Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Monday 22 May 2023

Morning (Time: 1 hour 10 minutes)

Paper reference **1SC0/1CH**

Combined Science

PAPER 2

Higher Tier

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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

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.*
- In the question marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

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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N:1/1/1/

P 7 2 5 5 7 A 0 1 2 0

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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

1 In an experiment, powdered calcium hydroxide was added to dilute hydrochloric acid and the pH was measured.

The method used was

step 1 measure 200 cm^3 dilute hydrochloric acid into a beaker

step 2 add 0.1 g of powdered calcium hydroxide to the beaker

step 3 find the pH of the mixture

step 4 repeat steps 2 and 3 until the pH stops changing.

(a) State what should be done after **step 2** to make sure that any reaction is complete.

(1)

.....

.....

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → .....

(c) Which row of the table shows the state symbols for powdered calcium hydroxide and dilute hydrochloric acid in the balanced chemical equation?

(1)

		calcium hydroxide	hydrochloric acid
☒	**A**	aq	l
☒	**B**	l	aq
☒	**C**	s	aq
☒	**D**	s	l

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(d) The results of the experiment are shown in Figure 1.

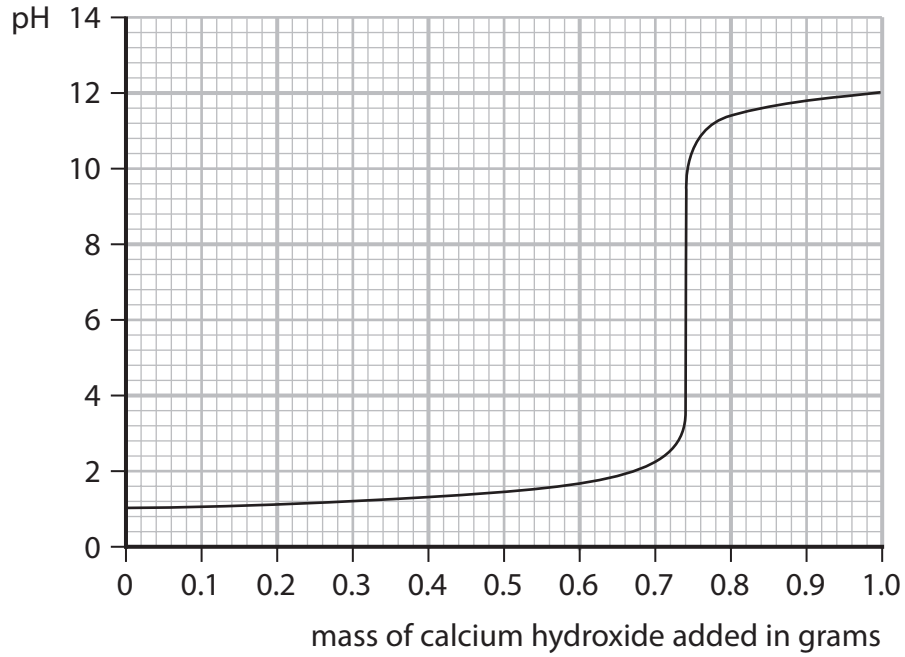

Figure 1

(i) Using Figure 1, give the pH of the acid at the start of the experiment.

(1)

pH = ...

(ii) Using Figure 1, give the mass of calcium hydroxide required to make a neutral mixture.

(1)

mass of calcium hydroxide = ... g

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

.....

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(Total for Question 1 = 9 marks)

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2 Figure 2 shows part of the reactivity series of metals.

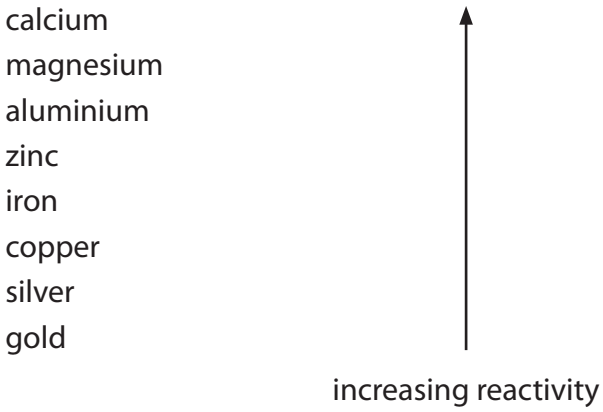

Figure 2

(a) Which metal reacts when added to cold water?

(1)

- ☒ **A** calcium
- ☒ **B** copper
- ☒ **C** gold
- ☒ **D** silver

(b) A student investigates the reactivity of four different metals.

The student adds an equal-sized piece of each metal to separate test tubes containing dilute hydrochloric acid.

