Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | | | | | |

Candidate Number | | | | |

Pearson Edexcel International GCSE (9–1)

Time 1 hour 15 minutes

Paper reference **4CH1/2C**

Chemistry

Unit: 4CH1
PAPER: 2C

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Pearson

The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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						

***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.

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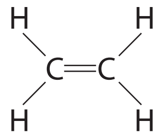
Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 This question is about the unsaturated hydrocarbon, ethene.

The displayed formula of ethene is



(a) (i) State the meaning of the term **hydrocarbon**.

(2)

....

....

....

....

(ii) Give the reason why ethene is described as unsaturated.

(1)

....

....

(b) Ethene is bubbled through bromine water until there is no further colour change.

Which of these is the appearance of the solution formed?

(1)

☒ **A** colourless

☒ **B** orange

☒ **C** purple

☒ **D** red

(c) Ethanol is produced industrially by the reaction between ethene and steam.

The equation for the reaction is

$$CH_2CH_2(g) + H_2O(g) \rightarrow CH_3CH_2OH(l)$$

(i) State the temperature and pressure used in this reaction.

(2)

temperature ....

pressure ....

(ii) Give the **molecular** formula of ethanol.

(1)

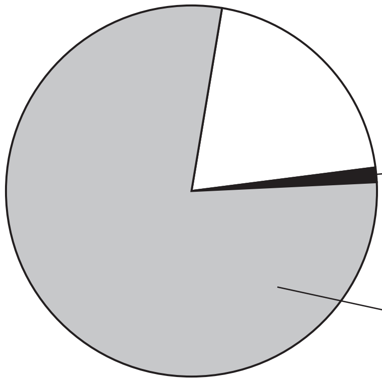
....

(Total for Question 1 = 7 marks)

2 This question is about gases in the air.

The pie chart represents the percentages of gases in dry, unpolluted air.

Gases with percentages of less than 1% in air are called trace gases.



(a) (i) Which of these is gas Z?

(1)

☒ **A** hydrogen

☒ **B** methane

☒ **C** neon

☒ **D** nitrogen

(ii) Which of these is the approximate percentage of oxygen in dry, unpolluted air?

(1)

☒ **A** 0.04%

☒ **B** 0.9%

☒ **C** 21%

☒ **D** 35%

(b) One of the trace gases is carbon dioxide.

(i) Identify **two** reactions that produce carbon dioxide by placing a tick (✓) in two boxes.

(2)

cracking an alkane	
complete combustion of an alkane	
reaction between magnesium and hydrochloric acid	
rusting of iron	
thermal decomposition of copper(II) carbonate	

(ii) Name an environmental problem that is caused by the percentage of carbon dioxide increasing in the atmosphere.

(1)

....

(iii) Name the trace gas with the highest percentage in dry, unpolluted air.

(1)

....

(c) Rainwater is acidic because carbon dioxide dissolves in water to form carbonic acid.

Acid rain is more acidic than rainwater because acidic pollutant gases also dissolve in water.

(i) Give the name of the acid that forms when nitrogen dioxide dissolves in water.

(1)

....

(ii) Name another pollutant gas that also forms acid rain.

(1)

....

(Total for Question 2 = 8 marks)

