OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

CHEMISTRY B

Unit 2 Modules C4 C5 C6 (Higher Tier)

B642/02

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Wednesday 26 January 2011
Afternoon

Duration: 1 hour

B642/02

B621910111

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

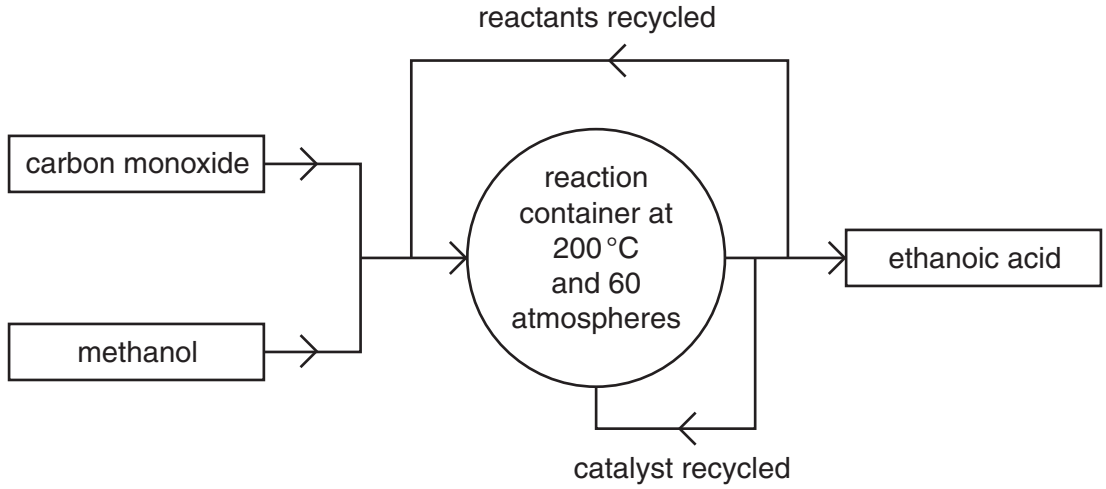
Answer **all** the questions.

Section A – Module C4

1 Ethanoic acid is an important industrial chemical.

Large amounts of ethanoic acid are needed every day.

Look at the flow chart. It shows how ethanoic acid is manufactured.



(a) Write down the **word** equation for the manufacture of ethanoic acid.

..... **[1]**

(b) Suggest **two** ways in which the cost of manufacturing ethanoic acid is reduced.

Use the flow chart to help.

1 .....

.....

2 .....

..... **[2]**

(c) Kritica is a research chemist.

She investigates the percentage yield of ethanoic acid as the conditions change.

The conditions she changes are the **temperature** and the **pressure**.

Look at the table. It shows the results of her investigation.

pressure in atmospheres	percentage yield at 100 °C	percentage yield at 300 °C	percentage yield at 500 °C	percentage yield at 700 °C
20	50	43	32	19
40	80	76	68	56
60	94	92	89	85
80	98	97	95	92
100	99	99	98	97

(i) Look at the column for **100 °C.**

How does increasing the **pressure** change the percentage yield?

..... **[1]**

(ii) How does increasing the **temperature** change the percentage yield?

..... **[1]**

[Total: 5]

2 Luke uses the internet to find information about some salts.

Look at the table. It shows the information Luke finds.

name of salt	formula of salt	ions present in salt
ammonium phosphate	$(NH_4)_3PO_4$	ammonium and phosphate
barium sulfate	$BaSO_4$	barium and sulfate
lead(II) nitrate	$Pb(NO_3)_2$	lead and nitrate
potassium iodide	KI	potassium and iodide
potassium nitrate	KNO_3	potassium and nitrate

(a) How many **atoms** are there in the formula for lead(II) nitrate?

..... **[1]**

(b) **(i)** What is the relative formula mass, M_r, of ammonium phosphate?

The relative atomic mass, A_r, of N = 14, of H = 1, of P = 31 and of O = 16.

.....

.....

.....

relative formula mass, M_r, = ... **[1]**

(ii) What is the percentage by mass of **phosphorus** in ammonium phosphate?

.....

.....

.....

percentage of phosphorus = ...% **[1]**

(c) A solution of silver nitrate is mixed with a solution of potassium iodide.