The student's observations for zinc and copper are recorded in Figure 3.

metal	observations
magnesium	
zinc	bubbles produced at a steady rate test tube feels slightly warm
iron	
copper	no reaction

Figure 3

(i) Use the information in Figure 2 and in Figure 3 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

.....

.....

iron

.....

.....

(ii) When metals react with acids, hydrogen gas is produced.

Describe the test to show that the gas is hydrogen.

(2)

.....

.....

.....

.....

(iii) When magnesium reacts with hydrochloric acid, magnesium chloride and hydrogen are formed.

Complete the balanced equation for the reaction.

(2)

Mg + ...HCl → $MgCl_2$ + ...

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(c) An excess of magnesium is added to some dilute hydrochloric acid of pH 2.
The mass of hydrogen gas produced is measured.

The experiment is repeated with excess magnesium but with the same volume of dilute hydrochloric acid of pH 1.

(i) State how many times greater the concentration of hydrogen ions is in the acid of pH 1 than in the acid of pH 2.

(1)

.....

.....

(ii) With the acid of pH 2, the mass of hydrogen gas produced when the reaction is complete is 0.005 g.

Predict the mass of hydrogen gas produced in the reaction with acid of pH 1.

(1)

.....

.....

mass = ... g

(Total for Question 2 = 9 marks)

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3 (a) Ammonia is manufactured in the Haber process by the reversible reaction between nitrogen and hydrogen.

(i) Write the balanced equation for the reversible reaction between nitrogen and hydrogen to make ammonia, NH_3.

(3)

.....

(ii) Which row shows the typical conditions of temperature and pressure used in the Haber process?

(1)

		temperature in °C	pressure in atmospheres
☒	**A**	250	100
☒	**B**	250	200
☒	**C**	450	500
☒	**D**	450	200

(iii) In the Haber process, iron is added to the vessel where the nitrogen and hydrogen react.

State the purpose of the iron.

(1)

.....

(iv) The reaction between nitrogen and hydrogen to make ammonia can reach dynamic equilibrium.

The reaction gives out heat.

Explain how the position of equilibrium changes if the temperature is decreased.

(2)

.....

.....

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(b) Compound **A** is a dark brown gas.

Compound **B** is a colourless gas.

Two molecules of **A** combine to form one molecule of **B** in a reversible reaction.

You are given

- a sealed glass tube containing an equilibrium mixture of **A** and **B**
- a beaker
- a kettle
- some ice

At room temperature, the equilibrium mixture is a pale brown colour.

Devise an experiment to show how the position of equilibrium of this reaction is affected by temperature.

The sealed tube must **not** be opened.

(3)

(Total for Question 3 = 10 marks)

4 A student investigates the mass of copper produced when copper chloride solution in a beaker is electrolysed using inert electrodes.

(a) Where is copper formed during the electrolysis?

(1)

- ☒ **A** at the anode
- ☒ **B** at the bottom of the beaker
- ☒ **C** at the cathode
- ☒ **D** on the surface of the electrolyte

(b) The student investigated the change in the mass of copper formed when the current was altered.

The results are shown in Figure 4.

current in A	mass of copper formed in g
0.0	0.000
0.2	0.040
0.4	0.080
0.6	0.118
0.8	0.158
1.0	0.196

Figure 4

(i) State and explain the trend shown in these results.

(3)

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(ii) Describe how, after the power supply has been switched off, the mass of copper formed can be measured.

(2)

.....

.....

.....

.....

(c) In another experiment, 74 mg of copper is formed.

Calculate the number of copper atoms in 74 mg of copper.

(relative atomic mass Cu = 63.5; Avogadro constant = 6.02×10^{23})

(3)

.....

.....

.....

.....

number of atoms = ...

(Total for Question 4 = 9 marks)

5 Crystals of copper sulfate are prepared by reacting copper oxide, a base, with dilute sulfuric acid.

(a) Name the other product of this reaction.

(1)

.....

(b) During the experiment, a spatula measure of copper oxide, a black powder, is added to warm, dilute sulfuric acid in a beaker.

When the mixture is stirred, the black powder disappears and the mixture turns pale blue.

The student then adds more copper oxide until the maximum amount of copper sulfate is formed without wasting copper oxide.

Explain how the student knows when to stop adding copper oxide.

(3)

.....

.....

.....

.....

.....

.....

(c) The reaction produces an aqueous solution of copper sulfate.

What is the best way to obtain crystals of copper sulfate from an aqueous solution?

(1)

☒ **A** pour the solution through filter paper in a funnel

☒ **B** heat the solution with a Bunsen burner until dry

☒ **C** heat the solution using a water bath

☒ **D** leave the solution in a cold, damp place

(d) When some water is removed from the aqueous solution of copper sulfate, crystals of copper sulfate are made.

Describe how the arrangement and movement of the particles change as crystals are formed from a solution.