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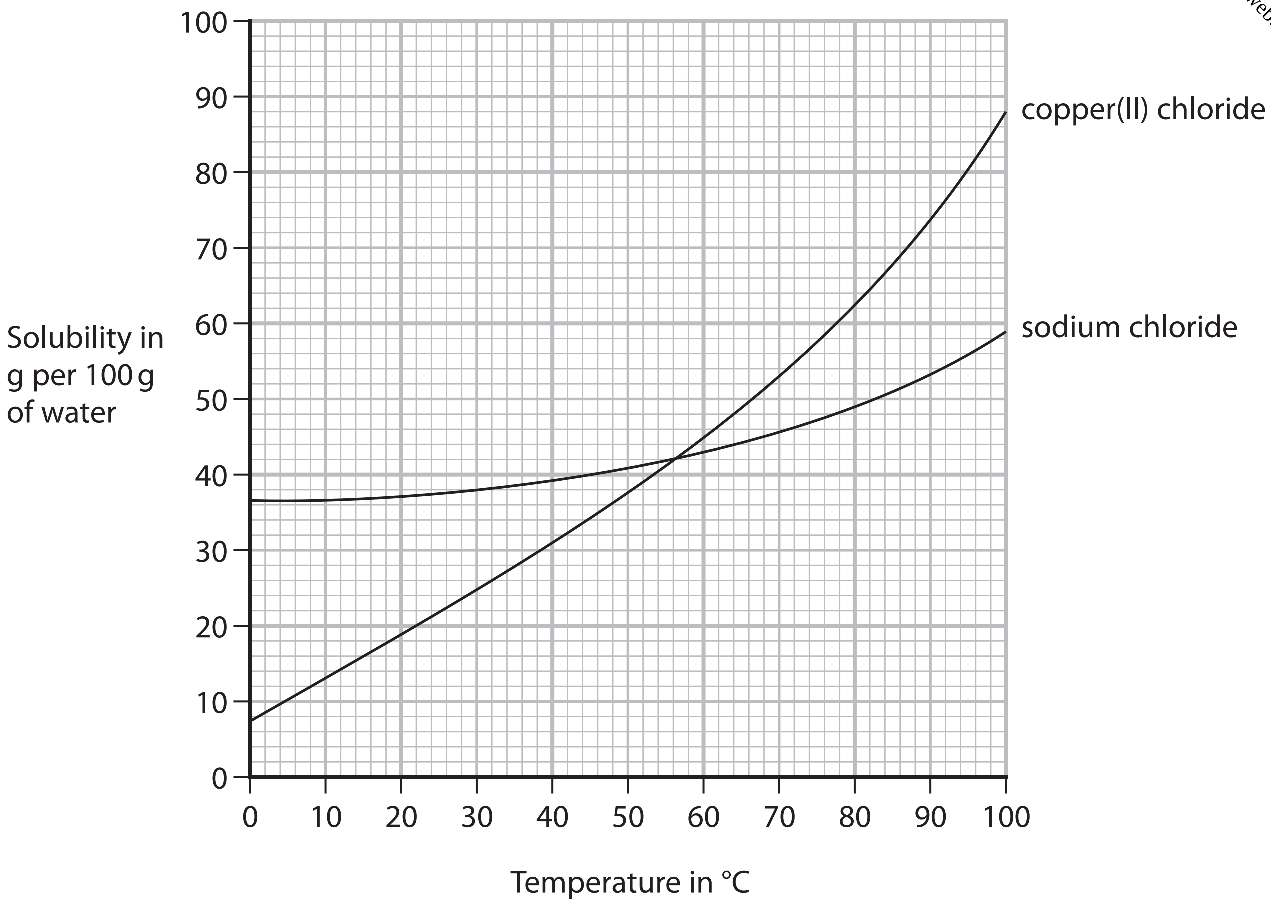
3 This question is about solubility.

(a) The graph shows the solubilities of copper(II) chloride and sodium chloride at different temperatures.



(i) Determine the temperature at which copper(II) chloride and sodium chloride have the same solubility.

Show on the graph how you obtained your answer.

(2)

temperature = ... °C

(ii) A saturated solution of copper(II) chloride in 100 g of water is cooled from 40 °C to 10 °C.

Determine the mass, in grams, of copper(II) chloride that crystallises.

(2)

mass of copper(II) chloride = ... g

(iii) Calculate the solubility of potassium chloride in grams per 100 grams of water.

(2)

solubility = ... g per 100 g of water

(iv) Suggest why the student's method is **not** suitable for determining the solubility of hydrated copper(II) sulfate.

(1)

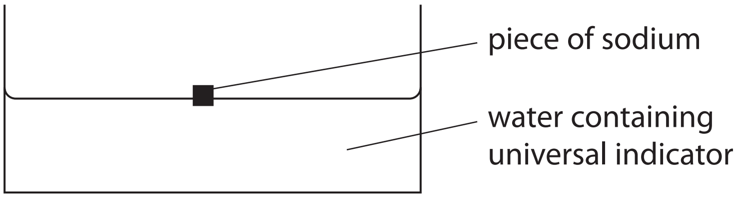
....

....