A yellow precipitate of silver iodide, AgI, is made.

Potassium nitrate solution is also made.

Write a **balanced symbol** equation for this reaction.

..... **[1]**

(d) Luke decides to make barium sulfate by reacting barium chloride with ammonium sulfate.

Luke starts with 2.00 g of barium chloride.

He does not get a 100 % yield of barium sulfate.

He predicts he should make 2.24 g of barium sulfate.

He actually makes 1.68 g of barium sulfate.

What is his percentage yield of barium sulfate?

.....

.....

.....

percentage yield = ...% **[2]**

[Total: 6]

3 Farmers use fertilisers to increase crop yield and make more money.

Look at the table. It shows some synthetic fertilisers.

synthetic fertiliser	formula of salt
ammonium phosphate	$(NH_4)_3PO_4$
potassium sulfate	K_2SO_4
sodium nitrate	$NaNO_3$
potassium phosphate	K_3PO_4

(a) Some fertilisers contain an essential element that is used to make proteins in plants.

Write down the names of these synthetic fertilisers.

Choose **two** fertilisers from the table.

..... and .....**[1]**

(b) Farmers sometimes put too much fertiliser on their fields.

This can cause **eutrophication**.

Look at the statements. They describe how eutrophication happens.

Put the statements in order by using numbers 1 to 6.

The first one has been done for you.

statement	number
aquatic animals in the river die	
algal bloom blocks sunlight	
other green plants in the river die and aerobic bacteria feed off these dead plants	
concentration of nitrate ions in the river water increases so algae grow rapidly	
rain washes away fertiliser from fields	1
concentration of oxygen in the river water decreases	

[2]

(c) Ammonium phosphate can be made by the reaction of an acid and an alkali.

Describe the preparation of a neutral solution of ammonium phosphate.

Include in your answer

- the name of the acid and the name of the alkali
- the experimental method used
- how a neutral solution is obtained.

A labelled diagram may help you answer the question.

.....

.....

.....

.....

.....

.....

.....

.....

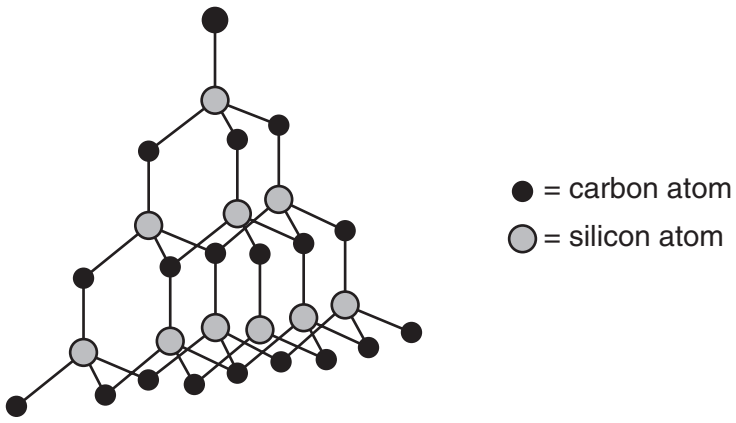
.....

[3]

[Total: 6]

4 Silicon carbide, SiC, is used in cutting tools.

Look at the diagram. It shows the structure of silicon carbide.



silicon carbide

Silicon carbide and diamond have similar structures.

(a) Silicon carbide has a high melting point.

Suggest why. Use ideas about the structure of silicon carbide.

.....

.....

.....

..... **[2]**

(b) Silicon carbide is used in cutting tools.

One reason for this is that it has a high melting point.

Suggest one **other** reason why silicon carbide is used in cutting tools.

..... **[1]**

[Total: 3]

Section B – Module C5

5 Sodium peroxide has the formula Na_2O_2.

(a) What is the **empirical** formula of sodium peroxide?

Choose from the list.

Na_2O

NaO_2

NaO

Na_2O_2

Na_4O_4

answer ..... **[1]**

(b) Sodium peroxide reacts with water to make oxygen.

Look at the equation for this reaction.

$$2Na_2O_2(s) + 2H_2O(l) \rightarrow 4NaOH(aq) + O_2(g)$$

Chloe finds that 7.80 g of sodium peroxide makes 1.60 g of oxygen.

What mass of oxygen can be made from 1.95 g of sodium peroxide?

