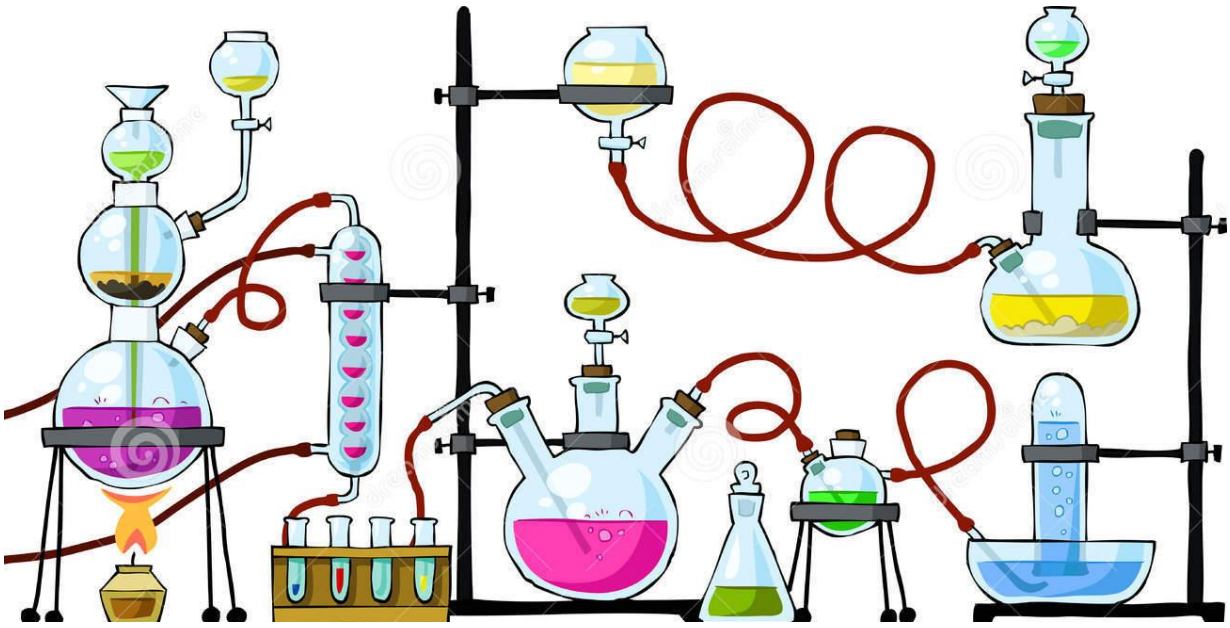


YEAR 11-12 TRANSITION SUMMER BOOKLET

NAME .....

CHEMISTRY

A – Level Chemistry

The aim of this transtion pack is to help you prepare for the A-level course. Some of the content below will be new to you, some you will have seen before as you will be revisiting important concepts from GCSE. It is important that you complete the tasks and we will be looking at them in September.

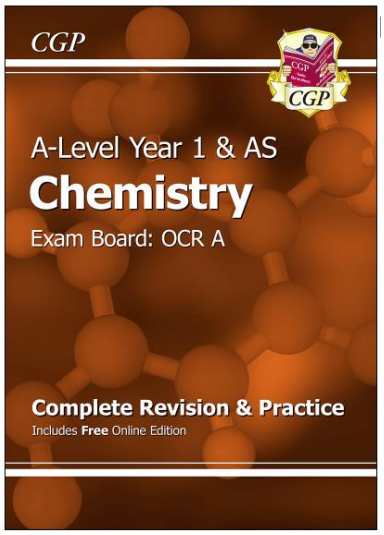
In order to prepare for the years ahead it is best to use both your GCSE classnotes and the various resources online to help you complete various activities.

Resources

OCR Specification for A-level
http://www.ocr.org.uk/qualifications/as-a-level-gce-chemistry-a-h032-h432-from-2015/

Activities from the Royal Society of Chemistry's website
http://www.rsc.org/learn-chemistry/

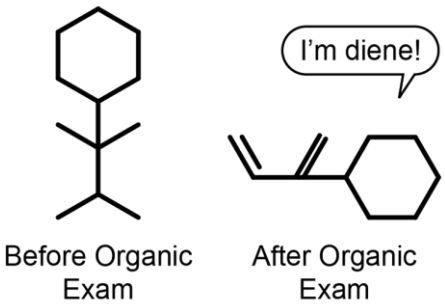
Good revision guide

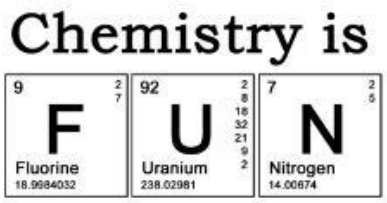


Please make sure you purchase the new specification.

