EDEXCEL GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C3 HIGHER TIER 5CH3H PAPERS

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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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1/1/1/1/

P 4 8 5 8 4 A 0 1 2 0

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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.

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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)

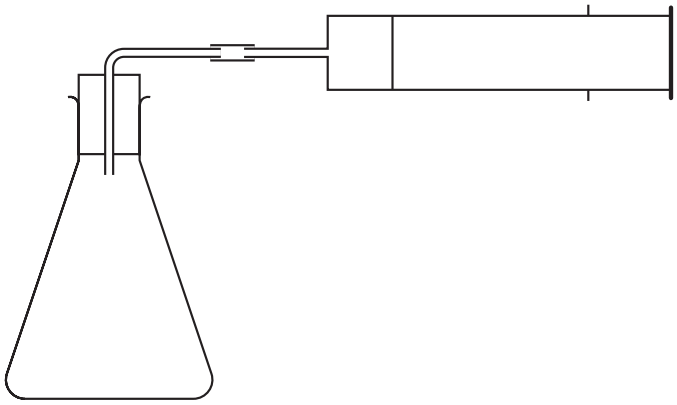
	gas volumes / cm^3		
	ethane	**oxygen**	**carbon dioxide**
☒ **A**	5	35	10
☒ **B**	5	70	20
☒ **C**	10	35	20
☒ **D**	10	70	40

*(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.



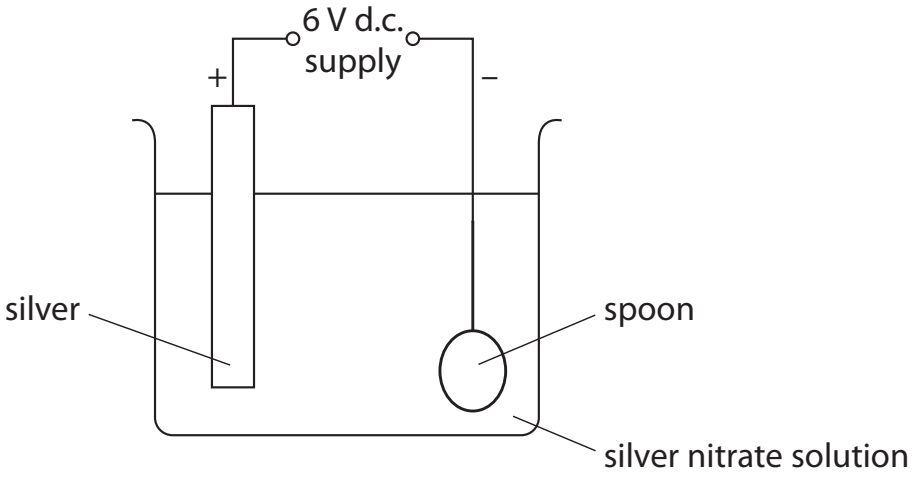
(6)

(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)

.....

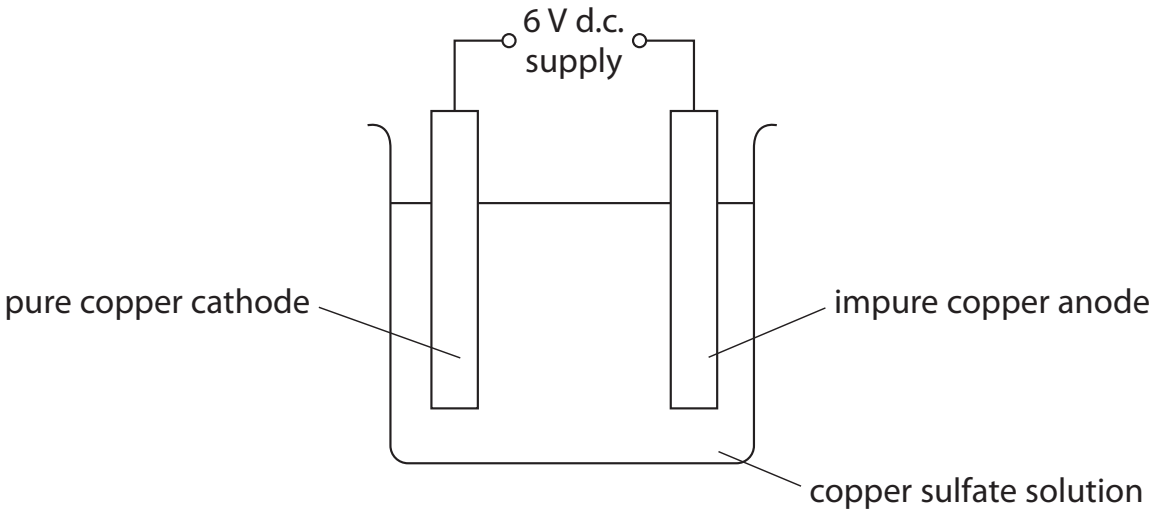
(ii) Which is the formula of silver nitrate?

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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Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCSE
In Chemistry (5CH3H) Paper 01

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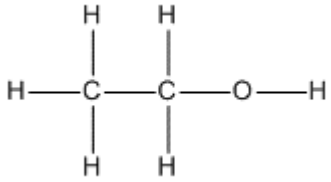
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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	$C_5H_{11}OH$	must be capital letters: reject h, c or o must be subscripts: reject C5H11OH or $C^5H^{11}OH$ allow $C_5H_{12}O$ C_5 , H_{12} and O can be in any order	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)		allow -OH for O-H, but reject -HO ignore bond angles reject C=C allow c or h or o permit fully correct dot and cross	**(1)**

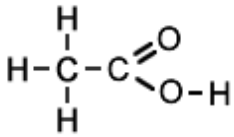
Question Number	Answer	Acceptable answers	Mark
1(b)(i)	($C_2H_5OH \rightarrow$) $C_2H_4 + H_2O$ fully balanced equation (allow multiples) (2) allow formulae in either order If does not score 2, allow 1 for either formula.	must be capital letters: reject h, c or o must be subscripts: reject C2H4 or C^2H^4 or H2O or H^2O allow structural formulae	**(2)**

Question Number	Answer	Mark
1(b)(ii)	☒ **A dehydration** **The only correct answer is A** **B** is not correct because this is not a reaction type **C** is not correct because water is removed, not added **D** is not correct because there is no oxygen added, but water	**(1)**

Question Number	Answer	Mark
1(c)	☒ **C** $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ **The only correct answer is C** **A** is not correct because there are insufficient oxygen atoms on LHS **B** is not correct because there are insufficient oxygen atoms on LHS **D** is not correct because there are too many oxygen atoms on LHS	**(1)**

(Total for Question 1 = 6 marks)

Question Number	Answer	Mark
2(a)	**B** oxidised **The only correct answer is B** **A** is not correct because it is not a reaction with a base **C** is not correct because ethanol is not a solid product from solutions **D** is not correct because oxygen is added, not removed	**(1)**

Question Number	Answers	Acceptable Answers	Mark
2(b)		allow -OH allow CH_3- ignore bond angles allow c or h or o	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	(magnesium + ethanoic acid) → magnesium ethanoate **(1)** **+** hydrogen **(1)**	ignore any formulae words in either order **exact spellings required**	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	effervescence / fizzing / bubbles / (magnesium) disappears	allow magnesium gets smaller / dissolves ignore movement / floating **reject** answers with additional incorrect response e.g. white precipitate / colour change / steam	**(1)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Acceptable</th><th>Mark</th></tr>
<tr><td>2(d)</td><td colspan="2">A description linking one use with <u>relevant property</u></td><td rowspan="6">ignore polyesters fabrics / clothing

allow specified tastes

MP2 dependent on MP1</td><td rowspan="6">(2)</td></tr>
<tr><td>sweets / confectionary / food (flavouring) (1)</td><td>flavouring / good taste / fruity or sweet smell or taste (1)</td></tr>
<tr><td>perfumes / cosmetics / named cosmetic item (1)</td><td>good smell/ scent / volatile (1)</td></tr>
<tr><td>soap (1)</td><td>esters react with NaOH / sweet smell (1)</td></tr>
<tr><td>paints / nail varnish remover(1)</td><td>solvent (1)</td></tr>
<tr><td>plastics / resins (1)</td><td>softening agent (1)</td></tr>
</table>

Question Number	Answers	Acceptable Answers	Mark
2(e)	A description including • sodium hydroxide / potassium hydroxide / alkali / base **(1)** • heat / boil / reflux **(1)** **MP2 is dependent on scoring MP1**	MP1: allow **correct** formulae / equations reject **dilute** alkali or 'alkaline' but allow MP2 MP2: allow specified temps ≥ 80 °C but ignore warm	**(2)**

(Total for Question 2 = 9 marks)

Question Number	Answers	Acceptable Answers	Mark
3(a)	calcium / Ca^{2+} / magnesium / Mg^{2+}	allow +2 for 2+, must have correct charge. Reject mg^{2+} if a list, all must be correct	**(1)**

Question Number	Answers	Acceptable Answers	Mark
3(b)	An explanation including • A temporary hardness **and** little or less soap needed (after boiling) / ($10.2cm^3$ before but) only $0.1cm^3$ after / softened (by boiling) / (all) hardness removed / more easily lathers (1) • B permanent hardness **and** no change (in soap used) / $20cm^3$ before and after / has not been softened (by boiling) (1) • C temporary <u>and</u> permanent hardness / 'both' types **and** only some reduction in soap needed (1) If gets no marks, allow 1 for: A temporary, B permanent, C temporary and permanent (1)	do not allow 'partially hard' etc do not allow <u>unexplained</u> use of data for MP3	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(c)(i)	$ZnCO_3 + 2HCl \rightarrow ZnCl_2 + H_2O + CO_2$ • correct formulae only LHS **(1)** • correct formulae only RHS **(1)** • balancing of **these** correct formulae **(1)**	ignore state symbols, even if incorrect allow = for →, multiples In this question only, incorrect use of capital / small letters or subscripts: max 2.	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(c)(ii)	• relative formula mass $ZnCl_2$ = [65 + 2 x 35.5] **(1)** (= 136) • concentration = 0.25 x M_r **(1)** **(**= 34(.0))	136 scores 1. 34 as final answer scores 2. allow ecf for M_r	**(2)**

Question Number	Answers	Acceptable Answers	Mark
3(d)	• mol HCl used = 0.095 x 18.5 / 1000 **(1)** (= 0.0017575) • conc NaOH = 0.0017575 x 1000 / 25.0 **(1)** (= 0.07(03))	0.07(03) as final answer scores 2. allow ecf for moles allow 18.5 x 0.095 = 25 x c **(1)** c = 18.5 x 0.095 / 25 **(1)**	**(2)**

(Total for Question 3 = 11 marks)

Question Number	Answer	Acceptable answers	Marks
4 (a)(i)	An explanation linking • carbon dioxide/CO_2 (1) • carbonate/CO_3^{2-} (1)	mark independently hydrogencarbonate/HCO_3^- allow 'copper carbonate' for MP2	**(2)**

Question Number	Answer	Acceptable answers	Marks
4 (a)(ii)	copper hydroxide / $Cu(OH)_2$ (1)	reject copper oxide, CuO, $CuOH_2$ C, O, H must be capital letters u must be small letter must have brackets around OH 2 must be subscript – reject Cu(OH)2 or $Cu(OH)^2$	**(1)**

Question Number	Answer	Acceptable answers	Marks
4 (a)(iii)	$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ correct formulae with no others on LHS (1) correct formula with no others on RHS (1) fully correct balanced ionic equation with correct state symbols (1)	allow +2 and -2 only penalise incorrect use of capital / small letters or subscripts but not for MP3 allow = for →, multiples	**(3)**

