Write your name here Surname	Other n	names
Pearson Edexcel GCSE	Centre Number	Candidate Number
Chemistry Unit C3: Chemistry	y in Action	Higher Tier
Wednesday 21 June 2017 Time: 1 hour	7 – Morning	Paper Reference 5CH3H/01

## **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 ▶



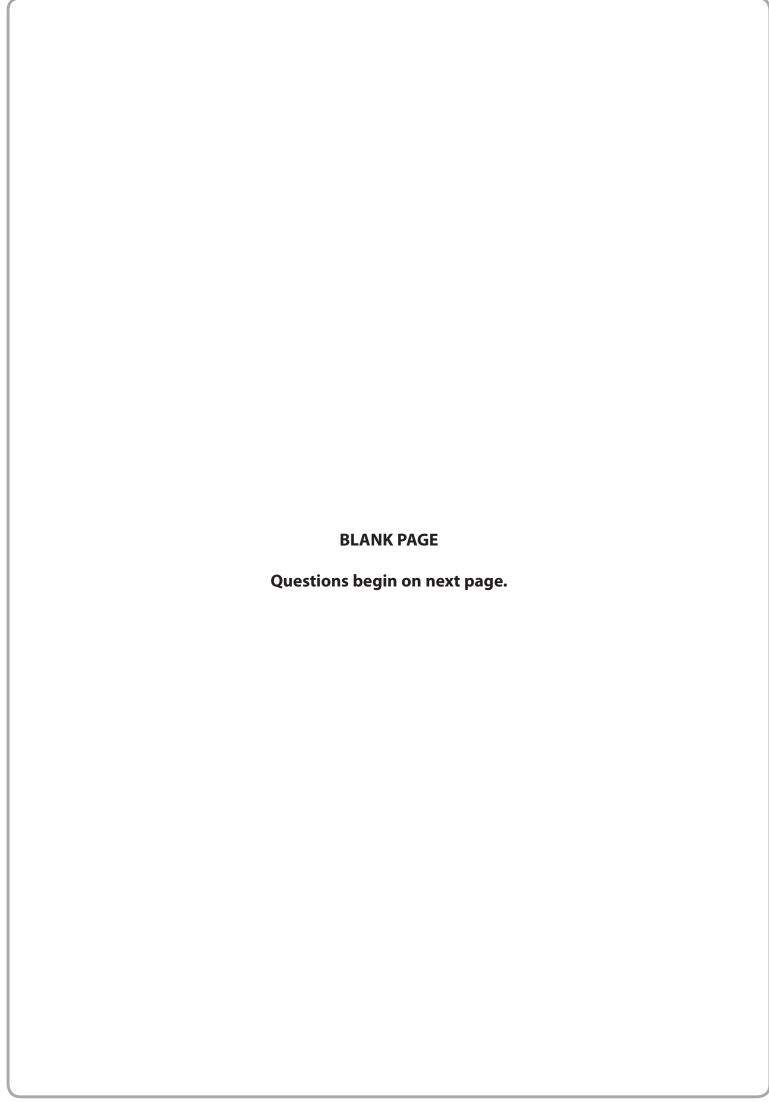


# The Periodic Table of the Elements

0 4 <b>He</b> Helium 2 2 00	<b>Ne</b> neon 10	40 <b>Ar</b> argon 18	84 <b>Kr</b> krypton 36	131 <b>Xe</b> xenon 54	[222] <b>Rn</b> radon 86	fully
7	fluorine	35.5 <b>CI</b> chlorine 17	80 <b>Br</b> bromine 35	127 	[210] <b>At</b> astatine 85	orted but not
0 4	0 O oxygen	32 <b>S</b> sulfur 16	79 <b>Se</b> selenium 34	128 <b>Te</b> tellurium 52	[209] <b>Po</b> polonium 84	ve been repo
τυ <u>ź</u>	N nitrogen	31 P phosphorus 15	75 <b>As</b> arsenic 33	122 <b>Sb</b> antimony 51	209 <b>Bi</b> bismuth 83	s 112-116 ha authenticated
4 5	carbon 6	28 Silicon 14	73 <b>Ge</b> germanium 32	119 <b>Sn</b> tin 50	207 <b>Pb</b> lead 82	mic numbers
w £	1.1 boron 5	27 AI aluminium 13	70 <b>Ga</b> gallium 31	115 In indium 49	204 <b>TI</b> thallium 81	Elements with atomic numbers 112-116 have been reported but not fully authenticated
			65 <b>Zn</b> zinc 30	112 <b>Cd</b> cadmium 48	201 <b>Hg</b> mercury 80	Elem
			63.5 <b>Cu</b> copper 29	108 <b>Ag</b> silver 47	197 <b>Au</b> gold 79	Rg roentgenium 111
			59 <b>Ni</b> nickel 28	106 <b>Pd</b> palladium 46	195 <b>Pt</b> platinum 78	[271] <b>Ds</b> damstadtium 110
			59 Co cobalt 27	103 <b>Rh</b> rhodium 45	192 <b>Ir</b> iridium 77	[268] <b>Mt</b> meitnerium 109
T T hydrogen			56 Fe iron 26	Ru ruthenium 44	190 <b>Os</b> osmium 76	[277] <b>Hs</b> hassium 108
			55 Mn manganese 25	[98] <b>Tc</b> technetium 43	186 <b>Re</b> rhenium 75	[264] <b>Bh</b> bohrium 107
0000	nass <b>ool</b> umber		52 Cr	96 <b>Mo</b> molybdenum 42	184 <b>W</b> tungsten 74	[266] <b>Sg</b> seaborgium 106