.....

.....

.....

mass of oxygen = ... g **[2]**

(c) The relative atomic mass, A_r, of sodium is 23.

Complete the following sentence about relative atomic mass.

Use words from the list.

carbon-12 **carbon-13** **hydrogen**

oxygen-16 **sodium-23**

The relative mass of sodium is the average mass of a sodium atom compared to

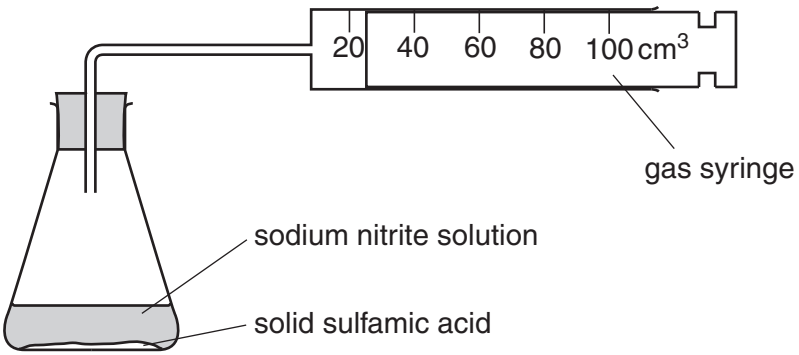
$1/12^{th}$ the mass of an atom of ..... . **[1]**

[Total: 4]

6 Jenny investigates the reaction between **excess** sulfamic acid and sodium nitrite solution.

Solid sulfamic acid reacts with sodium nitrite solution to make nitrogen.

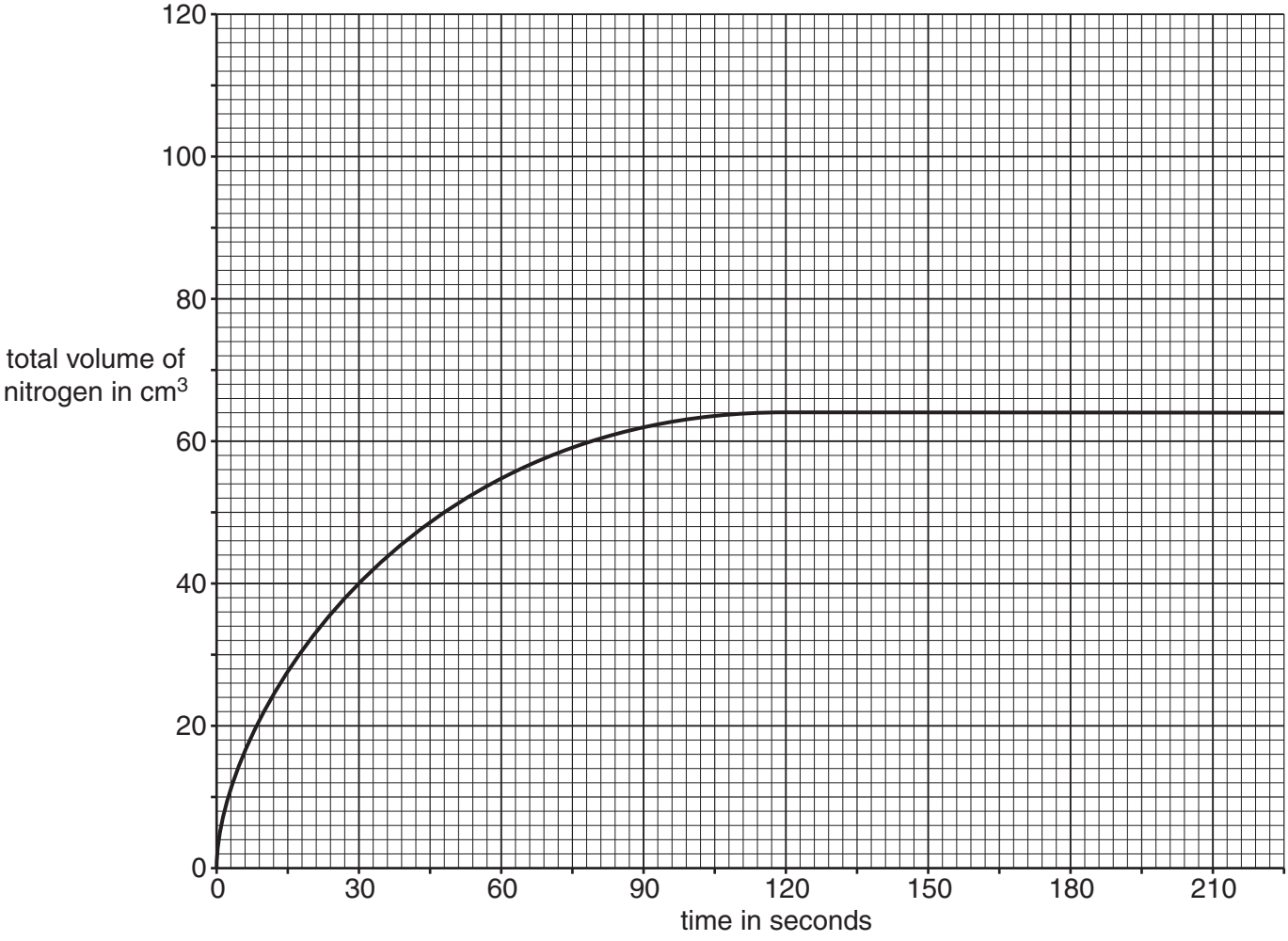
Look at the apparatus she uses.