Question Number	Answer	Acceptable answers	Marks
4 (b)	An description including WITH SILVER NITRATE • add silver nitrate (solution) (1) • chloride: white precipitate (1) • bromide: cream / **pale** yellow precipitate (1) • iodide: yellow precipitate (1) WITH CHLORINE (WATER) • add chlorine (1) • chloride: no change (1) • bromide: goes yellow/ orange (1) • iodide: goes yellow /brown or black ppt (1)	if no silver nitrate, scores 0. ignore anything else added to silver nitrate allow ppt(e) /solid penalise missing 'ppt' once only do not penalise: chlorine / Cl/ Cl_2 / Cl^- ⇒ white ppt (same for bromide, iodide) If no chlorine = 0. bromide and iodide colours must be different	**(4)**

(Total for Question 4 = 10 marks)

Question Number	Answers	Acceptable Answers	Mark
5 (a)(i)	An explanation linking • (equilibrium) shifts left / backwards / to reactants **(1)** • because reverse reaction is endothermic / absorbs heat / lowers temperature **(1)**	Ignore any mention of rate / collisions mark independently statements like 'increase in temp shifts to endothermic direction' scores MP2 only	**(2)**

Question Number	Answers	Acceptable Answers	Mark
5 (a)(ii)	An explanation linking • (equilibrium) shifts right / forwards / to products **(1)** • because fewer molecules on right / 3 molecules on L but 2 on R / to reduce pressure **(1)**	Ignore any mention of rate / collisions mark independently allow 'to reduce volume' moles/ particles = molecules	**(2)**

Question	Answers	Mark
5 (a)(iii)	**D** increases increases **The only correct answer is D** **A** is not correct because both rates increase **B** is not correct because both rates increase **C** is not correct because both rates increase	**(1)**

Question Number	Answers	Mark
5 (b)	**C** 10 35 20 **The only correct answer is C** **A** is not correct because the oxygen volume is doubled **B** is not correct because the ration 1: 14: 4 is incorrect **D** is not correct because the ethane volume is halved	**(1)**

Question		Indicative content	Mark
QWC	**5(c)**	A description including some of the following points • use balance to find mass of the magnesium ribbon (0.048g) • check the gas syringe is reading 0 (cm^3) • pour the (sulfuric) acid into the flask • add the magnesium to the acid • connect syringe • when all the magnesium has {reacted/disappeared/no further increase in volume of gas } • record the {final/maximum} volume of {hydrogen/gas ($48cm^3$)} • divide mass of magnesium by {24/relative atomic mass/A_r} to find number of moles Mg • 0.048/24 = 0.002 mol Mg • the same number of moles of hydrogen is produced / mole ratio magnesium : hydrogen is 1:1 / 1 mole of magnesium produces 1 mole of hydrogen • 0.002 mol hydrogen produced • divide volume of hydrogen collected by number of moles of hydrogen (to find volume of 1 mole) • volume of 1 mole hydrogen = 48/0.002 = 24000 cm^3	**(6)**
Level	0	No rewardable material	
1	**1-2**	• a limited description e.g. add the magnesium to the acid in the flask and measure gas volume OR relate mass of magnesium to volume of hydrogen • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3-4**	• a description of obtaining or using the results e.g. weigh then add the magnesium to the acid and stopper the flask, record the final volume of gas • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately. • spelling, punctuation and grammar are used with some accuracy	
3	**5-6**	• a detailed description of obtaining and using the results e.g. find mass of magnesium and add it to the acid, record the final volume of gas, find the number of moles of magnesium by dividing the mass by 24 then divide the volume of hydrogen by the number of moles • the answer communicates ideas clearly and coherently and uses scientific terminology accurately. • spelling, punctuation and grammar are used with few errors	

(Total for Question 5 = 12 marks)

Question Number	Answers	Acceptable Answers	Mark
6 (a)(i)	{loss / removal} of electrons	ignore 'reduction of electrons'	**(1)**

Question Number	Answers	Mark
6 (a)(ii)	C $AgNO_3$ **The only correct answer is C** **A** is not correct because there is one too few O **B** is not correct because there is one too many Ag **D** is not correct because there is one too many nitrate	**(1)**

Question Number	Answers	Acceptable Answers	Mark
6 (b)	An explanation linking CATHODE • copper (atoms) deposited / plated / gained / copper **ions** gain electrons / copper **ions** reduced/ $Cu^{2+} + 2e^- \rightarrow Cu$ / copper **ions** go to cathode (1) ANODE • copper (atoms/ions) removed / dissolve copper (atoms) lose electrons / copper (atoms) oxidised / $Cu \rightarrow Cu^{2+} + 2e^-$ (1) SOLID DEPOSIT • impurities / sludge / gold / silver (fall from anode) (1) COLOUR OF SOLUTION • (blue) copper (ions) do not change in number or concentration / copper (ions) enter and leave solution (at same rate) / copper (ions) leave at cathode but enter at anode (1)	words in **bold** must be present (words in brackets) need not be present but must not be contradicted	**(4)**

Question Number		Indicative content	Mark
QWC	6(c)	An explanation including some of the following points: in molten sodium chloride • ions present: sodium ions / Na^+, chloride ions / Cl^- • sodium ions attracted/migrate to negative electrode/cathode • sodium ions gain eletrons / are reduced • sodium produced at negative electrode/cathode / $Na^+ + e^- \rightarrow Na$ • chloride ions attracted/migrate to positive electrode/anode • chloride ions lose electrons / are oxidised • chlorine produced at positive electrode/anode / $2Cl^- - 2e^- \rightarrow Cl_2$ / $2Cl^- \rightarrow Cl_2 + 2e^-$ whereas in aqueous sodium chloride • ions present (from sodium chloride): sodium ions / Na^+, chloride ions / Cl^- • ions present (from water): hydrogen ions / H^+, hydroxide ions / OH^- • hydrogen ions attracted/migrate to negative electrode/cathode • hydrogen ions gain electrons / are reduced • hydrogen produced at negative electrode/cathode / $2H^+ + 2e^- \rightarrow H_2$ • chloride ions attracted/migrate to positive electrode/anode • chloride ions lose electrons / are oxidised • chlorine produced at positive electrode/anode • amount of chlorine depends on concentration of solution / $2Cl^- \rightarrow Cl_2 + 2e^-$ • sodium hydroxide remains in solution	**(6)**

Level	0	No rewardable material
1	**1-2**	• a limited explanation e.g. sodium and chlorine are produced from molten sodium chloride • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3-4**	• a simple explanation e.g. in molten sodium chloride ions present: Na^+ and Cl^- , sodium produced at cathode and chlorine produced at anode • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately. • spelling, punctuation and grammar are used with some accuracy
3	**5-6**	• a detailed explanation including reference to both molten and aqueous sodium chloride e.g. a full explanation of one electrolyte and a limited explanation of the other • the answer communicates ideas clearly and coherently and uses scientific terminology accurately. • spelling, punctuation and grammar are used with few errors

(Total for Question 6 = 12 marks)

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Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Wednesday 22 June 2016 – 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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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 ☒.

Hard and soft water

1 20 cm^3 samples of waters, **A**, **B**, **C** and **D**, are tested for hardness by adding soap solution and shaking the mixture.
The soap solution is added until a permanent lather is formed.

Each sample of water is tested before and after boiling.

The results are shown.

water sample	volume of soap solution needed to form permanent lather / cm^3	
	before boiling	after boiling
A	0.1	0.1
B	5.0	2.0
C	7.5	7.5
D	3.0	0.1

(a) (i) Which of the water samples is most likely to be pure water?

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

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Which water sample is most likely to contain **only** temporary hardness?

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

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

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(b) Without using soap solution, describe how you would show that a sample of hard water contains dissolved solid.

(2)

(c) Explain one method which removes both temporary **and** permanent hardness from water.

(2)

(d) Explain a disadvantage of having a domestic water supply that is hard.

(2)

(Total for Question 1 = 8 marks)

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Ions

2 (a) The qualitative test for chloride ions in solution is

add dilute nitric acid
then add silver nitrate solution

(i) Describe what you **see** if this test is carried out on a solution containing chloride ions.

(2)

.....

(ii) What is the **ionic equation** for the reaction that occurs between silver nitrate solution and potassium chloride solution?

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

(1)

☒ **A** $AgNO_3 + Cl^- \rightarrow AgCl + NO_3^-$

☒ **B** $AgNO_3 + KCl \rightarrow AgCl + KNO_3$

☒ **C** $Ag^+ + KCl \rightarrow AgCl + K^+$

☒ **D** $Ag^+ + Cl^- \rightarrow AgCl$

(iii) Doctors often request blood tests. The tests they require to be carried out are quantitative tests.

Describe the difference between a **qualitative** and a **quantitative** test.

(2)

.....

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(b) Describe a test to show that aluminium iodide contains aluminium ions.

(3)

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(Total for Question 2 = 8 marks)

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Ammonia

3 (a) Ammonia gas, NH_3, is formed by reacting ammonium chloride, NH_4Cl, with sodium hydroxide, NaOH.

$$NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3$$

In an experiment 4.0 g of sodium hydroxide react completely with ammonium chloride.

Calculate the maximum volume, in dm^3, of ammonia gas formed at room temperature and pressure.
(relative atomic masses: H = 1.0, N = 14, O = 16, Na = 23, Cl = 35.5
one mole of any gas occupies 24 dm^3, measured at room temperature and pressure)

(3)

maximum volume of ammonia = ... dm^3

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(b) Ammonia is manufactured using the Haber process.

The reaction of nitrogen with hydrogen to form ammonia is exothermic.
The process is carried out at 450 °C.
This reaction can reach a dynamic equilibrium.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(i) Explain what is meant by **dynamic equilibrium**.

(2)

(ii) Explain why a temperature of 450 °C is used for this process even though a higher temperature would increase the rate of production of ammonia.

(2)

(c) When ammonia gas is dissolved in water, an alkaline solution is formed.
State the name and the formula of the ion which causes the solution to be alkaline.

(2)

name .....

formula .....

(Total for Question 3 = 9 marks)

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Electrolysis

4 (a) Which of the following does **not** conduct electricity?

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

(1)

☒ **A** sodium chloride crystals

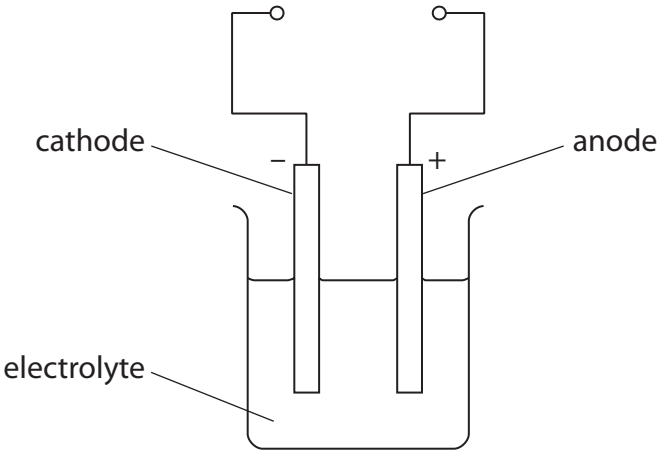
☒ **B** sodium chloride solution

☒ **C** molten sodium chloride

☒ **D** seawater

(b) Impure copper is purified by electrolysis.

A diagram of the apparatus that can be used is shown.



(i) Describe the use of this apparatus to purify a piece of impure copper.

(4)

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(ii) During the electrolysis a deposit forms under the anode.

Explain how this deposit forms.

(2)

.....

