Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number	Candidate Number

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Wednesday 21 June 2017 – Morning **Time: 1 hour**	Paper Reference **5CH3H/01**

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.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 8 5 8 4 A 0 1 2 0

Pearson

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.

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Questions begin on next page.

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 ☒.

Alcohols

1 (a) The names and formulae of the first three alcohols in the homologous series of alcohols are given in the table.

name of alcohol	formula
methanol	CH_3OH
ethanol	C_2H_5OH
propanol	C_3H_7OH

(i) Pentanol is another member of the alcohol homologous series.
A molecule of pentanol contains five carbon atoms.

Predict the formula of a molecule of pentanol.

(1)

.....

(ii) Draw the structure of a molecule of ethanol, C_2H_5OH, showing all the bonds.

(1)

(b) When ethanol vapour is passed over hot aluminium oxide, the ethanol forms water and one other product.

(i) Complete the balanced equation for this reaction.

(2)

$C_2H_5OH \rightarrow$ ..... + ...

(ii) Which type of reaction occurs when ethanol forms the products in this reaction?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** dehydration

☒ **B** distillation

☒ **C** hydration

☒ **D** oxidation

(c) Ethanol can be used as a fuel.

Which of these is the balanced equation for the complete combustion of ethanol?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** $C_2H_5OH + 2O_2 \rightarrow 2CO_2 + 3H_2O$

☒ **B** $2C_2H_5OH + 5O_2 \rightarrow 4CO_2 + 6H_2O$

☒ **C** $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

☒ **D** $2C_2H_5OH + 7O_2 \rightarrow 4CO_2 + 6H_2O$

(Total for Question 1 = 6 marks)

Carboxylic acids and esters

2 (a) Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

Ethanol can react to form ethanoic acid, CH_3COOH.

In this reaction ethanol is

☒ **A** neutralised

☒ **B** oxidised

☒ **C** precipitated

☒ **D** reduced

(b) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all the bonds.

(1)

(c) When a piece of magnesium ribbon is added to dilute ethanoic acid, a reaction occurs.

(i) Complete the word equation for this reaction.

(2)

magnesium + ethanoic acid → +

(ii) State what is **seen** during this reaction.

(1)

.....

.....

(d) Esters are useful organic compounds.

Describe a use of esters.

(2)

.....

.....

.....

(e) Describe how a fat can be reacted to form a soap.

(2)

.....

.....

.....

(Total for Question 2 = 9 marks)

3 (a) Give the name or the formula of an ion that causes hardness in water.

(1)

.....

(b) **A**, **B** and **C** are samples of hard water from three different sources.

A 10 cm^3 sample of each is tested for hardness by adding soap solution, from a burette, until a permanent lather is formed.
Another 10 cm^3 sample of each of **A**, **B** and **C** was boiled and then tested in the same way.

The results are shown.

water sample	volume of soap solution needed to form permanent lather / cm^3	
	before boiling	after boiling
A	10.2	0.1
B	20.0	20.0
C	35.3	12.2

There are two types of hardness, temporary and permanent.

Explain, using the information in the table, the types of hardness in each of the hard waters **A**, **B** and **C**.

(3)

.....

.....

.....

.....

.....

.....

(c) A solution of zinc chloride, $ZnCl_2$, is prepared by reacting zinc carbonate, $ZnCO_3$, with dilute hydrochloric acid.

(i) Write the balanced equation for this reaction.

(3)

.....

(ii) A solution of zinc chloride, $ZnCl_2$, has a concentration of 0.25 mol dm^{-3}.

Calculate the concentration of this solution in g dm^{-3}.

(relative atomic masses: Zn = 65, Cl = 35.5)

(2)

.....

.....

.....

.....

concentration of solution = ... g dm^{-3}

(d) In an experiment, 25.0 cm^3 samples of a solution of sodium hydroxide, NaOH, were titrated with 0.095 mol dm^{-3} hydrochloric acid, HCl.

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

18.5 cm^3 of the hydrochloric acid neutralised 25.0 cm^3 of the sodium hydroxide solution.

Calculate the concentration of the sodium hydroxide solution, NaOH, in mol dm^{-3}.

(2)

.....

.....

.....

.....

.....

.....

concentration of sodium hydroxide solution = ... mol dm^{-3}

(Total for Question 3 = 11 marks)

Analysis

4 (a) Excess dilute sulfuric acid is added to a solid sample of a copper compound.
A gas is given off and a blue solution is formed.