Key	relative atomic mass atomic symbol name atomic (proton) number		51 <b>V</b> vanadium 23	93 <b>Nb</b> niobium 41	181 <b>Ta</b> tantalum 73	[262] <b>Db</b> dubnium 105
r Poloti:	relativ <b>ato</b> atomic		48 Ti titanium 22	91 <b>Zr</b> zirconium 40	178 <b>Hf</b> hafnium 72	[261] <b>Rf</b> nutherfordium 104
			45 Sc scandium 21	89 <b>Y</b> yttrium 39	139 <b>La*</b> lanthanum 57	[227] <b>Ac*</b> actinium 89
2	<b>Be</b> beryllium 4	24 Mg magnesium 12	40 <b>Ca</b> calcium 20	88 <b>Sr</b> strontium 38	137 <b>Ba</b> barium 56	[226] <b>Ra</b> radium 88
	<b>Li</b> lithium 3	23 <b>Na</b> sodium 11	39 <b>K</b> potassium 19	85 <b>Rb</b> rubidium 37	133 <b>Cs</b> caesium 55	[223] <b>Fr</b> francium 87
	<u>, ≔</u>	13 digm 12	39 <b>⊼</b> 19	35 <b>3b</b> idiur 37	33 Siun 55	23 7. 7. 37

\* 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.



# **Answer ALL questions**

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

## **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 <sub>3</sub> OH
ethanol	C <sub>2</sub> H <sub>5</sub> OH
propanol	C <sub>3</sub> H <sub>7</sub> OH

(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)

(1)

(i)	Complete the	balanced	equation	for this	reaction.
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(2)

$$C_2H_5OH \rightarrow \dots + \dots + \dots$$

(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  $(\boxtimes)$  in the box next to your answer.

(1)

- $\square$  A  $C_2H_5OH + 2O_2 \rightarrow 2CO_2 + 3H_2O$
- $\begin{tabular}{ll} \hline \blacksquare & $2C_2H_5OH + 5O_2$ $\rightarrow $4CO_2$ $+ $6H_2O$ \\ \hline \end{tabular}$
- $\square$  C  $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
- $\begin{tabular}{lll} \hline \square & $2C_2H_5OH + 7O_2$ &$\rightarrow$ $4CO_2$ + $6H_2O$ \\ \hline \end{tabular}$

(Total for Question 1 = 6 marks)