(3)

(e) In this reaction, copper oxide, CuO, forms copper sulfate, $CuSO_4$.

Explain, in terms of electrons, whether the copper in copper oxide has been oxidised, has been reduced, or has not been oxidised or reduced.

(2)

(f) In another experiment, a copper sulfate solution with a concentration of 39.875 g dm^{-3} is used.

Calculate the mass of copper sulfate dissolved in 0.300 dm^3 of this solution.

(1)

mass = ... g

(Total for Question 5 = 11 marks)

6 (a) Figure 5 shows the structure of a molecule of compound **S**.

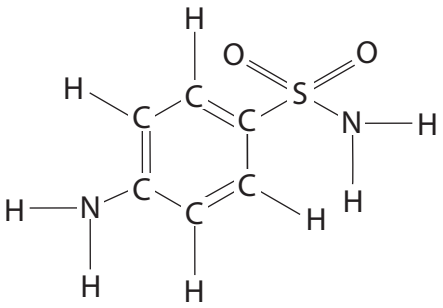

Figure 5

(i) Use Figure 5 to deduce the empirical formula of compound **S**.

(1)

.....

(ii) The melting points of three samples of **S** are shown in Figure 6.

sample	melting point in °C
A	160–164
B	166
C	163–165

Figure 6

State whether each of these samples, **A**, **B** and **C**, is pure or impure and justify your answers using the information in Figure 6.

(3)

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(b) A scientist uses chromatography in an investigation of compound **S**.

In the conditions used, compound **S** has an R_f value of 0.22.

Calculate the distance the spot of compound **S** moves if the solvent front has moved by 2.4 cm.

(2)

.....

.....

.....

.....

distance = ... cm

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*(c) A solution of sodium chloride in water needs to be separated to obtain a sample of pure, dry sodium chloride and a sample of pure water.

Figure 7 shows the boiling points of sodium chloride and water.

substance	boiling point in °C
sodium chloride	1465
water	100

Figure 7

Explain this difference in boiling points in terms of the structure and bonding of sodium chloride and water and how this difference is used to choose a method to separate sodium chloride solution into pure, dry sodium chloride and pure water.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.

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

Pearson Edexcel

Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCSE
In Combined Science (1SC0)
Paper 1CH

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Summer 2023
Publications Code 1SC0_1CH_2306_MS

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.**

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.
Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.
When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		Command Word	
Strand	**Element**	**Describe**	**Explain**
AO1		**An answer that combines the marking points to provide a logical description**	**An explanation that links identification of a point with reasoning/justification(s) as required**
AO2		**An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding**	**An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)**
AO3	**1a and 1b**	**An answer that combines points of interpretation/evaluation to provide a logical description**	
AO3	**2a and 2b**		**An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning**
AO3	**3a**	**An answer that combines the marking points to provide a logical description of the plan/method/experiment**	
AO3	**3b**		**An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning**

Question number	Answer	Additional guidance	Mark
1(a)	stir/ swirl/ shake (the beaker)	allow mix, warm/ heat ignore wait (until reaction over/ until powder disappears)	**AO1 2 (1)**

Question number	Answer	Additional guidance	Mark
1(b)	in either order: calcium chloride (1) water (1)	allow phonetic spellings but reject calcium chlor**ine** allow $CaCl_2$ but formula must be correct for the mark ignore 'solution'/ any state symbols allow H_2O but formula must be correct for the mark if three products given, allow (1) **only** if both correct products are given. four or more products scores (0)	**AO2 1 (2)**

Question number	Answer	Mark
1(c)	**C** s aq is the only correct answer **A, B** and **D** are not correct because the calcium hydroxide is a solid and the acid is an aqueous solution.	**AO2 1 (1)**

Question number	Answer	Additional Guidance	Mark
1(d)(i)	1	allow 0.9 or 1.1	**AO3 2 (1)**

Question number	Answer	Mark
1(d)(ii)	0.74 (g)	**AO3 2 (1)**

Question number	Answer	Additional guidance	Mark
1(d)(iii)	An explanation linking: START • solution is acidic / acids have low pH / high {concentration/ amount} of H^+ ions/ excess H^+ ions (1) REACTION • neutralisation/ $H^+ + OH^- \rightarrow H_2O$/ {the hydroxide/ alkali} <u>reacts</u> with the {acid/ H^+} (1) END • {amount/ concentration} of H^+ ions has reduced/ {amount/ concentration} of OH^- ions has increased / excess OH^- ions/ (excess of) hydroxide ions have pH > 7 (1)	allow for low pH: pH less than 7 / pH 1-6 / pH =1 ignore there is no alkali ignore references to 'strong' or weak' allow acid → neutral → alkali (2) allow calcium hydroxide is {an alkali/a base} ignore description of pattern – as calcium hydroxide added pH increases (0) ignore 'becomes alkaline'/ is alkaline/ is less acidic	**AO2 1 (3)**