(i) The gas turns limewater cloudy.

Explain how this result is used to identify the anion in the copper compound.

(2)

.....

.....

.....

.....

(ii) When sodium hydroxide solution is added to the blue solution,
a pale blue precipitate is formed.

Give the name or the formula of the pale blue precipitate.

(1)

.....

(iii) The blue solution contains sulfate ions.
Barium chloride solution is added to this blue solution.
A white precipitate of barium sulfate forms.

Write the ionic equation, including state symbols, for this reaction.

(3)

.....

(b) A colourless solution contains a halide ion.

Describe a test to show which of the halide ions, chloride, Cl^-, bromide, Br^-, or iodide, I^-, is present in the colourless solution.

(4)

(Total for Question 4 = 10 marks)

5 (a) Sulfur dioxide combines with oxygen to form sulfur trioxide in an exothermic reaction.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The reaction can reach equilibrium.

At 2 atmospheres pressure, 450 °C and using a vanadium(V) oxide catalyst, the equilibrium yield of sulfur trioxide, SO_3, is 96%.

(i) When a temperature higher than 450 °C is used, the equilibrium yield of sulfur trioxide decreases. All the other conditions are unchanged.

Explain why the equilibrium yield of sulfur trioxide decreases.

(2)

(ii) When a pressure higher than 2 atmospheres is used, the equilibrium yield of sulfur trioxide increases. All the other conditions are unchanged.

Explain why the equilibrium yield of sulfur trioxide increases.

(2)

(iii) Which of the following shows the effect of adding a catalyst on the rate of the forward reaction and on the rate of the reverse reaction?

Put a cross (☒) in the box next to your answer.

(1)

	effect of a catalyst on	
	rate of forward reaction	**rate of reverse reaction**
☒ **A**	decreases	decreases
☒ **B**	decreases	increases
☒ **C**	increases	decreases
☒ **D**	increases	increases

(b) The equation for the complete combustion of ethane is

$$2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$$

Which row of the table shows volumes of ethane and oxygen that react together and the volume of carbon dioxide they produce when they react as shown in this equation?
(all volumes of gases are measured under the same conditions of temperature and pressure)

Put a cross (☒) in the box next to your answer.

(1)

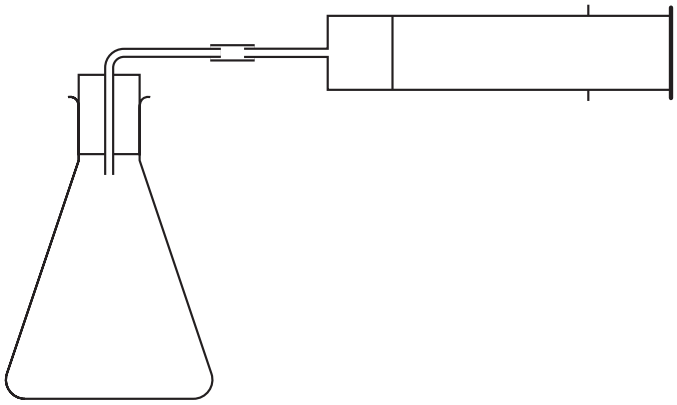
	gas volumes / cm^3		
	ethane	**oxygen**	**carbon dioxide**
☒ **A**	5	35	10
☒ **B**	5	70	20
☒ **C**	10	35	20
☒ **D**	10	70	40

*(c) The reaction between a known mass of magnesium ribbon and excess dilute sulfuric acid can be used to determine the volume occupied by one mole of hydrogen gas, H_2, at room temperature and pressure.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

In an experiment, 0.048 grams of magnesium formed 48 cm^3 of hydrogen, at room temperature and pressure.

Describe how the apparatus below can be used to obtain these results, showing how the results can be used to find the volume occupied by one mole of hydrogen gas, H_2, at room temperature and pressure.