.....

.....

(c) (i) In the electrolysis of molten lead bromide, $PbBr_2$, the half equation for the reaction occurring at the cathode is

$$Pb^{2+} + 2\ e \rightarrow Pb$$

Explain what **type** of reaction is shown in this equation.

(2)

.....

.....

(ii) Bromine, Br_2, is formed at the anode.
Write the half equation for the reaction occurring at the anode.

(2)

.....

(Total for Question 4 = 11 marks)

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Ethanoic acid

5 (a) (i) Ethanoic acid, CH_3COOH, reacts with ethanol to form ethyl ethanoate and water.

Complete the equation for the reaction by adding the formula of ethyl ethanoate.

(1)



(ii) Ethanoic acid is a typical acid.

State what you would **see** if solid calcium carbonate is added to some dilute ethanoic acid.

(1)

.....

.....

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

(1)

1.0 dm^3 of ethanoic acid solution, CH_3COOH, contains 6.0 g of ethanoic acid.
(relative molecular mass: $CH_3COOH = 60$)

The concentration of ethanoic acid, in mol dm^{-3}, is

☒ **A** 0.1

☒ **B** 0.6

☒ **C** 1.0

☒ **D** 10.0

*(c) Sodium ethanoate solution can be formed by neutralising sodium hydroxide solution with dilute ethanoic acid.

Pure crystals of sodium ethanoate can be obtained from this solution.

The volumes of sodium hydroxide solution and dilute ethanoic acid required to form the pure sodium ethanoate solution must be found by titration.

Describe how you would prepare a pure solution of sodium ethanoate from sodium hydroxide solution and dilute ethanoic acid, and how you would obtain pure, dry sodium ethanoate crystals from this solution.

(6)

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(d) In an experiment 25.0 cm^3 of 0.0100 mol dm^{-3} ethanoic acid, CH_3COOH, was titrated with 0.0200 mol dm^{-3} sodium hydroxide solution, NaOH.

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

Calculate the volume, in cm^3, of 0.0200 mol dm^{-3} sodium hydroxide solution needed to neutralise the ethanoic acid in this experiment.

(3)

volume of sodium hydroxide solution needed = ... cm^3

(Total for Question 5 = 12 marks)

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Organic chemistry

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

(1)

Butane is an alkane.

The formula of a molecule of butane is

☒ **A** C_3H_6

☒ **B** C_4H_{10}

☒ **C** C_3H_8

☒ **D** C_4H_8

(b) Ethanol is an alcohol.

Ethanol is present in various alcoholic drinks, such as wine, beer and whisky.

(i) It is dangerous to drive after having an alcoholic drink.

Suggest why it is more dangerous to drive a car after drinking 25 cm^3 of whisky than it is after drinking 25 cm^3 of beer.

(2)

.....

.....

.....

.....

(ii) If a bottle of wine is left open to the air, some of the ethanol is converted into ethanoic acid.

Give the name of the homologous series in which ethanoic acid is found.

(1)

.....

(c) Propanol, C_3H_7OH, can be dehydrated to form propene.

Write the balanced equation for this reaction.

(2)

.....

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*(d) The table gives information about four substances, **A**, **B**, **C** and **D**.

The substances, in no particular order, are ethane, ethanoic acid, ethanol and ethene.

	substance A	substance B	substance C	substance D
symbols of all atoms found in the formula	C H	C H O	C H O	C H
oxidises when left in the air	no	yes	no	no
observation when magnesium added	no reaction	no reaction	effervescence	no reaction
observation when added to sodium carbonate solution	no reaction	no reaction	effervescence	no reaction
observation when bromine water added	orange to colourless	stays orange	stays orange	stays orange
can be polymerised	yes	no	no	no

Identify substances **A**, **B**, **C** and **D**, explaining how you have used the information in the table to identify them.

(6)

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(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCSE in Chemistry (5CH3H) Paper 01 Unit C3: Chemistry in Action

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question number	Answer	Notes	Marks
1 (a) (i)	A		1

Question number	Answer	Notes	Marks
1 (a) (ii)	D		1

Question number	Answer	Notes	Marks
1 (b)	A description including: heat/ evaporate/ boil (the sample) (1) solid/ salt /(lime)scale/ residue/ calcium carbonate (1) M2 dependent on M1	Ignore any tests for ions ignore precipitate	2

Question number	Answer	Notes	Marks
1 (c)	An explanation linking: **ion-exchange** (resin/column) (1) {Ca^{2+}/ Mg^{2+} (ions)} are exchanged for {Na^{+}/ H^{+} (ions)} (1) OR add sodium carbonate/ bath salts (1) {Ca^{2+}/ Mg^{2+} (ions)} react with carbonate ions to form a precipitate / {$CaCO_3$ / $MgCO_3$} precipitates out (1) OR **distil** water/ **distillation** (1) pure water distils/ ions causing hardness remain behind (1)	If M1 scored, then allow atoms/ Ca/ Mg/ H instead of ions in M2 If M1 not scored, particles exchanged must be **ions** or show **charges** (ion formula need not be correct but must be a positive ion of Ca or Mg) (one of each pair needed) allow alternatives to exchange eg displace, replace, swap etc allow trade names eg Calgon For distillation: M2 depends on M1, except reject fractional distillation for M1, but mark on	2

Question number	Answer	Notes	Marks
1 (d)	An explanation linking: PROBLEM scum / (lime)scale / fur / lather is {harder to get/ less} (1) …… **with** relevant linked EXPLANATION waste of energy / appliance less efficient / blocked pipes / blocked boiler / damages appliance need to use more soap or shampoo / waste of soap (1)	 allow chemical names ignore cost unless linked to **these reasons** or need to use water softener ignore cost unless linked to more soap etc ignore taste ignore appearance of scale or requirement to clean	2

Question number	Answer	Notes	Marks
2 (a) (i)	**white** (1) precipitate/ solid (1) mark independently	If **additional** responses are given (eg fizzing, colour changes) then give max 1.	2

Question number	Answer	Notes	Marks
2 (a) (ii)	**D** $Ag^+ + Cl^- \rightarrow AgCl$		1

Question number	Answer	Notes	Marks
2 (a) (iii)	A description including: QUALITATIVE (identity of) what is present/ which ions present/ Cl^- present / what type of substance present (1) QUANTITATIVE how much is present / concentration / amount /gives a value (1)	ref. to blood not required ignore 'it's descriptive' 'no numbers' ignore 'has numbers' (note: just the word quantity is not enough)	2

Question number	Answer	Notes	Marks
2 (b)	A description including add (sodium) hydroxide (solution) / OH^- (ions) / ammonia (1) IF NO HYDROXIDE/AMMONIA, NO MARKS AWARDED (white) precipitate (1) Add more hydroxide/ excess: then dissolves / goes colourless (solution) / goes clear (1)	If **additional reagents** added, do not score M1 but mark on for M2 and M3 **reject** any description but white for the precipitate for M2 ignore heating	3

Question number	Answer	Notes	Marks
3 (a)	M_r NaOH = 23+16+1 (=**40**) (1) ratio **24/40** (1) 24/40 **x 4** (= 2.4 dm^3) (1) OR M_r NaOH = 23+16+1 (=**40**) (1) moles NaOH = **4/40** (=0.1) (1) 0.1 **x 24** (1) (= 2.4 dm^3) OR 23 + 16 + 1 (**=40**)g NaOH (1) gives 24 dm^3 ammonia (1) **24** x **4/40** (=2.4 dm^3) ammonia (1) OR Mass of ammonia = 1.7 (g) (1) Moles of ammonia = 1.7/17 = **0.1** (1) 0.1 **x 24** (1) (= 2.4 dm^3)	2.4 as <u>final answer</u> scores 3 [use answer line unless blank] ecf from incorrect M_r mol of NaOH = 0.1 will score 2 ecf from moles of ammonia units not required but penalise incorrect units for M3	3

Question number	Answer	Notes	Marks
3 (b) (i)	An explanation linking: forward reaction and backward reaction occur (at the same time) /reaction goes in both directions / reversible reaction (1) at same **rate** / {amounts/ concentrations} of each substance do not change (1) mark independently	 ignore reactants and products both present ignore general expressions such as 'reactions cancel out' 'no overall effect' allow 'speed' for 'rate' **rate** of forward reaction = rate of backward reaction will score 2	2

Question number	Answer	Notes	Marks
3 (b) (ii)	An explanation linking: if temperature were **higher**: lower equilibrium yield / equilibrium moves left / reverse reaction favoured / backward reaction favoured/ reactants favoured / ORA (1) because a higher temperature favours **endothermic** reaction / ORA (1)	 any comments on cost or safety to be ignored	2

Question number	Answer	Notes	Marks
3 (c)	hydroxide (ion) (1) OH^- (1)	ignore any formulae/ symbols on 'name' line. Reject answers with additional words eg 'calcium hydroxide' allow HO^- reject any other symbols reject OH, oH^-, Oh^-, oh^- must have **– sign** and as superscript	2

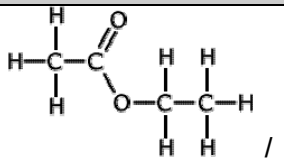
Question number	Answer	Notes	Marks
4 (a)	A sodium chloride crystals		1

Question number	Answer	Notes	Marks
4 (b) (i)	A description including POWER d.c. supply/ battery/ power pack / pass electricity through (1) ELECTRODES impure copper anode/positive electrode (1) pure copper cathode/negative electrode (1) ELECTROLYTE copper sulfate (solution) / Cu^{2+} (ions in solution) / any soluble copper compound (in solution) (1)	**Look at diagram as candidates may add labels which could score all 4 marks** allow unspecified copper salt **if in solution**	4

Question number	Answer	Notes	Marks
4 (b) (ii)	An explanation linking copper: removed from anode / pass into solution / (atoms in electrode) form copper ions (1) deposit/sludge is **impurities** (1)	 allow copper atoms oxidised allow **named** unreactive metals eg silver, gold	2

Question number	Answer	Notes	Marks
4 (c) (i)	An explanation including reduction (1) because (lead ions) gain electrons (1) mark independently	ignore redox for M1	2

Question number	Answer	Notes	Marks
4 (c) (ii)	$2Br^- \rightarrow Br_2 + 2e^-$ OR $2Br^- - 2e^- \rightarrow Br_2$ Br^- on left (charge required) (1) **<u>fully correct</u>** species including charges (but allow e for e^-) with balancing (2)	allow multiples	2

	Answer	Notes	Marks
5 (a) (i)	 / $CH_3COOCH_2CH_3$ / $CH_3COOC_2H_5$ / $C_4H_8O_2$	Any correct structure – must show all atoms but can be mixed displayed/structural accept CO_2 for COO allow **correct** reverses eg $C_2H_5OOCCH_3$ reject other 'isomers'eg $C_2H_5COOCH_3$; C_3H_8COO	1

Question number	Answer	Notes	Marks
5 (a) (ii)	effervescence/ fizzing/ bubbles / solid disappears	**allow** solid dissolves **ignore** gas/CO_2 given off **additional** incorrect responses negate this mark (list principle)	1

Question number	Answer	Notes	Marks
5 (b)	**A** 0.1		1

Question number	Answer	Mark
5 (c)*	A explanation to include some of the following points **Indicative content** **Basic titration** • pipette • burette • wash with appropriate solution • acid or alkali in flask • indicator • swirling • use white tile **End point** • correct starting colour of indicator • controlled addition until indicator changes colour (permanently) • add dropwise near endpoint • correct end colour of indicator • repeat titration until concordant results **Obtaining crystals** • mix volumes without indicator • warm until crystallisation starts • leave to crystallise • dry between absorbent paper/leave to dry	6
Level	No rewardable content	
1	• a limited description of the titration or the crystallisation • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	• a simple description of the titration or the crystallisation OR a limited description of both • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately; • spelling, punctuation and grammar are used with some accuracy	
3	• a detailed description of the titration and the crystallisation • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately; • spelling, punctuation and grammar are used with few errors	