(Total for Question 3 = 9 marks)

4 This question is about the reactions of Group 1 metals with water.

(a) A teacher adds a piece of sodium to some water containing universal indicator.



The equation for this reaction is

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

The sodium floats on the surface of the water and the universal indicator changes colour because an alkaline solution is formed.

(i) Give two other observations.

(2)

1 ....

....

2 ....

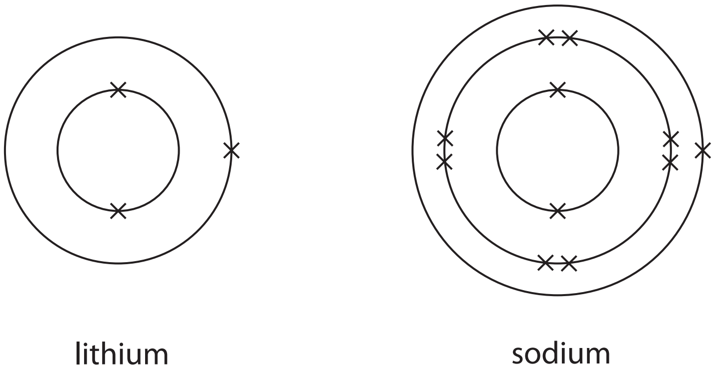
....

(ii) Give the final colour of the universal indicator.

(1)

....

(b) The diagram represents an atom of lithium and an atom of sodium.



(i) Give a reason why lithium and sodium have similar reactions with water.

(1)

....

....

(ii) Explain why lithium is less reactive than sodium.

(3)

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....

(c) The teacher adds 0.150 g of lithium to an excess of water and collects the hydrogen gas produced.

The equation for the reaction is

$$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$$

The teacher collects 254 cm^3 of hydrogen gas at room temperature and pressure (rtp).

Show by calculation that 1 mol of hydrogen gas has a volume of approximately 24 000 cm^3 at rtp.

(4)

(Total for Question 4 = 11 marks)

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5 Hydrogen peroxide solution decomposes to give water and oxygen gas.

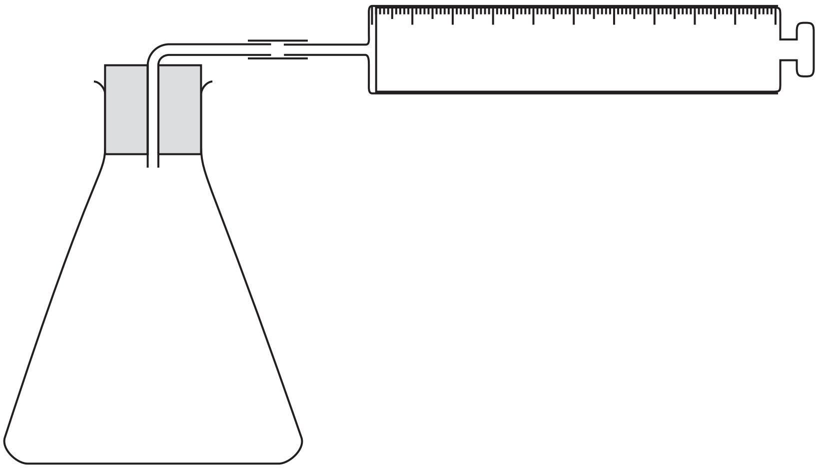
The equation for this reaction is

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

(a) Three different solids are catalysts for the decomposition of hydrogen peroxide solution.

A student is given hydrogen peroxide solution and a sample of each of the solid catalysts.