A link to the correct book can be found below (you may find it cheaper elsewhere). There is also a demo of the book available if you click on the link

https://www.cgpbooks.co.uk/Student/books_a_level_chemistry_ocr.book_CRAR53





Periodic Table

The early periodic table

John Newlands	Dmitri Mendeleev
• Ordered his table in order of atomic mass • Realised similar properties occurred every eighth element – 'law of octaves' but broke down after calcium.	• Ordered his table in order of atomic mass, but not always strictly. • Left gaps for undiscovered elements.

The modern periodic table

- When electrons, protons and neutrons were discovered in the early 20th century, elements were ordered in atomic (proton) number.
- Elements in the same group have the same number of electrons in their highest occupied energy level (outer shell)

Group 1 – Alkali metals

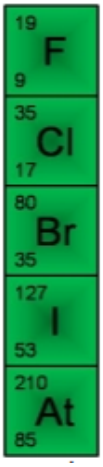
- Low density (first 3 are less dense than water)
- React with non-metals to form an ionic compound. These compounds are white solids which dissolve to form colourless solutions.
- They react with water to release hydrogen
- They form hydroxides which dissolve in water to give alkaline solutions (hence the name alkali metals)

As you go further down:

- The elements get more reactive because the electrons are further away from the positive nucleus.
- These outer electrons are more shielded from the inner she are lost more easily.

→

- *Most reactive.*
- *Lowest boiling and melting point.*



Group 7 – The halogens

- They exist as diatomic molecules (they come in pairs), the atoms share a pair of electrons to achieve a full outer shell.
- They react with metals to form ionic compounds in which the halide ion carries a -1 charge.
- A more reactive halogen can displace a less reactive in an aqueous solution of its salt.

E.g. Chlorine will displace bromine if we bubble the gas through a solution of potassium bromide:

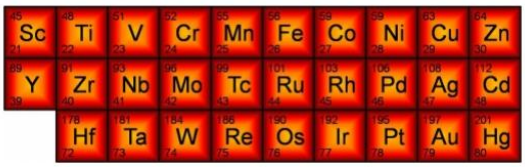
Chlorine + Potassium Bromide → Potassium Chloride + Bromine

As you go further down:

- The element is less reactive because the higher the energy level of the outer electrons, the less easily electrons are gained (attracted to the positive nucleus.)
- The higher its melting and boiling point

The transition metals

Compared to group 1, the transition elements:



- Are harder and stronger
- Have higher melting points (except for mercury) and higher densities
- Much less reactive and don't react as vigorously with oxygen or water
- Conduct heat and electricity due to their delocalised electrons
- They have ions with many different charges, so form coloured compounds, and are useful as catalysts.

Periodic Table: Worksheet

Q1. By 1869, about 60 elements had been discovered. Mendeleev arranged these elements in a table, in order of their atomic weight. He also put elements with similar chemical properties in the same columns.

Mendeleev and part of his table are shown below.

	Group							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Period 1	H							
Period 2	Li	Be	B	C	N	O	F	
Period 3	Na	Mg	Al	Si	P	S	Cl	
Period 4	K Cu	Ca Zn	– –	Ti –	V As	Cr Se	Mn Br	Fe Co Ni

(a) (i) Name **one** element in Group 1 of Mendeleev's table that is not in Group 1 of the periodic table on the Data Sheet. Give a reason why this element should not be in Group 1.

Name of element .....

Reason .....

.....

(2)

(ii) Which group of the periodic table on the Data Sheet is missing from Mendeleev's table?

.....

(1)

(b) The gaps (–) in Mendeleev's table were for elements that had not been discovered.

(i) Compare Mendeleev's table with the periodic table on the Data Sheet.

Name **one** of the elements in Period 4 that had not been discovered by 1869.

.....

(1)

(ii) Mendeleev was able to make predictions about the undiscovered elements.
This eventually led most scientists to accept his table.