Jenny measures the total volume of gas in the gas syringe every 30 seconds.

She plots the results on a graph.

Look at the graph.



(a) Look at the graph.

(i) What is the total volume of nitrogen made at the end of the reaction?

..... cm^3 **[1]**

(ii) The reaction is done at room temperature and pressure.

What is the total number of moles of nitrogen made after 30 seconds?

One mole of nitrogen occupies a volume of 24 000 cm^3 (24 dm^3) at room temperature and pressure.

.....

.....

.....

answer = ... moles **[2]**

(b) Sodium nitrite is the **limiting** reactant.

What does this mean?

.....

..... **[1]**

(c) Sulfamic acid is a **weak acid**.

What is a weak acid?

.....

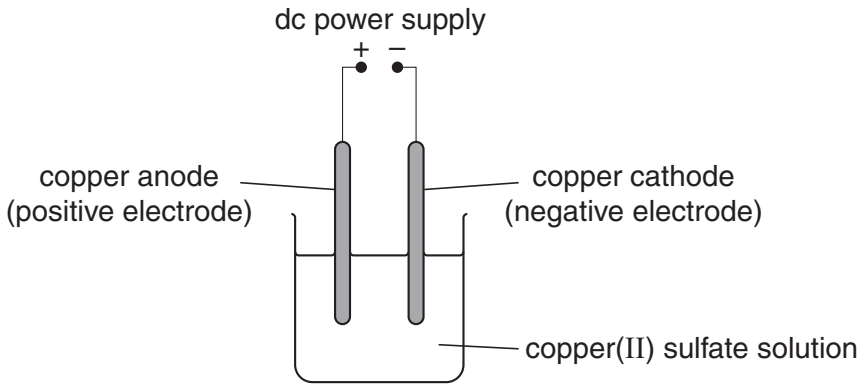
.....

..... **[2]**

[Total: 6]

7 Aimee investigates the factors that affect the electrolysis of copper(II) sulfate solution.

Look at the apparatus she uses.



Aimee finds the mass of the copper cathode.

Aimee then passes an electric current through the copper(II) sulfate solution.

After the electrolysis she dries the cathode and finds its mass again.

Aimee repeats the electrolysis several times.

She changes the time taken to do the electrolysis.

She also changes the size of the current used.

Look at her results table.

experiment number	current used in amps	time taken in seconds	mass of cathode	
			before starting in grams	after electrolysis in grams
1	2.0	180	1.24	1.36
2	4.0	180	1.20	1.44
3	2.0	360	1.34	1.58

(a) (i) In experiment **3** Aimee also measures the mass of the anode before the electrolysis.

The mass was 1.12 g.

Predict the mass of the anode at the end of the electrolysis.

Use information from the table of results.

.....

.....

mass of anode = ... g **[1]**

(ii) What is the effect of increasing the time on the mass of copper made at the cathode?

..... **[1]**

(iii) What is the effect of increasing the current on the mass of copper made at the cathode?

..... **[1]**

(b) At the anode copper atoms lose electrons to make copper ions, Cu^{2+}.