Question number	Answer	Notes	Marks
5 (d)	moles CH_3COOH = 0.01 x 25/1000 (= **0.00025**) (1) moles NaOH = **0.00025**/ 1:1 ratio (1) volume NaOH = 0.00025 **x 1000/0.02** (= 12.5cm^3) (1) OR 1:1 ratio (1) 25 x 0.01 = vol x 0.02 (1) volume NaOH = 0.00025 x 1000/0.02 (= 12.5cm^3) (1)	12.5 *as final answer* scores 3 0.0125 or 12500 scores 2 0.00025 not linked to any substance scores 1; linked to NaOH scores 2 apply ecf [delete 1 mark per error] units not required, but penalise incorrect units	3

Question number	Answer	Notes	Marks
6 (a)	**B** C_4H_{10}		1

Question number	Answer	Notes	Marks
6 (b) (i)	An explanation including AMOUNT OF ETHANOL each drink contains different concentration of ethanol / the whisky contains more alcohol than the beer/ each drink would mean absorbing a different quantity of alcohol (1) AFFECT ON BODY RELEVANT TO DRIVER slower reactions / longer reaction time / lowers inhibitions / poorer vision / dizziness / depressant (1)	alcohol/ethanol can be used interchangeably allow alternatives to concentration eg strength, % alcohol, units of alcohol ignore 'slower reaction time' ignore vague answers eg ability to drive affected / affects brain/ references to drunk or intoxicated	2

Question number	Answer	Notes	Marks
6 (b) (ii)	carboxylic acid(s) [both words required]	**reject** carboxyl group **Ignore** any formulae	1

Question number	Answer	Notes	Marks
6 (c)	$C_3H_7OH \rightarrow C_3H_6 + H_2O$ Any **two** formulae on correct side in equation format = 1 Fully correct balanced equation (allow multiples) = 2	reject formulae with small letters or non-subscripts eg h_2O H2O, H^2O, H_2o, H2o allow = for →	2

Question number	Answer	Mark
6 (d)*	A explanation to include some of the following points **Indicative content** Ethene • **A** • C and H only in molecule / hydrocarbon • bromine water orange to colourless / unsaturated / alkene • can be polymerised / unsaturated Ethanol • **B** • C, H and O in molecule / not hydrocarbon • oxidises in air / alcohol • no other reactions with metal or carbonate / not acid Ethanoic acid • **C** • C, H and O in molecule / not hydrocarbon • reacts with magnesium giving effervescence / acid • reacts with sodium carbonate giving effervescence/ acid Ethane • **D** • C and H only in molecule/ hydrocarbon • no reaction with bromine water / saturated / alkane Logical order • candidates may identify three and hence deduce fourth	6
Level	No rewardable content	
1	• a limited description identifying two substances and considering one piece of evidence • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	• a simple description identifying at least two substances and considering at least two pieces of evidence • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately; • spelling, punctuation and grammar are used with some accuracy	
3	• a detailed description identifying all four substances and considering at least three pieces of evidence • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately; • spelling, punctuation and grammar are used with few errors	

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Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Wednesday 17 June 2015 – 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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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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.

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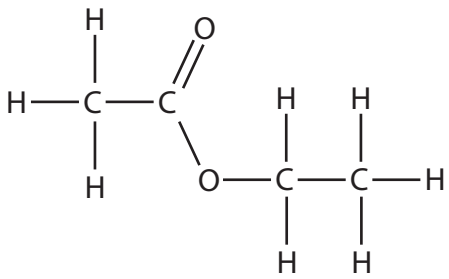
Questions begin on next page.

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 ☒.

Saturated and unsaturated organic compounds

1 The structure of a molecule of an ester, ethyl ethanoate, is shown.



(a) (i) Give the molecular formula of this compound.

(1)

.....

(ii) Write the word equation for the reaction of ethanol with another compound to form ethyl ethanoate and another product.

(2)

.....

(iii) A hazard from the ethyl ethanoate fact sheet is shown in the box.

Exposure to the vapour of ethyl ethanoate can cause you to feel dizzy or to faint

Suggest why, despite this hazard, it is still safe to use ethyl ethanoate in sweets.

(1)

.....

.....

.....

.....

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(b) Vegetable oils and fats are esters.

One of these oils is boiled with concentrated sodium hydroxide solution.
The mixture is poured into concentrated sodium chloride solution.
A white solid is formed.

(i) What type of substance is the white solid?

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

(1)

☒ **A** alcohol

☒ **B** fat

☒ **C** polyester

☒ **D** soap

(ii) The white solid is formed in a mixture with a solution of other substances.

Describe how a pure sample of the white solid can be obtained from this mixture.

(2)

.....

.....

.....

.....

.....

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

Liquid oils can be converted into solid fats by hydrogenation.

In this reaction

(1)

☒ **A** a salt and water are formed

☒ **B** the liquid oil is reacted with oxygen gas

☒ **C** unsaturated molecules in the liquid oil become saturated

☒ **D** C═C bonds are formed

(Total for Question 1 = 8 marks)

Identifying salts

2 (a) A technician had two bottles containing solid salts.
One bottle contained a potassium salt and the other contained a sodium salt.
Unfortunately the labels had fallen off the bottles.
The technician tested the salts to find the ions present.

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

Both salts contained the same anion.

A solution of one salt was made and some dilute nitric acid was added.
Drops of silver nitrate solution were added.
A yellow precipitate formed.

This test shows the anion in the salt is

(1)

☒ **A** bromide, Br^-

☒ **B** chloride, Cl^-

☒ **C** iodide, I^-

☒ **D** sulfate, SO_4^{2-}

(ii) The technician wanted to find out which bottle contained the sodium salt and which bottle contained the potassium salt.

Explain how the technician should do this.

(2)

.....

.....

.....

.....

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(b) When sodium hydroxide solution is mixed with a solution containing copper ions, Cu^{2+}, copper hydroxide, $Cu(OH)_2$, is formed.

(i) Describe what you would **see** when these solutions are mixed.

(2)

.....

.....

(ii) Write the ionic equation for this reaction.

.....

(3)

(Total for Question 2 = 8 marks)

Ethanol

3 (a) Ethanol is produced by the fermentation of glucose.

Yeast is needed for the fermentation reaction.

(i) State **two** other conditions for fermentation.

(2)

.....

.....

.....

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

A dilute solution of ethanol can be converted to a concentrated solution of ethanol by

(1)

☒ **A** filtration

☒ **B** fractional distillation

☒ **C** dehydration

☒ **D** cracking

(iii) Write the balanced equation for the fermentation of glucose, $C_6H_{12}O_6$.

(2)

.....

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(b) In industry, ethene is converted to ethanol.

(i) State **two** conditions for this reaction.

(2)

(ii) A country has large reserves of crude oil.

It is a relatively wealthy country with a large population but it has only a small amount of fertile land.

Explain why the country would prefer to produce its ethanol from ethene rather than by fermentation.

(3)

(Total for Question 3 = 10 marks)

Gases

4 (a) Propene is a gaseous hydrocarbon.

Draw the structure of a molecule of propene, showing all bonds.

(2)

(b) Nitrogen reacts with hydrogen to form ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(i) Calculate the minimum volume of nitrogen, in dm^3, required to react completely with 1000 dm^3 of hydrogen.

All volumes are measured at the same temperature and pressure.

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

(1)

☒ **A** 333 dm^3

☒ **B** 1000 dm^3

☒ **C** 3000 dm^3

☒ **D** 4666 dm^3

(ii) The minimum volumes of nitrogen and hydrogen that must react completely to form 5000 dm^3 of ammonia are calculated.

These volumes are mixed and left, under appropriate conditions, until the reaction reaches equilibrium.

Explain which gas or gases will be present when equilibrium is reached.

(2)

.....

.....

.....

.....

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(iii) The Haber process is carried out under a pressure of about 200 atm.

Explain the effect on the **equilibrium yield** of ammonia, if the process is carried out at a pressure higher than 200 atm.

(2)

(iv) Explain the effect on the **rate of attainment of equilibrium**, if the process is carried out at a pressure higher than 200 atm.

(3)

(Total for Question 4 = 10 marks)

Water

5 (a) A solution is made by dissolving calcium chloride in water.

11.1 g of calcium chloride are dissolved in water.

The volume of the solution is made up to 500 cm^3.

Calculate the concentration, in mol dm^{-3}, of calcium chloride, $CaCl_2$, in this solution.

(relative atomic masses: Cl = 35.5, Ca = 40.0)

(3)

concentration = ... mol dm^{-3}

(b) The concentration of a solution of an alkali can be determined by titration with an acid.

25.0 cm^3 portions of the solution of the alkali are transferred into a conical flask and titrated with the acid solution, using a suitable indicator.

(i) Describe how you would measure out and transfer 25.0 cm^3 of the solution of the alkali.

(2)

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

The burette readings of acid added were

	titration 1	titration 2	titration 3
final volume / cm^3	27.20	30.10	25.35
initial volume / cm^3	2.05	5.20	0.10
volume of acid added / cm^3	25.15	24.90	25.25

The volume of acid added that should be used in the calculation is

(1)

☒ **A** 24.90 cm^3

☒ **B** 25.00 cm^3

☒ **C** 25.10 cm^3

☒ **D** 25.20 cm^3

*(c) Some salts dissolved in water cause the water to be hard.

When mixed with a small volume of soap solution, hard water does not form a lather.

You are provided with three unlabelled samples of water.

- one is soft water
- one is permanent hard water
- one is temporary hard water

You are provided with soap solution and the usual laboratory apparatus.

Describe tests that you should carry out on each sample to identify the type of water in each sample.

(6)

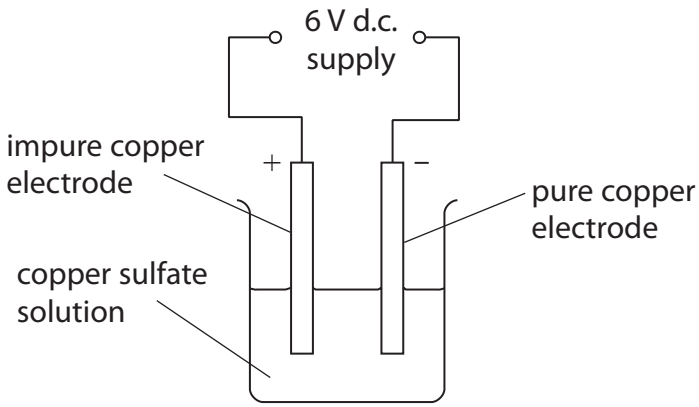
(Total for Question 5 = 12 marks)

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Electrolysis

6 (a) Impure copper is purified by electrolysis using the apparatus shown.



(i) Give the name of the electrode which is made of pure copper.

(1)

.....

(ii) Describe how each electrode will have changed at the end of the electrolysis process.

(2)

.....

.....

.....

.....

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

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$$

This half equation shows the process of

(1)

☒ **A** displacement

☒ **B** oxidation

☒ **C** redox

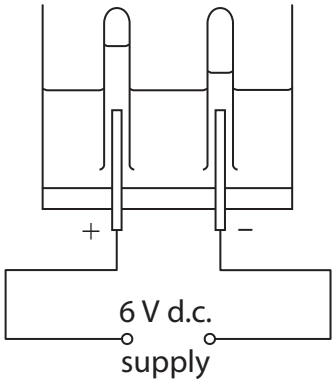
☒ **D** reduction

(iv) Copper sulfate solution is the electrolyte used in this electrolysis process.