Suggest what predictions Mendeleev was able to make about these undiscovered elements.

.....

.....

.....

(2)

(c) In terms of their electronic structure:

(i) state why lithium and sodium are both in Group 1

.....

.....

.....

(1)

(ii) explain why sodium is more reactive than lithium. Draw a diagram to support your response.

.....

.....

.....

.....

.....

.....

(3)
(Total 10 marks)

Standard Form: Worksheet

Scientists often write numbers in standard form. When doing this the number is always written in the form

$A \times 10^n$ where A is a number between 1 and 10
n is the number of places we move the decimal point (+ to the right, - to the left)

Look at the number written in full and then put the decimal point straight after the first number (that isn't zero). Then count how many places you would have to move the decimal point to get it back to where it was.

Please complete the table:

Number	**Standard Form**	**Number**	**Standard Form**
8 937	8.937×10^3	0.001 68	
6 832 000 000	6.832×10^9	0.000 009 36	
0.02678	2.678×10^{-2}		6.73×10^{-4}
0.000 000 000 000 376	3.76×10^{-13}		3.193×10^5
8 245 000	8.245	602 000 000 000 000 000 000 000	

Units

Scientists often use a **prefix** on the front of the unit.

terra (T)	$\times 10^{12}$	1 000 000 000 000
giga (G)	$\times 10^9$	1 000 000 000
mega (M)	$\times 10^6$	1 000 000
kilo (k)	$\times 10^3$	1 000
milli (m)	$\times 10^{-3}$	0.001
micro (μ)	$\times 10^{-6}$	0.000 001
nano (n)	$\times 10^{-9}$	0.000 000 001
pico (p)	$\times 10^{-12}$	0.000 000 000 001

Some examples are shown in the table below

Distance	**In metres**		
	Working	**Standard form**	**Full number**
25.6 km	25.6×10^3 m	2.56×10^4 m	2560 m
1.28 mm	1.28×10^{-3} m	1.28×10^{-3} m	0.001 28m
786 pm	786×10^{-12} m	7.86×10^{-10} m	0.000 000 000 786

Questions

1. Complete the table after the examples shown:

Distance	**In metres**		
	Working	**Standard form**	**Full number**
375 Gm			
128 nm			
0.786 nm			
35 mm			
20.1 Tm			
45 pm			
27.6 μm			

2 The radius of a hydrogen atom is 25 pm. Write this in metres in both standard form and as a full number.

standard form ……. full number ……..

3 The radius of a copper atom is 0.135 nm. Write this in metres in both standard form and as a full number.

standard form ……. full number ……..

4 The radius of a carbon atom is 70 pm. The nucleus is 10000 times smaller. Give the radius of a carbon nucleus in metres in both standard form and as a full number.

standard form ……. full number ……..

5 The radius of a nitrogen atom is 65 pm. The radius of a silver atom is 0.160 nm. Give the radius of both atoms in standard form in metres and state which atom is bigger.

nitrogen atom ……. silver atom …….. larger atom = …….

6 The diameter of a carbon atom is 140 pm. How many carbon atoms would fit in a line of carbon atoms 0.30 m long? Show your working and give your answer to 3sf.

……

……

7 The diameter of a copper atom is 0.270 nm. How many copper atoms would fit in a line of copper atoms 50 cm long? Show your working and give your answer to 3sf.

……

……

Percentage yield: Worksheet

Even though no atoms are gained or lost in a chemical reaction, it is not always possible to obtain the calculated amount of a product because: • the reaction may not go to completion because it is reversible • some of the product may be lost when it is separated from the reaction mixture • some of the reactants may react in ways different to the expected reaction. The amount of a product obtained is known as the yield. When compared with the maximum theoretical amount as a percentage, it is called the percentage yield.

$$\text{Percentage yield} = \frac{\text{Amount of product produced}}{\text{Maximum amount of product possible}} \times 100$$

Actual and theoretical yields

1. a) What is:

   (i) the actual yield _____

   (ii) the theoretical yield _____

   (iii) the percentage yield? _____

   b) Give three reasons why the actual yield in the experiment to prepare ammonium phosphate was lower than the theoretical yield.

   _____

   _____

   c) What does '100%' yield mean? _____

   d) What does '50%' yield mean? _____

2. a) An industrial process to produce fertiliser obtained 56.0 tonnes of fertiliser. The theoretical yield was 84.0 tonnes. What is the percentage yield?