Write down the **symbol equation** for this reaction.

Use e^- to represent an electron.

..... **[2]**

[Total: 5]

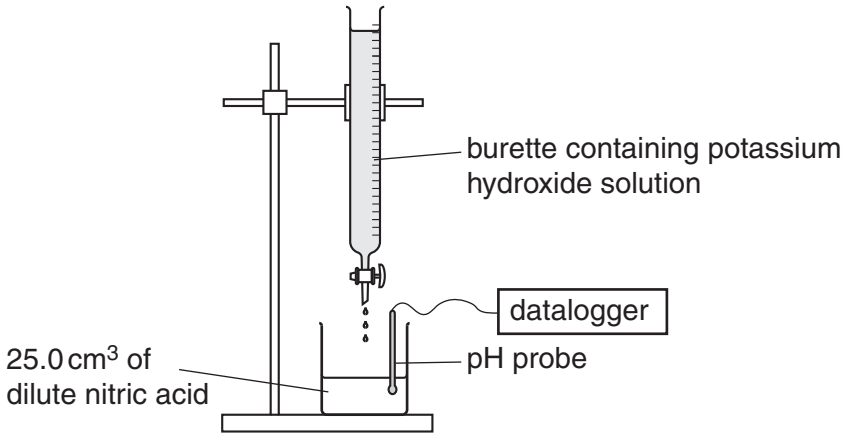
8 Zak investigates the neutralisation of dilute nitric acid.

He measures out 25.0 cm^3 of 0.150 mol/dm^3 dilute nitric acid.

He puts this acid into a beaker.

Zak reacts the dilute nitric acid with an alkali, potassium hydroxide solution.

Look at the diagram. It shows the apparatus he uses.

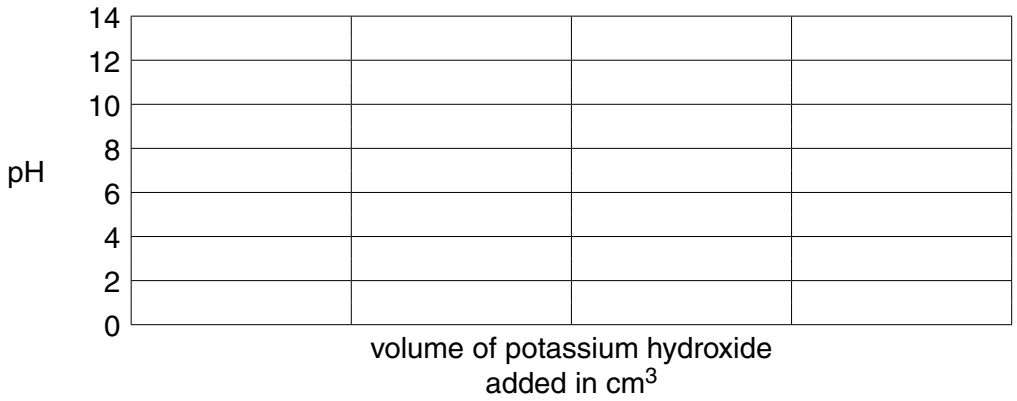


Zak slowly adds the alkali to the dilute nitric acid.

He uses a pH probe to measure the pH of the solution in the beaker.

(a) The pH of the solution in the beaker changes as more and more potassium hydroxide is added.

Draw a sketch graph to show how the pH changes.



[2]

(b) Zak uses 25.0 cm^3 of 0.150 mol/dm^3 dilute nitric acid.

How many moles of nitric acid does Zak use?

.....

.....

.....

number of moles = ... **[1]**

(c) Zak repeats the experiment but does not use the datalogger and the pH probe.

He wants to find the volume of potassium hydroxide solution that will just neutralise the nitric acid.

He puts two drops of litmus solution into the beaker.

(i) Describe how Zak can tell when the dilute nitric acid has just been neutralised.

.....

..... **[1]**

(ii) Explain why universal indicator would be less suitable than litmus solution.

.....

.....