Explain how copper sulfate solution conducts electricity.

(2)

(b) Sodium sulfate solution is electrolysed in the apparatus shown.



Sodium sulfate solution contains sodium ions, Na^+, sulfate ions, SO_4^{2-}, hydrogen ions, H^+, and hydroxide ions, OH^-.

Hydrogen is produced at one electrode and oxygen is produced at the other electrode.

Explain how these products are formed from the ions in the electrolysis process, indicating how you would identify the products.

You may give ionic equations in your answer.

(6)

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(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCSE in Chemistry (5CH3H) Paper 01 Unit C3: Chemistry in Action

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	$C_4H_8O_2$	capital letters; numbers must be subscripts ignore structural formulae such as $CH_3COOCH_2CH_3$ i.e. must have just C_4, H_8 and O_2 in any order.	**(1)**

Question Number	Answer	Mark
1(a)(ii)	ethanol + ethanoic acid → ethyl ethanoate + water (2) LHS= 1 mark [allow acetic acid]; RHS= 1 mark [allow ethyl acetate] Allow = for arrow. Fully correct formula equation = 2 (part mark not possible with formulae)	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	no vapour/ little vapour (given off) / it is not a gas / it is a solid (not vapour) OR small amount/ concentration in sweets	allow gas for vapour allow ethyl ethanoate is in a liquid state	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	**D** soap		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	A description linking • filter / decant off water (1) • (then) wash/rinse (1) Can only score second mark if first marking point awarded	ignore anything before filtering that would not contaminate soap but do not allow to evaporate water/ heat BEFORE filtering ignore anything after washing, including drying	**(2)**

Question Number	Answer	Mark
1(c)	**C** unsaturated molecules in the liquid oil become saturated	**(1)**

Total for Question 1 = 8 marks

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	**C** iodide, I^-		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	A description linking two points from • flame test / description of flame test mentioning **in** flame (1) • sodium gives a **yellow** flame (1) • potassium gives a {lilac/purple/violet} flame (1)	description can be using (nichrome) wire or damp splint Ignore: hold over/ around/under/above flame Ignore: yellow-orange, orange or any other colour	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	A description linking • blue (1) • precipitate / solid (1) Marked independently. If further, incorrect observations given, use list principle	allow appropriate qualifiers: e.g. 'light blue' but **not** other colours eg green-blue allow ppt	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	$Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$ (3) Identifies Cu^{2+} on **LHS <u>and</u>** $Cu(OH)_2$ on **RHS** in equation format (1) OH^- formula on **LHS** (1) These two marks are independent and can be scored even if additional ions, correct or incorrect, are given balancing correct symbols (1) This mark is only awarded for a fully correct ionic equation with no additional ions	allow multiples accept $Cu^{2+}(OH^-)_2$ allow Cu^{++}/ Cu^{+2} reject incorrect symbols such as cu^{2+}, Oh^- etc. ignore: state symbols allow = instead of →	**(3)**

Total for Question 2 = 8 marks

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	A description including two of the following • dissolve the sugar/aqueous solution (1) • **warm**/ 25-40°C (1) • in absence of air / no oxygen/ anaerobic / attach airlock (1) • pH neutral / slightly acidic /4-7 • **sterile** conditions ignore any mention of pressure	ignore incorrect answers ignore heat / hot allow any temperature or range within 25-40 allowed ignore clean etc ignore 'optimum' {temp/pressure/pH}	**(2)**

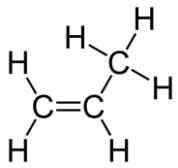
Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	**B** fractional distillation		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(iii)	$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ (2) correct formulae (<u>with no others</u>) (1) balancing <u>the three</u> formulae (1) ignore state symbols	allow C_2H_6O/ CH_3CH_2OH for C_2H_5OH reject CO2 / CO^2 allow multiples	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	Any two of • (reacts with) steam (1) • catalyst/phosphoric acid (1) • **<u>high temperature</u>** / 200°C - 450^{0}C (1) • **<u>high</u>** pressure/ 50-100 atm (1)	allow reacts with water <u>ignore incorrect catalyst</u> ignore hot / heat	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	An explanation linking any three of LAND: country needs land for: farming / food / crops / homes /not enough land to grow sugar crop for fermentation (1) OIL SUPPLY: (reliable supply of) crude oil for **ethene** (1) SPEED: fermentation slow/batch; hydration continuous/ fast (1) PURITY: hydration makes {pure(r) ethanol / high concentration} (1) ATOM ECONOMY: higher atom economy for ethene process (1)	ignore incorrect responses ignore land needed for growing yeast ignore cheaper/ easier ignore yield	**(3)**

Total for Question 3 = 10 marks

Question Number	Answer	Mark
4(a)	 any 3 carbon molecule **and** <u>one</u> C=C (1) fully correct molecule with <u>all bonds</u> (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	**A** 333 dm^3		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	An explanation linking • <u>all / three</u> gases present/ <u>nitrogen, hydrogen and ammonia</u> (1) • ammonia decomposes/ ammonia turns back to reactants/ reaction goes both ways / reversible (1)	reject ammonium ignore incomplete reaction assume that "both reactions" refer to forward and backward reaction allow **<u>dynamic</u>** equilibrium	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(iii)	An explanation linking • increased / high**er** {yield / amount of ammonia} (1) • because fewer (gas) molecules/ moles on RHS/ 4 mole(cule)s on left and 2 on right/ decreased volume on RHS/equilibrium shifts to RHS/ equilibrium shifts in forward direction (1)	mark independently ignore "high yield" reject answers referring to exothermic or endothermic ignore any references to rate	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(iv)	An explanation to include • **rate** increased/ time to reach equilibrium reduced (1) • because gas molecules closer / more concentrated (1) • so increased **collision** rate / more **collisions** in a given time / more frequent **collisions**(1)	mark independently ignore any refs to equilibrium ignore 'time is faster'/ allow 'quicker' allow atoms/ particles instead of molecules; allow more molecules present (in same container) do not allow 'more collisions'	**(3)**

Total for Question 4 = 10 marks

Question Number	Answer	Acceptable answers	Mark
5(a)	$CaCl_2$ = 40 + 35.5 + 35.5 (=111) (1) THEN moles = 11.1 / 111 (= 0.1) (1) conc = **moles** x 1000/500 (=0.2) (1) OR mass conc = 11.1 x 1000/500 (=22.2) (1) conc = **mass conc**/111 (= 0.2) (1)	0.2 scores 3 ecf: 11.1 / Mr ecf: mass conc / 111	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(b)(i)	A description linking • **pipette** (1) • one practical point eg draw liquid up to line/ use pipette filler/ rinse first / read at eye level (1)	**ignore** burette etc for 1st mpt if using measuring cylinder/ burette allow suitable practical point eg read at eye level/ add dropwise from burette near 25 cm^3 (1) ignore as 2nd point: transfer liquid to flask / safety precautions	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b)(ii)	**D** 25.20 cm^3		**(1)**

Question Number		Indicative Content	Mark
QWC	***5(c)**	A description / explanation including some of the following points **soft** • add soap (solution) • shake/ mix • lather (immediately) • no scum/ no precipitate **permanent hard** • add soap (solution) • shake • no lather / less than with soft water • scum/ precipitate • boiled sample • same results / boiling does not change • becomes soft after ion exchange but not after boiling **temporary hard** • add soap (solution) • shake • no lather / less than with soft water • scum/ precipitate • **boiled** sample • after boiling precipitate / (lime)scale formed • lather (immediately) credit quantitative approaches e.g. titration with soap solution	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description e.g. test and one result / when shaken with soap, soft water makes lather but no scum • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple description e.g. describe test and results to distinguish the soft water and the two samples that are hard water / when shaken with a small amount of soap, soft water makes a lather and no scum but the other waters make scum but no (less) lather • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed description e.g. describe test and results to identify all three of the samples / as 3-4 and boil the two hard water samples and repeat test. That which now gives a lather is temporarily hard • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Total for Question 5 = 12 marks

Question Number	Answer	Acceptable answers	Mark
6(a)(i)	cathode Reject anode		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(a)(ii)	A description to include ANODE/IMPURE COPPER/ +VE ELECTRODE • becomes smaller/ loses mass / loses copper / copper atoms form ions / copper is oxidised / copper (ions) enter solution (1) CATHODE/ PURE COPPER/ -VE ELECTRODE • {red-brown/copper} deposit/ becomes larger / gains mass / gains copper / copper ions are reduced / copper (ions) from solution add to electrode (1)	 allow half equation allow half equation	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(a)(iii)	**D** reduction		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(a)(iv)	An explanation linking **<u>ions</u>** / cations / copper ions / anions / sulfate ions (1) (are free to) <u>move</u> (in solution) (1)	 **reject electrons** / atoms / molecules ignore 'charged particles' allow flow 2nd mark dependent on 1st MP	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(b)**	A description / explanation including some of the following points marks can be scored from diagrams incorrectly balanced equations can be used as evidence of reaction occurring but po not otherwise credited **electrolysis process** • ions move when current passed • negative ions move to anode • overall decomposition of water • $2H_2O \rightarrow 2H_2+O_2$ **Anode/ positive electrode** • sulphate ions move to anode • hydroxide ions move to anode • hydroxide ions lose electrons/oxidation • hydroxide ions form oxygen • half equation: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ • half volume gas at this electrode • oxygen test: glowing splint in gas relights **cathode/ negative electrode** • sodium ions move to cathode • hydrogen ions move to cathode • hydrogen ions gain electrons / reduction • hydrogen ions form hydrogen • half equation: $2H^+ + 2e^- \rightarrow H_2$ • double volume gas at this electrode • hydrogen test: lit splint in gas burns/ pops • hence double volume of hydrogen gas	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. states which ions go to which electrode • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation e.g. explain formation of one product • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation e.g. explaining formation of BOTH products at electrodes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total for Question 6 = 12 marks

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Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Thursday 19 June 2014 – Afternoon
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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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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.

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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 ☒.

Ethanol

1 Ethanol is present in alcoholic drinks.

(a) Ethanol is produced by fermentation of carbohydrates.

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

The conditions used for fermentation are

(1)

☒ **A** add manganese(IV) oxide, temperature below 20 °C

☒ **B** add yeast, temperature of about 35 °C

☒ **C** add manganese(IV) oxide, temperature of 45 °C

☒ **D** add yeast, temperature above 60 °C

(b) Ethanol, C_2H_5OH, is also produced by the reaction of ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(c) Ethanol is a member of the homologous series, the alcohols.

(i) Describe what is meant by an **homologous series**.

(2)

.....

.....

.....

.....

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(ii) Draw the structure of a molecule of methanol, CH_3OH.

Show all the covalent bonds.

(1)

(d) When a bottle of wine is left open for a few days, ethanol in the wine changes into ethanoic acid.

(i) State the type of reaction that occurs when ethanol changes into ethanoic acid.

(1)

.....

(ii) Describe what you would **see** when a piece of magnesium ribbon is added to dilute ethanoic acid.

(2)

.....

.....

.....

.....

(Total for Question 1 = 9 marks)

Qualitative Analysis

2 (a) Three solids, **A**, **B**, and **C**, are analysed.

(i) Solid **A** is potassium iodide.

A small amount of solid **A** is dissolved in water to form a solution.

Describe the test to show that the solution of **A** contains iodide ions.

(2)

(ii) Solid **B** is ammonium chloride.