   _____

   b) An industrial process to extract iron produces 670 tonnes of iron. The theoretical yield is 700 tonnes. What is the percentage yield?

   _____

   c) An experiment to produce magnesium oxide gives an actual yield of 0.80 g. The theoretical yield is 1.6 g. What is the percentage yield?

   _____

   d) Jed is producing a sample of sodium chloride by titrating hydrochloric acid with sodium hydroxide and evaporating the solution. He obtains 2.4 g of sodium chloride. The theoretical yield is 4.2 g. What is the percentage yield?

   _____

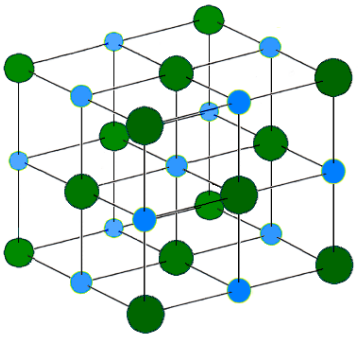
   e) Alice carries out an experiment to make copper sulfate. She obtains 3.93 g of copper sulfate crystals. The theoretical yield is 7.50 g. What is the percentage yield?

   _____

Bonding

- **Compounds**- substances in which 2 or more elements are chemically combined.
- Chemical bonding involves either **transferring** (ionic) of electrons, or the **sharing** (covalent) of electrons on the highest energy level to achieve the electronic structure of a **noble gas**.
- In ionic bonding, ions are formed. Ions have the electronic structure of a **noble gas**.
- **Ions** – Atoms which have lost or gained electron/electrons.

1. IONIC COMPOUNDS



- A giant structure of ions.
- It is held together by **strong electrostatic attraction of oppositely charged ions.**
- The forces act in all directions in the lattice, and this is called ionic bonding.
- They have high melting and boiling points, because a lot of energy is required to break the many strong bonds.
- When dissolved in water or melted, ionic compounds conduct electricity because the ions are free to move and carry current.

An example is sodium chloride (salt): Na+ and Cl-

Group 1 – ALKALI METALS react with non-metals to create an ion with a +1 charge.
Group 7 – HALOGENS react with alkali metals to form halide ions with a -1 charge.

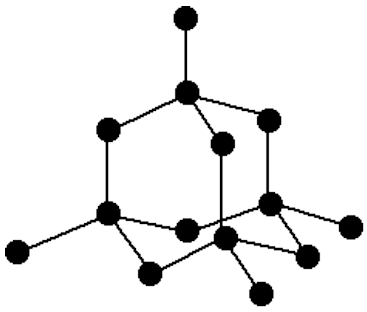
2. COVALENT BONDING

- When atoms share electrons, this is covalent bonding. Covalent bonding is strong.
- Covalently bonded substances consist of simple molecules e.g. HCl, H_2, O_2, Cl_2, NH_3, CH_4.
- Others have giant covalent structures (macromolecules) e.g diamond, silicon dioxide.

Simple Covalent Molecules

- Substances that consist of simple molecules have low boiling and melting points.
- Substances that consist of simple molecules have **weak intermolecular forces between the molecules**. (These are broken in boiling or melting, not the covalent bonds.) Only a small amount of energy is need to break these weak forces so they have low boiling and melting points.
- Substances that consist of simple molecules don't conduct electricity, because simple molecules do not have an overall electric charge.

Giant Covalent structures

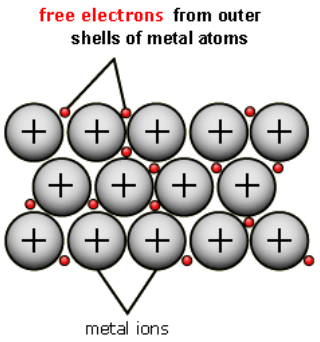


- Examples of covalent structures include diamond and graphite (forms of carbon) and silicon dioxide (silica).
- In diamond (right), each carbon is joined to 4 other carbons covalently. Diamond is very hard.
- In graphite, each carbon is joined to 3 other carbons, forming layers.
- In graphite, the layers can slide over each other due weak intermolecular forces between the layers. This means that graphite is soft and slippery.
- Due to the delocalised electrons in graphite, it can conduct heat and electricity.