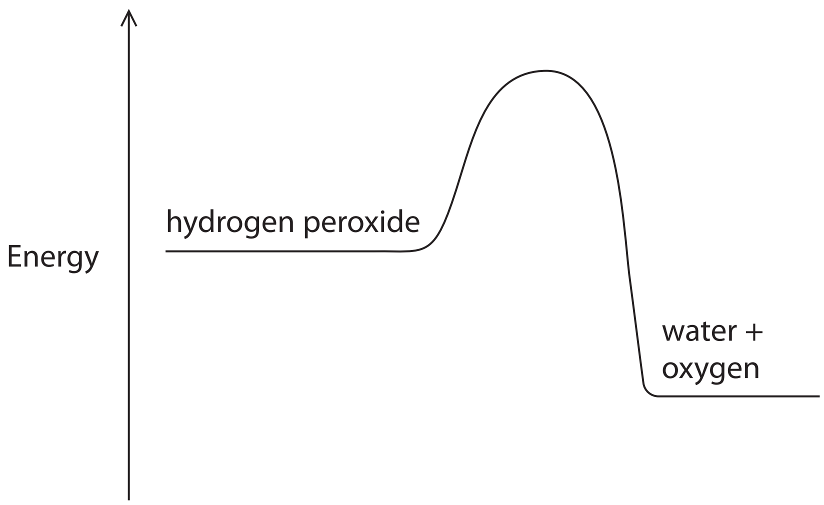
The student has a timer, a measuring cylinder, a balance and the apparatus shown in the diagram.



Describe a method the student could use to find which of the three solids is the most effective catalyst for the decomposition of hydrogen peroxide solution.

(5)

(b) The diagram shows the reaction profile for the decomposition of hydrogen peroxide without a catalyst.



(i) Label the diagram to show the activation energy (E_a) and the enthalpy change (ΔH) for this reaction.

(2)

(ii) On the diagram, draw a curve to show the reaction profile for the same reaction when a catalyst is used.

(1)

(Total for Question 5 = 8 marks)

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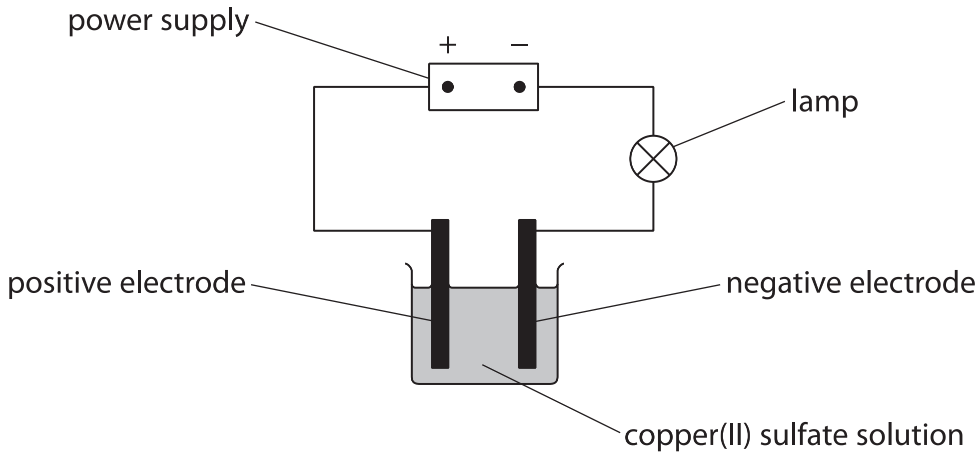
6 This question is about the electrolysis of copper(II) sulfate solution.

(a) The diagram shows the apparatus used for the electrolysis.



A student records the total increase in mass of the negative electrode every minute for 8 minutes.

The table shows the results.