Describe the test to show that solid **B** contains ammonium ions.

(3)

(iii) Solid **C** is dissolved in water.

When sodium hydroxide solution is added to the solution of **C**, a red-brown precipitate is formed.

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

This test shows that the ion present in solid **C** is

(1)

☒ **A** copper, Cu^{2+}

☒ **B** iron(II), Fe^{2+}

☒ **C** iron(III), Fe^{3+}

☒ **D** sodium, Na^{+}

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(b) Sodium hydroxide solution can be used to test for aluminium ions and for calcium ions in solution.

Describe the results of these tests for aluminium ions and for calcium ions, explaining how the results distinguish between the two ions.

(3)

.....

.....

.....

.....

(Total for Question 2 = 9 marks)

Organic chemistry

3 (a) Margarine is made by hydrogenation of a liquid oil.

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

In hydrogenation of a liquid oil

(1)

- ☒ **A** hydrogen is removed from the liquid oil
- ☒ **B** the liquid oil reacts with steam
- ☒ **C** double bonds are formed
- ☒ **D** the liquid oil is changed into a solid

(b) Soaps are made by boiling oils with concentrated solutions of alkalis.

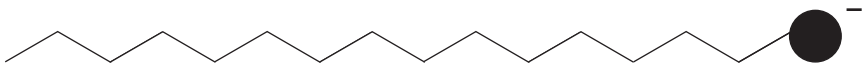
(i) Which of the following would be a suitable alkali to use in the production of soaps?

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

(1)

- ☒ **A** sodium chloride
- ☒ **B** sodium hydroxide
- ☒ **C** sodium nitrate
- ☒ **D** sodium sulfate

(ii) The diagram shows a soap anion.



Explain how soap anions remove grease marks from clothes during washing with water.

(2)

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(c) Esters are made by reacting alcohols with carboxylic acids.

(i) Give the name of the carboxylic acid that has three carbon atoms in each molecule.

(1)

.....

(ii) When ethanoic acid, CH_3COOH, reacts with ethanol, C_2H_5OH, ethyl ethanoate is one of the products formed.

Write the balanced equation for the reaction.

(2)

.....

(d) Polyesters are used to make plastic bottles.

State another use of polyesters.

(1)

.....

(Total for Question 3 = 8 marks)

Making sodium chloride

4 To make pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid, a titration has to be used.

The equation for the reaction is

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(\ldots\ldots) + H_2O(\ldots\ldots)$$

(a) Which state symbols follow NaCl and H_2O to complete the equation?

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

(1)

		NaCl	**H_2O**
☒	**A**	s	l
☒	**B**	aq	aq
☒	**C**	s	aq
☒	**D**	aq	l

(b) The reaction above is a neutralisation reaction.

Write the ionic equation for the reaction.

(2)

.....

(c) When sodium hydroxide solution is titrated with dilute hydrochloric acid, an acid-base indicator is used.
The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask.
At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

.....

(ii) State the colour change for this indicator at the end point.

(1)

from ..... to .....

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(d) A sodium hydroxide solution was made up by dissolving 20.0 g of sodium hydroxide in water and making the volume of the solution up to 1.00 dm^3. Calculate the concentration of sodium hydroxide, NaOH, in this solution in mol dm^{-3}.

(relative atomic masses: H = 1.00, O = 16.0, Na = 23.0)

(2)

concentration = ... mol dm^{-3}

(e) In another experiment, a titration was carried out.
25.0 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution, NaOH, was titrated with hydrochloric acid.
The volume of the hydrochloric acid required to neutralise the sodium hydroxide solution was 30.0 cm^3.

Calculate the concentration of the hydrochloric acid, HCl, in mol dm^{-3}.

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

(3)

concentration = ... mol dm^{-3}

(Total for Question 4 = 10 marks)

Electrolysis

5 (a) Some metal objects are electroplated to improve their appearance.

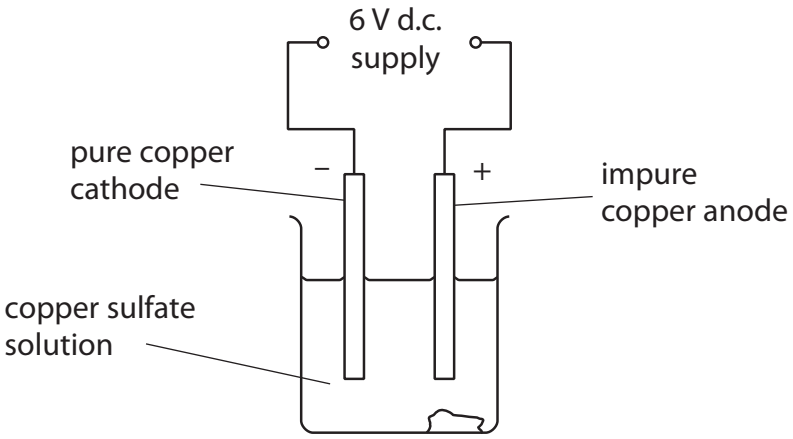
Give another reason why some metal objects are electroplated.

(1)

.....

.....

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
The electrodes were removed, washed, dried and their masses redetermined.

The table shows the masses of the electrodes before and after electrolysis.

	mass of electrode before electrolysis / g	mass of electrode after electrolysis / g	change in mass
mass of impure copper anode	40.0	35.0	5.0 g decrease
mass of pure copper cathode	10.0	14.8	4.8 g increase

Explain these results.

(3)

.....

.....

.....

.....

.....

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(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

*(d) Sodium chloride is an ionic compound.
It contains sodium ions, Na^+, and chloride ions, Cl^-.

When molten sodium chloride is electrolysed, sodium metal and chlorine gas are formed.

Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

(Total for Question 5 = 12 marks)

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Gases and ammonia

6 (a) Hydrogen reacts with oxygen to form water vapour.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

If 200 cm^3 of hydrogen react completely with 100 cm^3 of oxygen, what is the maximum volume of water vapour formed, if all volumes are measured at the same temperature and pressure?

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

(1)

☐ **A** 100 cm^3

☐ **B** 200 cm^3

☐ **C** 300 cm^3

☐ **D** 400 cm^3

(b) Zinc reacts with dilute hydrochloric acid to form zinc chloride and hydrogen.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

Calculate the maximum volume of hydrogen formed, at room temperature and pressure, when 13.0 g of zinc reacts completely with excess hydrochloric acid.
(relative atomic mass: Zn = 65.0,
1 mol of any gas occupies 24 dm^3 at room temperature and pressure)

(2)

.....

.....

.....

.....

volume of hydrogen = ... dm^3

(c) In industry, ammonia is produced by the Haber process.

$$\text{nitrogen} + \text{hydrogen} \rightleftharpoons \text{ammonia}$$

(i) What is the source of the hydrogen used in the Haber process?

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

(1)

☒ **A** air

☒ **B** reaction of zinc with dilute sulfuric acid

☒ **C** electrolysis of water

☒ **D** natural gas

(ii) When nitrogen reacts with hydrogen, the amount of ammonia gradually increases until it becomes constant.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Explain why the amount of ammonia remains constant.

(2)

.....

.....

.....

.....

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*(d) The reaction between nitrogen and hydrogen is exothermic.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

If nitrogen and hydrogen were reacted at 90 atm pressure and 300 °C, without a catalyst, some ammonia would be formed eventually.

In the Haber process a pressure of 150 atm and a temperature of 450 °C are used, in the presence of an iron catalyst.

Explain, with reasons, why the Haber process conditions are better for the manufacture of ammonia.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCSE in Chemistry (5CH3H) Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

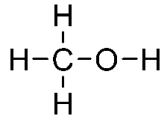
Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Acceptable answers	Mark
1(a)	**B** add yeast, temperature of 35°C		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	C_2H_4 (1) + H_2O (1) → C_2H_5OH award one mark max if incorrectly balanced	allow correct molecular formula C_2H_6O allow H_4C_2 correct multiples ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	A description linking any two from • same **general** formula (1) • same functional group (1) • (consecutive) compounds differ by CH_2 (1) • gradual variation in physical properties (1) • {similar / same} chemical {properties / reactions} (1)	 allow $C_nH_{2n+1}OH$ (2) allow C_nH_{2n} or any correct general formula (2) ignore same properties/physical properties allow a correct trend, e.g. bp increases with number of carbon atoms (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)		allow –OH allow correct dot and cross diagram	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(d)(i)	oxidation		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(d)(ii)	A description including any two from • effervescence/fizzing/bubbling (1) • solid disappears (1) • colourless solution (1)	ignore incorrectly named gases ignore gas given off/evolved allow magnesium floats on surface of acid allow solid dissolves (1) ignore solution <u>turns</u> colourless ignore clear	**(2)**

(Total for Question 1 = 9 marks)

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	A description linking • add dil nitric acid then silver nitrate solution (1) • yellow precipitate/solid (1)	 allow silver nitrate solution alone(1) reject if wrong reagent / acid mentioned colour and form both required reject cream reject yellow-orange	 **(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	A description linking • add to sodium hydroxide (solution) and warm (1) • test gases with (moist) (red) litmus paper (1) • (litmus paper) turns blue (1)	 allow sodium hydroxide (solution) alone (1) allow heat solid alone (1) allow Universal Indicator paper/ pH paper(1) allow correct colour change for named indicator	 **(3)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	**C** iron(III), Fe^{3+}		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	A description to include • **white** {precipitate/solid} with calcium (ions) (1) • **white** {precipitate/solid} with aluminium (ions) (1) • (precipitate/solid) dissolves in **excess** for aluminium ions / (precipitate/solid) remains in **excess** for calcium ions (1) 3rd mark dependent on first and/or second mark being awarded	<u>both</u> (ions) form a **white** (1) {precipitate/solid} (1) allow 'both will turn white' for 1 mark allow 'more' for 'excess' ignore clear	**(3)**

(Total for Question 2 = 9 marks)

Question Number	Answer	Acceptable answers	Mark
3(a)	**D** the liquid oil is changed into a solid		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	**B** sodium hydroxide		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	An explanation linking any two of • tail / {hydrophobic / hydrocarbon } end into grease (1) • head / {anion / hydrophilic} end into water (1) • allows grease to mix with water when surrounded by soap (anions) / grease is surrounded by soap (1) • surface tension lowered (1)	allow correctly labelled diagram (2) head is soluble in water (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)(i)	propanoic (acid)		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)(ii)	$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5$ (1) + H_2O (1) award one mark if incorrectly balanced	correct products but no / incorrect reactants shown (1) allow correct molecular formulae allow correct multiples ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(d)	(making) fibres/fleece/clothing/ fabrics/bedding/computer mouse mats/yarns/ropes/safety belts/filters/insulating tape/wood finishes/(plastic) carrier bags	allow any named item of clothing	**(1)**

(Total for Question 3 = 8 marks)

Question Number	Answer	Acceptable answers	Mark
4(a)	**D** aq l		**(1)**

Question Number	Answer	acceptable answers	Mark
4(b)	H^+ + OH^- (1) → H_2O (1)	LHS (1) RHS (1) ignore state symbols, even if incorrect. allow inclusion of spectator ions, Na^+ and Cl^-, if shown on both sides for one mark max	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	suitable acid-base indicator eg methyl orange, phenolphthalein	litmus reject universal indicator allow recognisable phonetic spelling	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	correct colour change for suitable indicator in 4(c)(i): methyl orange : yellow → orange/pink/red phenolphthalein : magenta/pink → colourless	 litmus : blue → red ignore clear	**(1)**