..... **[1]**

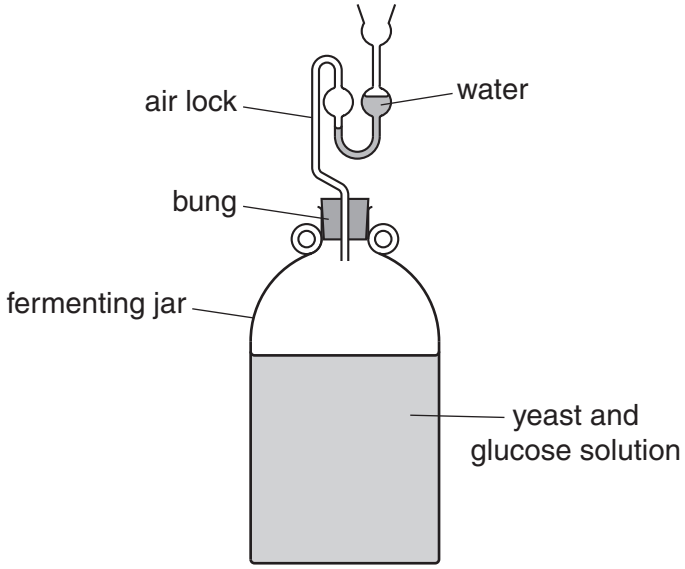
[Total: 5]

Section C – Module C6

9 This question is about ethanol.

Look at the diagram.

It shows how ethanol can be made by fermentation.



(a) (i) The air lock prevents air entering the reaction mixture.

Why is it important to keep air out of the reaction mixture?

..... **[1]**

(ii) The optimum temperature for fermentation is between 25 °C and 50 °C.

Temperatures of 0 °C or 70 °C are not used for fermentation.

Explain why.

0 °C .....

.....

70 °C .....

..... **[2]**

(b) Ethanol can also be made by reacting ethene with water (steam).

Write down the **word** equation for this reaction.

..... **[1]**

[Total: 4]

10 This question is about rusting.

(a) The rusting of iron involves both oxidation and reduction.

Write down the name of this type of reaction.

..... **[1]**

(b) Galvanised iron is iron coated in a thin layer of zinc.

The iron does not rust.

Write about the ways in which zinc prevents iron rusting.

.....

.....

.....

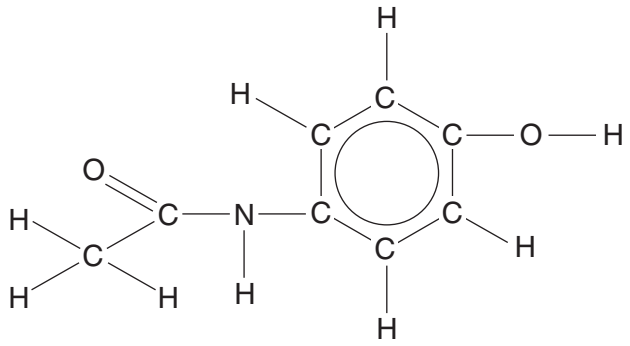
..... **[2]**

[Total: 3]

11 This question is about analgesics.

(a) Look at the table. It shows some displayed and molecular formulas.

Complete the table.

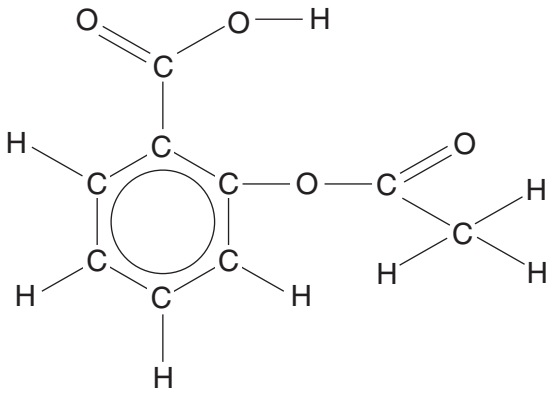
name of compound	molecular formula of compound	displayed formula of compound
ethanol	C_2H_6O	
paracetamol		

[3]

(b) Look at the displayed formula of aspirin.

In this form aspirin does not dissolve in water.

What change is made to the structure of aspirin to make it soluble?



You can draw on the structure to help explain your answer.