		Carboxylic acids and esters	
2	(a) Complete the	e sentence by putting a cross (⊠) in the box next to your answer.	(1)
	Ethanol can r	react to form ethanoic acid, CH <sub>3</sub> COOH.	
	In this reaction	on ethanol is	
	■ A neutralise	ed	
	■ B oxidised		
	☑ C precipitat	red	
	<b>D</b> reduced		
	(b) Draw the struthe bonds.	ucture of a molecule of ethanoic acid, CH <sub>3</sub> COOH, showing all	(1)
	a reaction occ	e of magnesium ribbon is added to dilute ethanoic acid, curs.  e the word equation for this reaction.	
	(i) Complete	the word equation for this reaction.	(2)
ma	agnesium + ethai aci	noic → +	
	(ii) State wha	at is <b>seen</b> 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 fe	or Question 2 = 9 marks)

Sa	ltc	an	d	50	he	ti,	۸n	
34	ILS.	an	u	SO	ıu	LI	O I I	15

3	(a)	Give the name	or the formul	la of an	ion that	causes h	nardness ir	water.
_	(4)	GIVE CITE HAITIE	or the forma	ia oi aii	ion that	caasesi	idi di iC33 ii	ı vvaccı.

(1)

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

A 10 cm<sup>3</sup> sample of each is tested for hardness by adding soap solution, from a burette, until a permanent lather is formed.

Another 10 cm<sup>3</sup> 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 / cm³				
	before boiling	after boiling			
Α	10.2	0.1			
В	20.0	20.0			
С	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 <b>A</b> , <b>B</b> and <b>C</b> .	

	plution of zinc chloride, $ZnCl_2$ , is prepared by reacting zinc carbonate, $ZnCO_3$ , a 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 <sup>-3</sup> .	
(	Calculate the concentration of this solution in g dm <sup>-3</sup> .	
	(relative atomic masses: Zn = 65, Cl = 35.5)	(2)
	concentration of solution =	gdm <sup>-</sup>
	n experiment, 25.0 cm³ samples of a solution of sodium hydroxide, NaOH, e titrated with 0.095 mol dm⁻³ hydrochloric acid, HCl.	
	$NaOH + HCI \rightarrow NaCI + H_2O$	
18.5	cm <sup>3</sup> of the hydrochloric acid neutralised 25.0 cm <sup>3</sup> of the sodium hydroxide solu	tion.
Calc	culate the concentration of the sodium hydroxide solution, NaOH, in mol dm <sup>-3</sup> .	(2)
	concentration of sodium hydroxide solution =	mol dm <sup>-</sup>
	(Total for Question 3 = 11 ma	rks)

			Analysis	
4	(a)		tess dilute sulfuric acid is added to a solid sample of a copper compound. 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)

Describe a test to show which of the halide ions, iodide, $I^-$ , is present in the colourless solution.	chloride, Cl⁻, bromide, Br⁻, or	(-)
		(4)
	(Total for Question 4 = 10 m	arks)

Ga		_	c
Ud	15	е	5

		Gases	
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, $450^{\circ}$ 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.

X

X

X

X

 $\times$  A

 $\bowtie$  B

 $\times$  C

 $\boxtimes$  D

(1)

	effect of a catalyst on		
	rate of forward reaction	rate of reverse reaction	
Α	decreases	decreases	
В	decreases	increases	
C	increases	decreases	
D	increases	increases	

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

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

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)

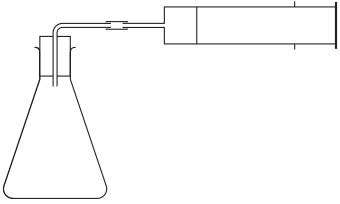
gas volumes / cm³				
ethane	oxygen	carbon dioxide		
5	35	10		
5	70	20		
10	35	20		
10	70	40		

\*(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<sub>2</sub>, at room temperature and pressure.