Link 4ci and 4cii together on e-Pen

Question Number	Answer	Acceptable answers	Mark
4(d)	rel mass NaOH = 23.0 + 16.0 + 1.00 (1) concentration = $\frac{20.0}{\text{formula mass}}$ x 1 (1)	(= 40.0) (1) 0.5 (mol dm^{-3}) without working (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(e)	moles of NaOH = $\frac{25.0 \times 1.50}{1000}$ (1) (= 0.0375 moles) ratio 1 : 1 / moles NaOH = moles HCl (1) conc of HCl = $\frac{0.0375 \times 1000}{30.0}$ (1) (= 1.25 (mol dm^{-3})) OR 25.0 x 1.50 = 30.0 x conc acid (2) conc of HCl = $\frac{25.0 \times 1.50}{30.0}$ (1) (=1.25 (mol dm^{-3}))	0.0375 (1) – without working shown conc of HCl = 1.25 (mol dm^{-3})(3) without any working shown allow ecf conc = $\frac{30.0 \times 1.50}{25.0}$ = 1.80 (2) (mol dm^{-3}) allow 0.00125 /0.125 / 12.5 max 2	**(3)**

(Total for Question 4 = 10 marks)

Question Number	Answer	Acceptable answers	Mark
5(a)	improves resistance to corrosion	ignore rusting	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	An explanation to include • anode dissolves / half equation given / atoms lose electrons /copper becomes ions/copper (atoms) oxidised (1) • copper ions moving from anode to cathode (1) • copper plated on cathode / half equation given / ions gain electrons/copper ions reduced/copper ions form atoms (1) • {difference/0.2g} is impurities (1) • would expect same decrease in mass (as increase) (1)	ignore references to mass increase of cathode and mass decrease of anode ignore 'impure copper (ions)' for the second marking point allow difference is metal around it eaten away/ impurities/sludge fallen to bottom of container /under anode (1) (there needs to be a reference to the difference in electrode masses for this point)	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(c)	$2O^{2-} \rightarrow O_2 + 4e^{(-)}$ (2) OR $O^{2-} \rightarrow O + 2e^{(-)}$ (1) $2O \rightarrow O_2$ (1)	Unbalanced equation (1)	**(2)**

Question Number		Indicative Content	Mark
QWC	***5(d)**	A description including some of the following points • sodium chloride is melted and ions are free to move at cathode • {sodium / positive} ions move to cathode • (sodium) metal forms at cathode • sodium ions gain electrons ... • to form atoms • this is reduction • $Na^+ + e^- \rightarrow Na$ at anode • {chloride / negative} ions move to anode • (chlorine) gas forms at anode • chloride ions lose electrons ... • to form atoms • this is oxidation • two chlorine atoms combine to form a chlorine molecule / share electrons • $Cl^- \rightarrow Cl + e^-$ / $2Cl^- \rightarrow Cl_2 + 2e^-$ • $2\,Cl \rightarrow Cl_2$	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. gives at least one relevant description or explanation • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. for anode or cathode gives at least three descriptions or relevant explanations • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. for both anode and cathode gives a total of at least five descriptions or relevant explanations • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question 5 = 12 marks)

Question Number	Answer	Acceptable answers	Mark
6(a)	**B** 200 cm^3		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b)	65.0 g Zn produces 24 dm^3 H_2 (1) 13.0 g Zn produces $\frac{13.0}{65.0}$ x 24 (1) (= 4.8 dm^3 H_2)	$\frac{13.0}{65.0}$ mol Zn produces $\frac{13.0}{65.0}$ mol H_2 Vol of H_2 = $\frac{13.0}{65.0}$ x 24 (2) (= 4.8dm^3) 4.8 dm^3 (2) without working allow 65/13 x 24 (1) = 120dm^3 13/65 (1) x (1/24) = 0.00833 dm^3 0.2 anywhere 1 mark x 24 anywhere 1 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(c)(i)	**D** natural gas		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(c)(ii)	An explanation linking forward and back reactions take place / reversible / dynamic (1) at the same rate / equilibrium (1)	dynamic equilibrium = 2 marks	 **(2)**

Question Number		Indicative Content	Mark
QWC	***6(d)**	A description including some of the following points Higher pressure: • higher pressure gives increased yield • equilibrium shifts to right hand side • because decrease in number of molecules going from left to right • therefore decrease in volume • favoured by increase in pressure • reaches equilibrium faster • because molecules closer together • so get more frequent collisions Higher temperature • higher temperature reaches equilibrium faster • because molecules move faster • therefore more frequent collisions • molecules have more energy • therefore more collisions have required energy • but yield will be lower • because higher temperature favours endothermic reaction • equilibrium shifts to left hand side • which is decomposition of ammonia / ammonia reforms elements Use of catalyst • catalyst causes reaction to reach equilibrium faster / catalyst increases rates (of both forward and back reactions) • *lowers the activation energy (of both forward and back reactions)* • *reaction follows a new pathway* • does not affect yield • equilibrium position not affected	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description e.g. one valid effect of change OR general comment indicating improved yield or faster rate • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple description e.g. at least two valid effects of change with one point of explanation OR at least three valid effects of change • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed description e.g. at least three valid effects of change with two points of explanation OR at least two valid effects with three points of explanation (in total) • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question 6 = 12 marks)

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Write your name here

Surname	Other names

Edexcel GCSE

Centre Number | Candidate Number

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Thursday 23 May 2013 – 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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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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.

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Questions begin on next page.

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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 ☒.

Electrolysis

1 (a) The ions in sodium chloride solution are

sodium ions, Na^+
chloride ions, Cl^-
hydrogen ions, H^+
hydroxide ions, OH^-

Sodium chloride solution is electrolysed using a direct electric current.

(i) Which of these ions will be attracted to the cathode during the electrolysis of sodium chloride solution?

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

(1)

☒ **A** H^+ ions only

☒ **B** H^+ and Na^+ ions

☒ **C** Cl^- ions only

☒ **D** Cl^- and OH^- ions

(ii) Chlorine is one of the products of the electrolysis.

The half-equation for the production of chlorine is

$$2Cl^- \rightarrow Cl_2 + 2e$$

Explain how the half-equation shows that chloride ions are oxidised.

(2)

.....

.....

(iii) Suggest why the solution remaining at the end of the electrolysis is alkaline.

(1)

.....

.....

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(iv) The electrolysis of sodium chloride solution does not produce metallic sodium.

State what change you would make to the electrolyte to obtain metallic sodium.

(1)

.....

.....

(b) (i) When copper sulfate solution is electrolysed using inert electrodes, oxygen is formed at the positively charged anode.

Explain how the oxygen is formed from ions in the solution.

(2)

.....

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.....

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(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

Calculate the number of moles of copper, Cu, produced in this experiment.

(Relative atomic mass: Cu = 63.5)

(1)

.....

amount of copper produced = ... mol

(Total for Question 1 = 8 marks)

Organic chemistry

2 (a) (i) Which of the following is the formula for a molecule of butane?

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

(1)

☒ **A** C_3H_6

☒ **B** C_3H_8

☒ **C** C_4H_8

☒ **D** C_4H_{10}

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

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

Ethanol, C_2H_5OH, can be converted into ethanoic acid, CH_3COOH.

In this reaction, ethanol is

(1)

☒ **A** dehydrated

☒ **B** neutralised

☒ **C** oxidised

☒ **D** reduced

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(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

.....

.....

.....

.....

(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)

$CH_3COOH + C_2H_5OH \rightarrow$ ..... + ...

(Total for Question 2 = 8 marks)

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Ethanol

3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

.....

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.....

(c) A country has large amounts of available fertile land.
It has no reserves of crude oil.
It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)

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(d) Ethanol is a member of the homologous series of alcohols.
The first three members of the series are

methanol	CH_3OH
ethanol	C_2H_5OH
propanol	C_3H_7OH

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

.....

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(Total for Question 3 = 9 marks)

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Ammonia

4 When nitrogen and hydrogen react to form ammonia, the reaction can reach a dynamic equilibrium.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) Explain what is meant by a **dynamic equilibrium**.

(2)

(b) In industry, the reaction between nitrogen and hydrogen is affected by the conditions used.

(i) The pressure used is 250 atmospheres.
Explain how the use of a higher pressure would affect the equilibrium yield of ammonia.

(2)

(ii) The reaction between nitrogen and hydrogen to form ammonia is exothermic.
The temperature used is 450 °C.

Explain how the use of a lower temperature would affect the equilibrium yield of ammonia.

(2)

P 4 1 9 4 1 A 0 1 0 2 0

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(iii) Even at 450 °C, the reaction is very slow.

State what is used in industry to overcome this problem.

(1)

.....

(c) (i) Calculate the minimum volume of hydrogen required to completely convert 1000 dm^3 of nitrogen into ammonia.

(1)

.....

.....

volume of hydrogen = ... dm^3

(ii) Ammonia is reacted with excess nitric acid, HNO_3, to make ammonium nitrate, NH_4NO_3.

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

Calculate the mass of ammonium nitrate produced by the complete reaction of 34 g of ammonia.

(Relative atomic masses H = 1.0, N = 14, O = 16)

(3)

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mass of ammonium nitrate produced = ... g

(Total for Question 4 = 11 marks)

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Using titration

5 Titration can be used to determine the exact amount of hydrochloric acid that reacts with a given amount of sodium hydroxide solution.

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



(a) What type of reaction takes place when hydrochloric acid reacts with sodium hydroxide solution?

(1)

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

☒ **A** neutralisation

☒ **B** oxidation

☒ **C** precipitation

☒ **D** reduction

(b) Suggest why universal indicator must not be used in titration experiments.

(1)

.....

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*(c) Sodium chloride solution can be made from dilute hydrochloric acid and sodium hydroxide solution.

Describe a titration experiment to find the exact volume of hydrochloric acid needed to neutralise 25.0 cm^3 of sodium hydroxide solution and how you would use this result to obtain pure, dry crystals of sodium chloride.

(6)

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(d) Sodium hydroxide solution is titrated with dilute hydrochloric acid.

The results of the experiment are

volume of sodium hydroxide solution = 25.0 cm^3

volume of 0.100 mol dm^{-3} hydrochloric acid used

rough titration	= 23.1 cm^3
1st titration	= 22.6 cm^3
2nd titration	= 22.8 cm^3

(i) State the volume of hydrochloric acid that must be used to calculate the concentration of sodium hydroxide solution.

(1)

volume of hydrochloric acid = ... cm^3

(ii) In a different experiment, 25.0 cm^3 of sodium hydroxide solution reacted with 23.2 cm^3 of 0.100 mol dm^{-3} hydrochloric acid, HCl.

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

(3)

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

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.....

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

(Total for Question 5 = 12 marks)

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Identifying salts

6 (a) Substance **X** is an ammonium salt.

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

A test was carried out to find which anion is present in substance **X**.
Dilute hydrochloric acid was added to a sample of substance **X**.
There was effervescence and the gas given off turned limewater milky.

The anion present in substance **X** is

(1)

☒ **A** carbonate ion, CO_3^{2-}

☒ **B** chloride ion, Cl^-

☒ **C** nitrate ion, NO_3^-

☒ **D** sulfate ion, SO_4^{2-}

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

.....

.....

.....

.....

.....

(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

.....

P 4 1 9 4 1 A 0 1 6 2 0

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*(c) A technician found some colourless crystals of a substance left, unlabelled, in a beaker in a laboratory.