Fullerenes

- Carbon can also form fullerenes with different numbers of carbon atoms.
- They are based on hexagonal rings of carbon atoms.
- They can be used as lubricants, to deliver drugs in the body and catalysts.
- Nanotubes can be used for reinforcing materials, for example tennis rackets.

3. METALS



- Metals consist of giant structures of atoms arranged in a regular pattern.
- **Metallic bonding is the electrostatic attraction between the positive metal ions and the delocalised electrons.**
- The electrons on the outer shell of metal ions are delocalised.
- Metals can conduct heat and electricity because of the delocalised electrons in their structures.
- Metals are malleable as the layers of atoms are equally sized so can easily slide over each other, so metals can be bent and shaped.

- Alloys are made from a mixture of 2 or more different types of metals.
- The different sized atoms distort the layers in the structure, making it harder for them to slide over each other. So alloys are harder than pure metals.

Bonding Questions

Draw dot-and-cross diagrams for these molecules/compounds. Remember the bonding could be ionic (metal and non metal) or covalent (non metals only).

(i) H_2

(ii) Cl_2

(iii) NaCl

(iv) Li_2O

(v) NH_3

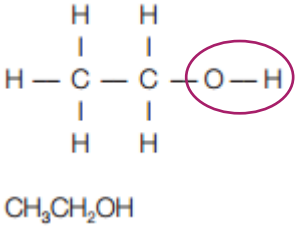
(vi) Al

Organic Chemistry

Alcohols

- Alcohols contain the functional group –OH
- The first 3 members of the series are methanol, ethanol and propanol.

Methanol, ethanol and propanol:



CH_3CH_2OH

- Burn in air
- Dissolve in water to form a neutral solution
- React with sodium to produce hydrogen
- They are used as fuels and solvents, and ethanol is the main alcohol in alcoholic drinks.

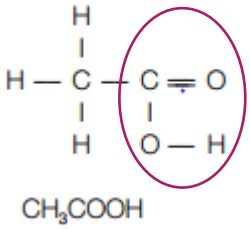
Oxidisation

- Ethanol can be oxidised to form ethanoic acid.
- It can be oxidised by chemical oxidising agents or microbial action.
- Vinegar is an aqueous solution which contains ethanoic acid.

Carboxylic acids

- Ethanoic acid is a member of the carboxylic acids, they have the functional group –COOH.

Carboxylic acids:

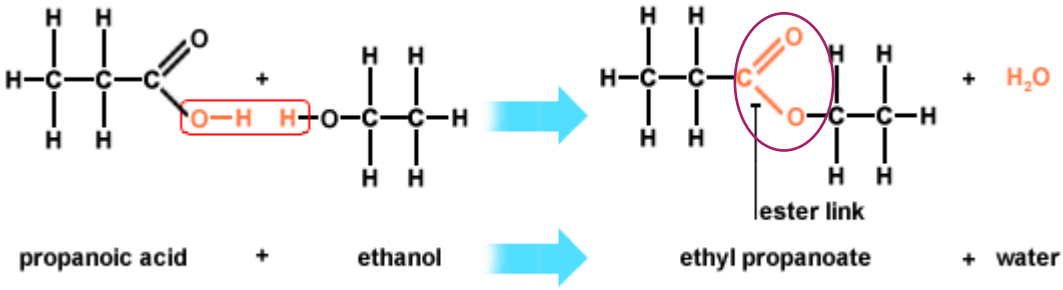


CH_3COOH

- Dissolve in water to produce acidic solutions
- React with carbonates to produce carbon dioxide
- React with ethanol in the presence of an acid catalyst to produce esters
- They do not ionise completely, so do not release many H+ ions, so it is a weak acid.
- This means they have a higher pH (weak acid) than solutions of strong acids of the same concentration.

Esters

- Ethel ethanoate is the ester produced by ethanoic acid and ethanol.
- They have the functional group –COO-.
- They are volatile compounds with distinctive smells and are used as flavourings and perfumes.



Organic Chemistry: Worksheet

Alcohols

Alcohols contain the functional group –OH and have the suffix –ol when naming.
The general formula for alcohols is:

$$C_nH_{2n+1}OH$$

Draw the structures of methanol, ethanol and propanol.