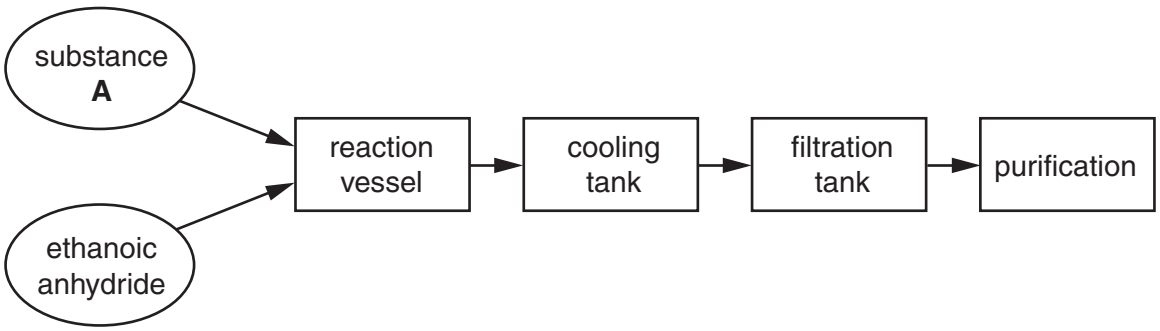
.....

.....

..... **[1]**

(c) Look at the flow chart.

It shows how aspirin is made.



Aspirin is made from two chemicals.

One chemical is ethanoic anhydride, the other chemical is substance **A**.

Write down the name of substance **A**.

Choose from the list.

ethanoic acid **ethanol** **glycerol** **salicylic acid**

answer ..... **[1]**

[Total: 5]

12 This question is about hardness in water.

Hardness in water is caused by chemicals dissolved in the water.

There are two types of hardness, temporary and permanent.

Write down the name of a chemical which causes **temporary** hardness.

Choose from the list.

calcium hydrogencarbonate

calcium sulfate

sodium carbonate

sodium chloride

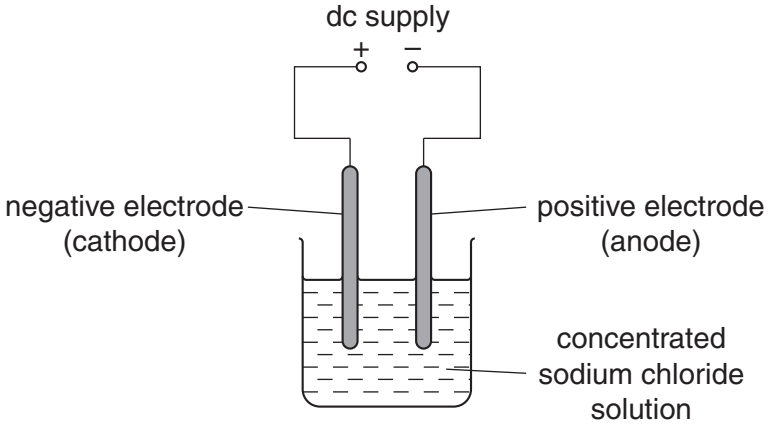
answer ..... **[1]**

[Total: 1]

13 Ahmed carries out an experiment on electrolysis.

He uses **concentrated** sodium chloride, NaC*l*, solution as the electrolyte.

Look at the apparatus he uses.



(a) (i) Hydrogen gas is given off at the cathode.

Write down the name of the gas given off at the **anode**.

..... **[1]**

(ii) Hydrogen ions, H^+, gain electrons to make hydrogen gas, H_2.

Write down the **balanced symbol** equation for this reaction.

Use e^- to represent an electron.

..... **[2]**

(b) Hydrogen is used in a fuel cell.

Hydrogen reacts with oxygen. Energy is given out.

Write down the name of the **type** of reaction that gives out energy.

Choose from the list.

displacement

endothermic

exothermic

fermentation

answer ..... **[1]**

[Total: 4]

14 This question is about oils and fats.

Sunflower oil contains unsaturated molecules.

An unsaturated molecule has at least one double bond between carbon atoms.

(a) Jean tests the sunflower oil for unsaturation.

Write about how she carries out this test.

Your answer should include

- the name of the chemical she uses
- any colour changes she would see.

.....

.....

.....

..... **[2]**

(b) Sunflower oil is heated with sodium hydroxide solution.

Glycerol and soap are produced.

Write down the name of this chemical process.

Choose from the list.

displacement

electrolysis

precipitation

saponification

answer ..... **[1]**

[Total: 3]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.