She knew the substance was one of potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

Explain how, using chemical tests, the technician could find out if the substance left in the beaker was potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

You may include equations in your answer.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2013

GCSE Chemistry (5CH3H)
Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	B H^+ and Na^+ ions		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking • electron(s) (1) • (have been) lost/removed (1) conditional on electrons	ignore reference to number of electrons do not allow negative charge chlorine gains electrons (0) allow chlorine loses electrons (1)	**(2)**

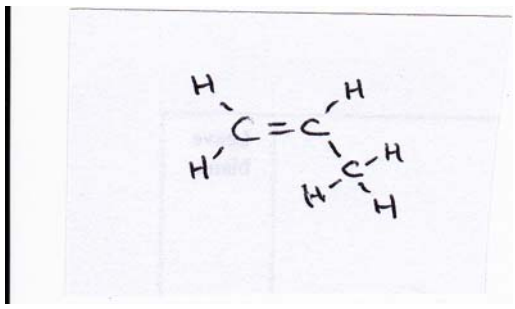
Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	Any one from • it contains (excess) {hydroxide/OH^-} ions (1) • {sodium/Na^+} ions and {hydroxide/ OH^-} ions remain (1) • it is sodium hydroxide/NaOH (1) • {hydrogen/H^+} ions have been removed (at the cathode) (1)	ignore solution has pH greater than 7 allow no hydrogen ions left/acidic **ions** removed	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iv)	use {molten/liquid} {sodium chloride /electrolyte} / melt {it/sodium chloride/electrolyte}	ignore just liquid/liquid sodium	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	An explanation linking Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are oxidised (1)	half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	D C_4H_{10}		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	 **one** C=C in a molecule with three consecutive carbon atoms (1) rest of structure correct, ignore bond angles, conditional on first marking point(1)	allow -CH_3 do not allow two C=C in a molecule allow (1) for completely correct dot and cross diagram	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)	C oxidised		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	A description including two from • effervescence / fizzing / bubbles of gas (1) • solid {disappears/clears} /(colourless)solution formed (1)	ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid (solid/sodium carbonate/it) dissolves (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	$CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$ / $CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$ (1) H_2O (1)	allow displayed formulae/ $C_4H_8O_2$ do not allow formulae ending in –COOH/-COO or any formula that does not show an ester do not allow H2O / H^2O /lower case h/HOH maximum (1) if additional incorrect balancing ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(a)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$ C_2H_4 as **reactant** (1) rest of equation correct conditional on C_2H_4 as a reactant (1)	do not allow H2O / H^2O /lower case h/HOH allow C_2H_6O for ethanol ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)	A description including any two from • dissolve sugar in water /sugar solution (1) • (add) yeast (1) • warm / any temperature or range within 15 to 40°C (1) • anaerobic / {no/little} {air/oxygen} can enter the apparatus (1)	 allow glucose solution ignore carbohydrate allow room temperature ignore heat unless specified temperature ignore optimum temperature do not allow just 'sealed container' ignore fractional distillation	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)	An explanation linking Marking point 1 – sugar- one from • sugar obtained from {plants /crops/specific crop} (1) • (plenty of) land available to grow {plants /crops/specific crop} (for fermentation)(1) Marking point 2 - ethene • ethene obtained from {crude oil / fractional distillation /cracking} (1) Marking point 3 – cost/energy – one from • cannot afford to buy crude oil (1) • crude oil is too expensive (1) • more expensive to {use/buy/produce} ethene (1) • cheaper to use fermentation (1)	ignore answers that just repeat the information in the question ignore vague answers such as carbon neutral/environmentally friendly for marking point 1 **OR** 2, allow plants renewable/{crude oil/ethene} non-renewable (1) allow {little/no} {heat/energy} required for fermentation (1) allow {high temperature /high pressure} required for hydration of ethene (1)	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(d)	An explanation including any two from • formulae differ by CH_2 • same general formula • all have {OH/hydroxyl group}	general formula is $C_nH_{2n+1}OH$ (2) allow increase by {CH_2/1 carbon **and** 2 hydrogens} do not allow incorrect general formula allow have similar **chemical** {reactions /properties}/same functional group/OH from an incorrect general formula ignore 'hydroxide'/all end in (an)ol /all alcohols ignore physical properties maximum (1) if hydroxide ions /carboxyl group	**(2)**

Question Number	Answer	Acceptable answers	**Mark**
4 (a)	An explanation linking Marking point 1 – one from • forward and back reactions take place (at the same time) (1) • rate of the forward and back reactions is the same (1) Marking point 2 – one from • no (overall) change in the {amount/concentration/mass/ volume} of each {substance / reactant / product} (1) • no observable change (1)	assume 'both reactions' implies the forward and back reaction allow reversible reaction with the same rate (1) allow reversible reaction in a closed system (1) do not allow the forward reaction equals the reverse reaction allow overall effect is nil (1) allow reactants and products reach a balance (1) ignore forward reaction cancels out back reaction do not allow {amount / concentration /mass/volume} of reactants and products are equal	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	An explanation linking two of • higher pressure favours forward reaction/equilibrium shifts to the right (1) • because decrease in {volume / number of molecules}/side with lower volume (1) • yield increases (1)	ignore answers related to rate/collisions maximum (1) if 3 statements given, but 1 is incorrect	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	An explanation linking any two of • lower temperature favours forward reaction/equilibrium shifts to the right (1) • because (forward) reaction is exothermic (1) • yield increases (1)	ignore answers related to rate/collisions if answer refers to increasing temperature, maximum (1) for (forward) reaction is exothermic / reverse reaction is endothermic maximum (1) if 3 statements given, but 1 is incorrect	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(iii)	catalyst	iron	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	3 x 1000 (1) (= 3000)		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	marks are for the working Method 1 14 + (3 x 1) (1) g of NH_3 makes 14 + (4 x 1) + 14 + (3 x 16) (1) g NH_4NO_3 34 g of NH_3 makes $\frac{(14 + (4 \times 1) + 14 + (3 \times 16)) \times 34}{17}$ or $\frac{80 \times 34}{17}$ or 2(14 + (4 x 1) + 14 + (3 x 16)) g NH_4NO_3 (1) = 160 g Method 2 moles of NH_3 = $\frac{34}{17}$ (1) = 2 moles of NH_4NO_3 = moles of NH_3 or relative formula mass NH_4NO_3 = 80 (1) mass NH_4NO_3 = 2 x 80 (1) = 160 g	full marks awarded for an answer of 160 g with or without any working allow ecf on incorrect M_r s for either method allow ecf for incorrect moles eg if moles of NH_3 = 0.5 relative formula mass NH_4NO_3 = 80 (1) mass NH_4NO_3 = 0.5 x 80 (1) = 40 g	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(a)	A neutralisation		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	Any one from • no {sharp/clear/distinct} change in colour • gradual colour change • there are too many different colours	ignore not as accurate/reliable allow too difficult to see when it is {neutral/reaction is complete} ignore speed of colour change	**(1)**

Question Number		Indicative Content	Mark
QWC	***5(c)**	A description including some of the following points **titration experiment** • rinse pipette with alkali and burette with acid • measure alkali using a pipette • into suitable container e.g. flask/beaker • add a few drops of indicator / suitable named indicator (eg methyl orange/phenolphthalein) • flask on a white tile • fill burette with acid • read level/volume (of acid) in burette • add acid from burette to the flask slowly / swirl the flask • until {indicator just changes colour/correct colour change for named indicator (eg methyl orange yellow to peach/orange, phenolphthalein pink to colourless)/solution is neutral} • read level/volume (of acid) in burette • repeat experiment • until concordant results **salt preparation** • mix the same volume of alkali with the volume of acid determined from the first experiment but do not add indicator (or add (activated) charcoal to remove indicator, then filter) • pour solution into an evaporating basin • {heat solution/leave the water to evaporate} until pure salt crystals are left	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description of titration and/or salt preparation e.g. add hydrochloric acid to sodium hydroxide solution in a flask, then evaporate the water from solution. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description of titration and/or salt preparation e.g. pipette sodium hydroxide solution into flask, add indicator, place hydrochloric acid in burette, add acid to alkali until colour change. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description including titration **and** salt preparation e.g. pipette sodium hydroxide solution into flask, add indicator, hydrochloric acid in burette, add acid to alkali until colour change, repeat until concordant results, evaporate water. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
5(d)(i)	$\frac{22.6 + 22.8}{2}$ (1) (= 22.7)		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(d)(ii)	marks are for the working no. moles HCl = $\frac{23.2 \times 0.1}{1000}$ (1) (= 2.32×10^{-3}) no. moles NaOH = no. moles HCl (1) conc NaOH = $\frac{2.32 \times 10^{-3} \times 1000}{25.0}$ (1) (= 0.0928 mol dm^{-3}) mark consequentially OR $\frac{\text{no. moles NaOH reacting}}{\text{no. moles HCl reacting}} = \frac{1}{1}$ (1) $\frac{25.0 \times \text{conc}}{23.2 \times 0.1} = \frac{1}{1}$ (1) conc NaOH = $\frac{0.1 \times 23.2}{25.0}$ (1) (= 0.0928) mol dm^{-3} OR use of $c_1v_1 = c_2v_2$ (1) 0.1x 23.2 = conc x 25.0 (1) conc NaOH = $\frac{0.1 \times 23.2}{25.0}$ (1) (= 0.0928) mol dm^{-3}	0.0928/0.093 with or without working (3) 0.09 with no working (2) common incorrect answers with working 0.108/0.1077 (2) – used 1:1 ratio but 25x0.1/23.2 0.928 (2) – used 1:1 ratio but missed out 0.1	**(3)**

Question Number	Answer	Acceptable answers	Mark
6(a)(i)	A carbonate ion CO_3^{2-}		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(a)(ii)	A description including warm / heat / boil (1) {**gas/ammonia**} turns (damp red/pink) litmus blue / (damp red/pink) litmus turns blue when held above (the mixture)(1)	maximum (1) if additional reagents added ignore any ppt allow pungent smell / smell of {ammonia/wet nappies} /alkaline **gas /** effect of ammonia on other named indicators /dense white fumes with conc hydrochloric acid ignore litmus turns blue in ammonium ions/sodium hydroxide/mixture do not allow gas/ammonia if blue litmus turns red/pink	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(b)	$Al^{3+} + 3OH^- \rightarrow Al(OH)_3$ OH^- (1) $Al(OH)_3$ (1) balancing 3, conditional on correct formulae (1)	allow multiples allow HO^- (1) allow $Al(HO)_3$ (1) do not allow $Al(HO)^3$/lower case h ignore state symbols/$3Na^+$ on both sides	**(3)**

Question Number		Indicative Content	Mark
QWC	***6(c)**	An explanation including some of the following points **test for cation** • flame test • if the flame is yellow/not lilac, sodium ions are present • if the flame is lilac/not yellow, potassium ions are present **test for iodide ions** • make a solution of the crystals in water • add dilute nitric acid • add silver nitrate solution • if there is a yellow precipitate, iodide ions are present • if there is no precipitate, sulfate ions are present • $Ag^+ + I^- \rightarrow AgI$ OR • make a solution of the crystals in water • add chlorine water • then cyclohexane • if the cyclohexane/top layer turns purple, iodide ions were present • if there is no colour change, sulfate ions are present • $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$ **test for sulfate ions** • make a solution of the crystals in water • add dilute {hydrochloric/nitric} acid • add barium {chloride/nitrate} solution • if there is a white precipitate, sulfate ions are present • if there is no precipitate, iodide ions are present • $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description of test for any 1 ion e.g. flame test, yellow flame, sodium ions are present. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description to identify a cation and an anion e.g. if the substance is sodium sulfate, it will give a yellow flame in a flame test and a white precipitate with barium chloride solution. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description to identify at least 3 ions e.g. carry out a flame test, yellow flame, sodium ions present, lilac flame, potassium ions present, add silver nitrate solution to solution of substance, yellow precipitate, iodide ion. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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