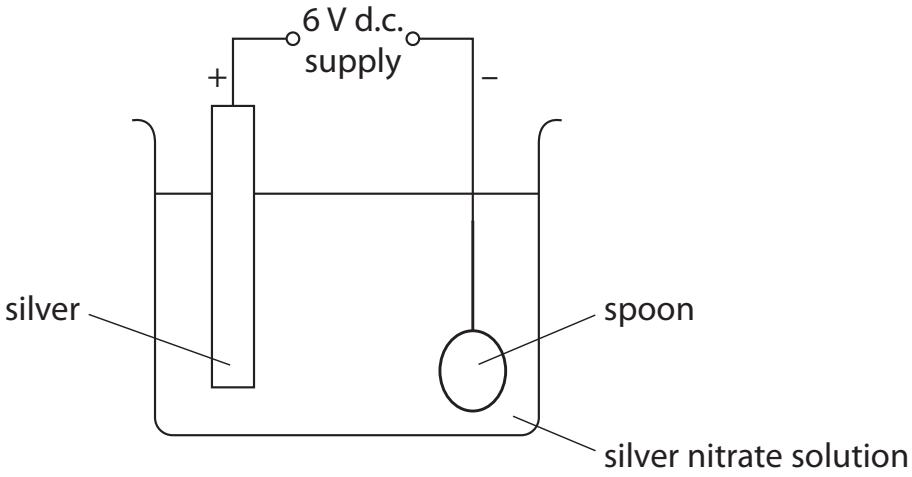
(6)

(Total for Question 5 = 12 marks)

Electrolysis

6 (a) A metal spoon is plated with silver using electrolysis.

The diagram shows the apparatus used.



(i) In this electrolysis, oxidation occurs at the silver electrode.

State, in terms of electrons, what is meant by oxidation.

(1)

.....

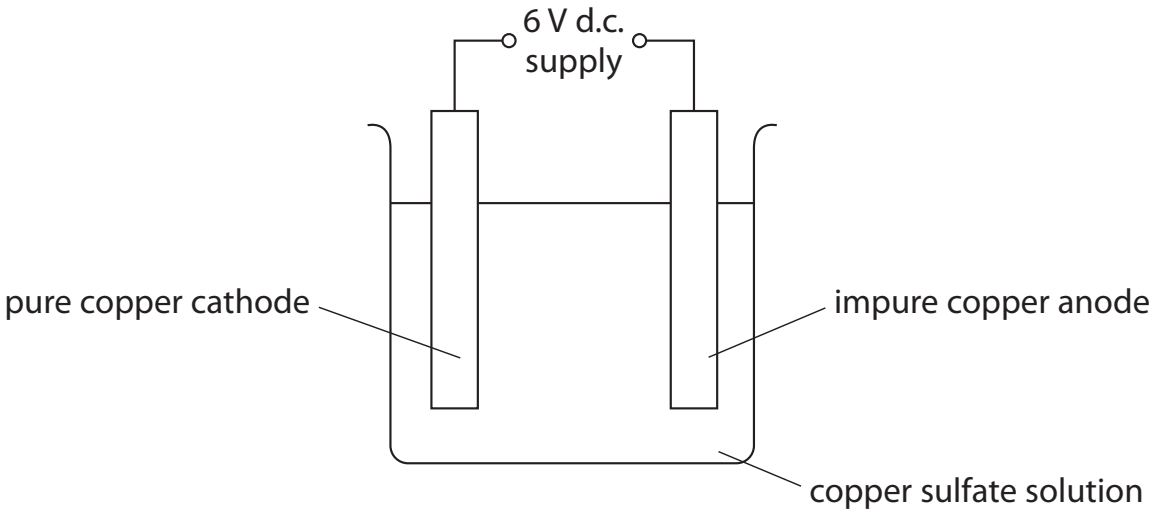
(ii) Which is the formula of silver nitrate?

Put a cross (☒) in the box next to your answer.

(1)

- ☒ **A** $AgNO_2$
- ☒ **B** Ag_2NO_3
- ☒ **C** $AgNO_3$
- ☒ **D** $Ag(NO_3)_2$

(b) The diagram shows the apparatus used for the electrolysis of copper sulfate solution using a pure copper cathode and impure copper anode.



During the electrolysis the size of the cathode increases, the size of the anode decreases and a solid deposit appears under the anode. The colour of the solution remains the same throughout.

Explain these observations.

(4)

*(c) The products of electrolysis can vary depending on whether the salt forming the electrolyte is molten or in aqueous solution.

Explain this statement by referring to the products of electrolysis of molten sodium chloride and of electrolysis of sodium chloride solution.

Include in your answer the names of all the ions present in each electrolyte and how the product at each electrode is formed from ions present.

You may use half-equations if you wish.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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