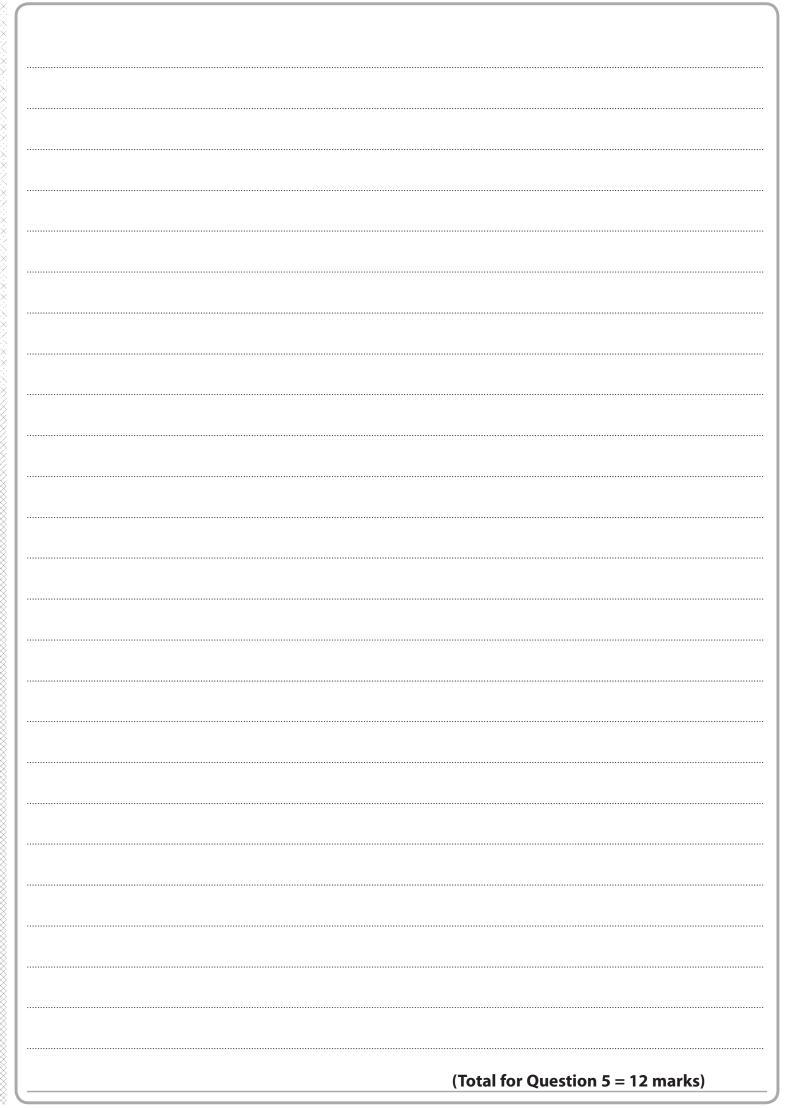
$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

In an experiment, 0.048 grams of magnesium formed 48 cm<sup>3</sup> 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<sub>2</sub>, at room temperature and pressure.



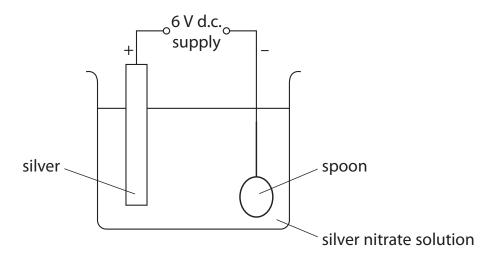
(	)		
			(6)



# **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)

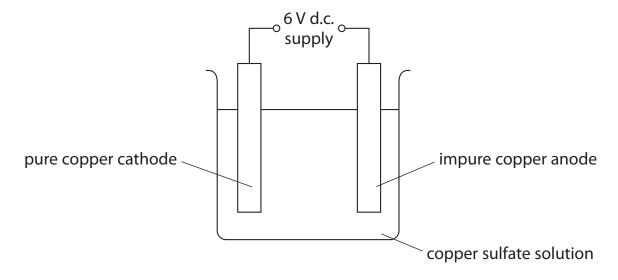
(ii) Which is the formula of silver nitrate?

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

(1)

- A AgNO<sub>2</sub>
- B Ag<sub>2</sub>NO<sub>3</sub>
- C AgNO<sub>3</sub>
- $\square$  **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.

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.	ne
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.	I
You may use half-equations if you wish.	(6)

(Total for Question 6 = 12 marks)
<b>TOTAL FOR PAPER = 60 MARKS</b>