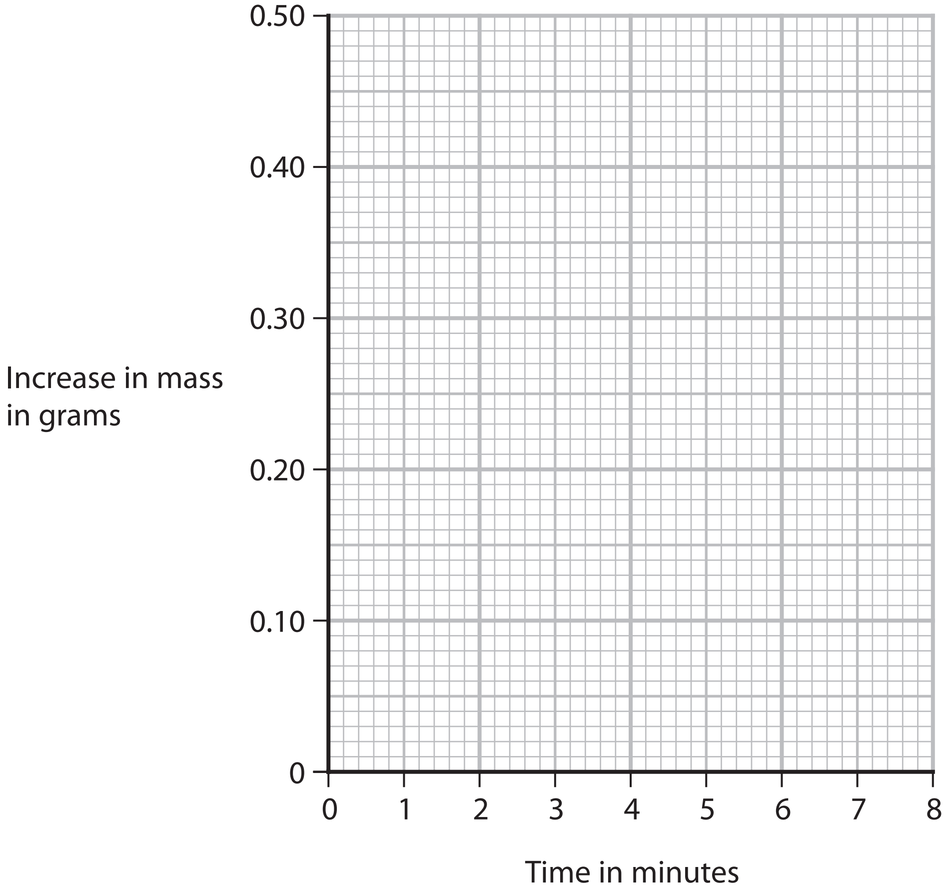
Time in minutes	**Total increase in mass of the negative electrode in grams**
0	0.00
1	0.15
2	0.27
3	0.34
4	0.39
5	0.41
6	0.42
7	0.42
8	0.42

(i) Plot the student's results.

(1)

(ii) Draw a curve of best fit.

(1)



(iii) Explain the shape of the graph.

(2)

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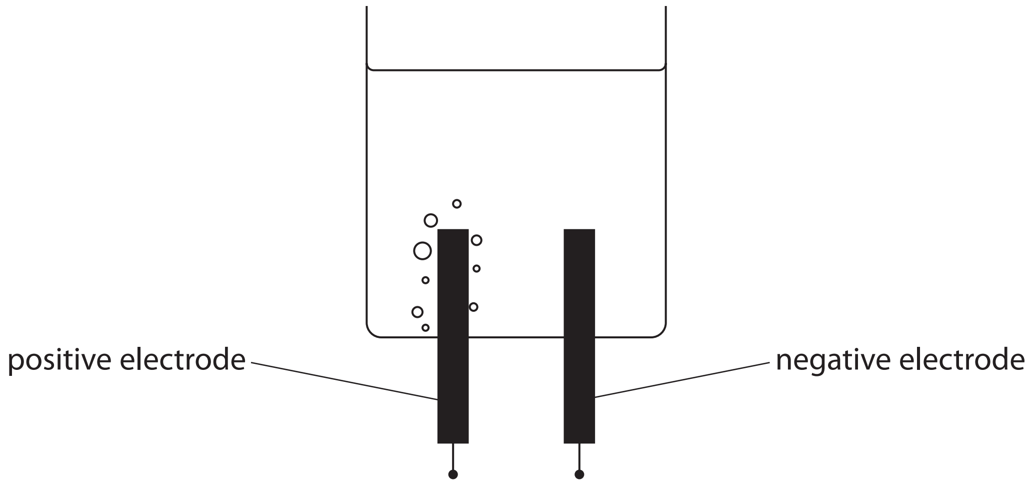
(b) The product at the positive electrode is oxygen gas.

(i) The student repeats the electrolysis using different apparatus.



Describe how the student should collect a sample of pure oxygen at the positive electrode.

(2)

....

....

....

....