Methanol (CH_3OH)

Ethanol (C_2H_5OH)

Propanol (C_3H_7OH)

Alcohols dissolve in water to form a neutral solution because they have covalent bonds. They react with metals in the same way as water, producing hydrogen when reacted with sodium.
Alcohols combust in the same way as alkanes; reacting with oxygen to form carbon dioxide and water.

Write the word and balanced symbol equations for the combustion of methanol, ethanol and propanol.

Methanol:

Ethanol:

Propanol:

Carboxylic Acids

Ethanol can be oxidised to form ethanoic acid (a carboxylic acid). Carboxylic acids have the functional group –COOH and the suffix –oic acid.

Draw the structures of methanoic acid, ethanoic acid and propanoic acid.

Methanoic acid (HCOOH)

Ethanoic acid (CH_3COOH)

Propanoic acid (CH_3CH_2COOH)

Carboxylic acids react with metal carbonate in the same way as other acids:

Metal Carbonate + Ethanoic Acid $\longrightarrow$ Metal Ethanoate + Carbon Dioxide + Water

Write the word equation for the reaction of calcium carbonate and ethanoic acid below:

Carboxylic acids dissolve in water to form an acidic solution. They are considered to be **weak acids** as they only **partially dissociate** when dissolved in water. This means that not all of the carboxylic acid molecules dissociate into their ions:

$$CH_3COOH \longrightarrow H^+ + CH_3COO^-$$

Strong acids such as hydrochloric acid fully dissociate when dissolved in water:

$$HCl \longrightarrow H^+ + Cl^-$$

This means that every HCl molecule will dissociate to form the positive and negative ions.
Strong acids have low pH's of 1. Weak acids have higher pH's of 5 or 6.

Esters

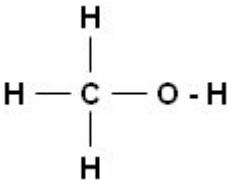
Carboxylic acids and alcohols react together in the presence of an acid catalyst to produce **esters**. Esters have the functional group –COO–.

Ethyl ethanoate is the ester formed from ethanol and ethanoic acid. *Draw the structure of ethyl ethanoate below:*

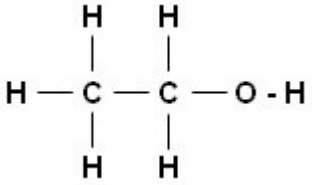
Esters have distinctive smells and are used as flavourings and perfumes.

Exam Questions

Q1. The structures shown are of the first two members of a homologous series of organic compounds.



Methanol



Ethanol

(a) (i) Complete the diagram for propanol, the next member of the homologous series.

C — C — C

Propanol

(1)

(ii) Which **one** of the statements about ethanol is correct? Tick (✓) **one** box.

Statement	Tick (✓)
Ethanol dissolves in water to form a neutral solution.	
Ethanol reacts with sodium to produce chlorine.	
Ethanol does **not** burn in air.	

(b) Ethanoic acid (CH_3COOH) can be produced from ethanol (CH_3CH_2OH).

(i) What type of reaction happens when ethanoic acid is produced from ethanol?

.....

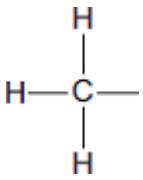
(ii) State one use of ethanoic acid.

.....

Q2. This question is about organic compounds.

(a) Wine contains ethanol (CH_3CH_2OH).

(i) Complete the displayed structure of ethanol.



(1)

(ii) Wine left in a glass for several days turns sour. The sour taste is caused by ethanoic acid.

Complete the sentences.

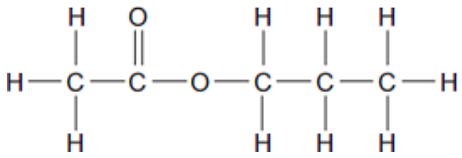
The ethanoic acid is produced from a reaction between ethanol and ..... .

This type of reaction is ..... .

(2)

(b) Propyl ethanoate, a fragrance, can be produced by reacting ethanoic acid with an alcohol. Propyl ethanoate is a member of a series of organic compounds. The members of the series all have the same functional group.

The displayed structure of propyl ethanoate is:



(i) Draw a ring around the functional group for this series on the displayed structure of propyl ethanoate.

(1)

(ii) Name the series of organic compounds with this functional group.

.....

(1)

(iii) The alcohol used to make propyl ethanoate has the formula $CH_3CH_2CH_2OH$

Name this alcohol.

.....

(1) (Total 6 marks)