water & neutral salt d) Universal indictor turns orange or red, pH 2-4. Blue litmus paper turns red
5.15	Complete the following word equations: a) Magnesium + ethanoic acid **(1)** b) Copper carbonate + ethanoic acid c) Calcium oxide + ethanoic acid **(1)**	a) → magnesium ethanoate + hydrogen b) → copper ethanoate + water + carbon dioxide c) → calcium ethanoate + water
5.16 Higher	a) Name the type of chemical produced when an alcohol reacts with a carboxylic acid **(1)** b)Name the chemicals produced when ethanol reacts with ethanoic acid **(1)** *c) Writing a balanced symbol equation for this reaction.* **(2)**	a) An **ester (1)** b) **ethyl ethanoate** and water **(1)** c) $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$ **(2)**
5.17	Describe three uses for **esters (3)**	Flavours in foods as taste nice **(1)**, perfumes as smell nice **(1)**, used to make polyester plastic- used to make plastic bottles or as fibres for clothing. **(1)**
5.18	Name a use for recycled polyester	To make fleeces **(1)**
5.19	What type of chemical are oils and fats? **(1)**	Esters **(1)**

Structural diagram	Formula	Name	Homologous series