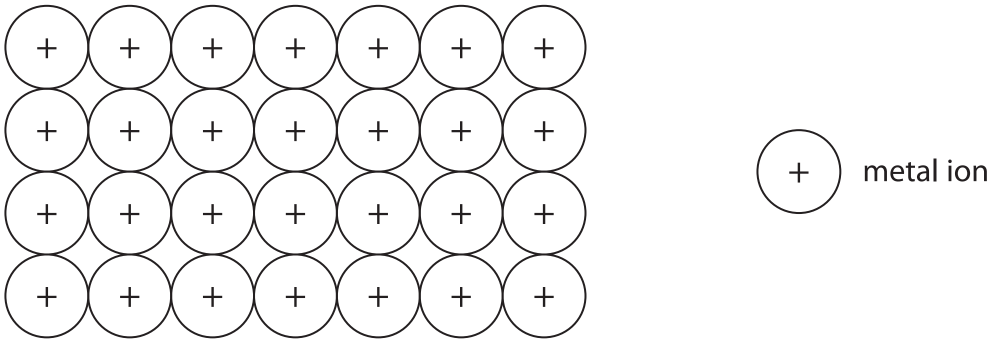
(ii) Give an ionic half-equation for the formation of oxygen.

(2)

....

(c) The wire used to connect the power supply to the electrodes is made of copper metal.

The diagram shows the arrangement of the ions in a metal.



(i) Metals that are malleable can also be stretched to form long, thin wires.

Suggest why metals can be stretched to form wires.

(2)

....

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....

(ii) Explain why metals conduct electricity.

(2)

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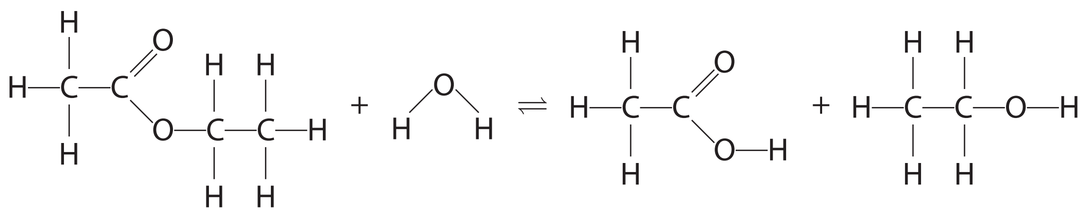
(Total for Question 6 = 12 marks)

7 This question is about esters.

Ester A reacts with water to form ethanoic acid and ethanol.

The displayed formulae of the reactants and products are shown in this equation



ester A

The molar enthalpy change (ΔH) for the reaction is 0 kJ/mol.

(a) (i) Draw a ring around the functional group in ester A.

(1)

(ii) Give the name of ester A.

(1)

....

(iii) Describe a chemical test, other than using an indicator, to show that the reaction mixture contains ethanoic acid.

(2)

....

....

....

....

(b) Explain why the molar enthalpy change (ΔH) for the reaction between ester A and water is 0 kJ/mol.

In your answer, refer to the bonds broken and the bonds formed.

(2)

....

....

....

....

(c) A mixture of ester A and water is left in a sealed container until the reaction mixture reaches dynamic equilibrium.

(i) Describe what is meant by dynamic equilibrium.

(2)

....

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....

....

(ii) Explain why adding a catalyst does not change the position of equilibrium.

(2)

....

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....

....

(d) The ethanoic acid produced in the reaction is completely neutralised by 22.75 cm^3 of 0.150 mol/dm^3 barium hydroxide solution.

The equation for the neutralisation reaction is

$$2CH_3COOH + Ba(OH)_2 \rightarrow Ba(CH_3COO)_2 + 2H_2O$$

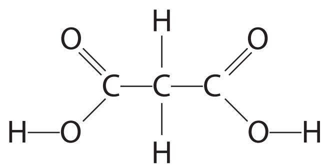
Calculate the amount, in moles, of ethanoic acid neutralised.

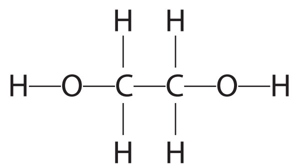
Give your answer to 3 significant figures.

(3)

amount = ... mol

(e) The structures of two organic compounds are shown.





These compounds react together to form a polymer.

Give the repeat unit of the polymer formed.

(2)

(Total for Question 7 = 15 marks)

TOTAL FOR PAPER = 70 MARKS

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