Question number	Answer	Mark
2(a)	**A** calcium is the only correct answer **B**, **C** and **D** are incorrect because copper, silver and gold do not react with cold water	**AO1 1 (1)**

Question number	Answer	Additional guidance	Mark
2(b)(i)	 MAGNESIUM many bubbles / bubbles produced quickly / bubbles vigorously OR test tube feels hot / warm / warmer than with zinc (1) IRON few bubbles / bubbles produced slowly / some bubbles OR test tube feels <u>very</u> slightly warm (1)	Mark answer lines first, if blank or only contain statements that can be ignored, then look at the table. Ignore hydrogen / gas / reactivity of metal reject incorrect additional observations for each metal allow 'magnesium disappears/ dissolves' ignore steady bubbling / slightly warm ignore steady bubbling / no bubbling allow does not feel warm ignore test tube feels slightly warm	**AO3 2 (2)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	a description to include the following points • apply lighted splint (to the gas) (1) • (squeaky) pop (1)	 allow apply flame / ignite ignore 'squeaky pop test' reject glowing splint MP2 depends on MP1	**AO1 2 (2)**

Question number	Answer	Additional guidance	Mark
2(b)(iii)	$Mg + 2HCl \rightarrow MgCl_2 + H_2$ H_2 (1) 2 (1)	 reject H2, H^2, 2H, 2h, h_2, h^2	**AO2 1 (2)**

Question number	Answer	Mark
2(c)(i)	ten (times) / 10 (x) / (x) 10	**AO1 1 (1)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	0.05 (g) OR 0.005 x factor from (c)(i)	0.05 scores whether (c)(i) correct or not. if answer **not** 0.05, only then apply ecf and no working is required e.g x2 AND 0.01 (1); x100 AND 0.5 (1)	**AO3 1 (1)**

Question number	Answer	Additional guidance	Mark
3(a)(i)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ (3)	MP1: three formulae and no others on correct sides of an equation. allow incorrect cases and subscripts e.g. n^2 (1) MP2 depends on MP1: balancing these correct formulae, allow multiples (1) MP3: stand alone mark: equilibrium symbol, allow ⇄, ⇋ (1) allow equation written in reverse	**AO2 1 (3)**

Question number	Answer	Mark
3(a)(ii)	**D** 450 200 is the only correct answer **A**, **B** and **C** are incorrect because the temperature is 450℃ and the pressure is 200 atm.	**AO1 1 (1)**

Question number	Answer	Additional guidance	Mark
3(a)(iii)	catalyst/ increase rate of reaction(s)/ lower activation energy/ increase rate of attainment of equilibrium	ignore provide an alternative route for the reaction	**AO1 1 (1)**

Question number	Answer	Additional guidance	Mark
3(a)(iv)	An explanation including any two from: • <u>moves in</u> exothermic direction (1) • moves {right/ forwards / towards ammonia/ to products} (1) • to oppose the temperature reduction / to release heat / to increase the temperature (1)	MP1/ MP2/ MP3 are marked independently reject contradictions within MP2 or within MP3 allow to increase yield ignore just 'to oppose the (temperature) change' allow to increase heat	**AO1 1 (2)**

Question number	Answer	Additional guidance	Mark
3(b)	A description including METHOD OF HEATING AND COOLING • put tube into hot water (1) • then into cold water/ add cold water/ add ice (1) OBSERVATIONS • colour goes darker AND colour goes lighter/ colourless	steps 1 and 2 can be reversed, but must be practical e.g. ignore 'heat tube up' allow water from kettle reject placing tube in kettle/ heating with steam MP3 is for <u>observation</u> but depends on tube being heated and cooled (even if MP1 and/or MP2 not scored) allow colour changes in <u>both</u> hot and cold ignore clear allow suitable diagram(s) ignore opening of tube ignore attempts at explanation	**AO3 3a (3)**

Question number		Mark
4(a)	**C** at the cathode is the only correct answer **A**, **B** and **D** are incorrect because the copper ions are positive so are reduced at the cathode.	**AO2 2 (1)**

Question number	Answer	Additional Guidance	Mark
4(b)(i)	An explanation including: • as current increases mass increases / the mass is proportional to the current (1) • because the higher the current the more **electrons** (per second) (1) • so more copper **ions** {are reduced/ gain electrons/ are discharged} (1)	ignore names of electrodes overall trend required e.g. more mass at 0.4A than 0.2A (0), as current up by 0.2 mass up 0.04 (1), more current, more copper(1) allow positive correlation (between current and mass) allow 'amps' for 'current', 'amount' for mass allow 'greater flow of electrons' allow higher rate of electron transfer allow electrons move faster allow higher (amount of) charge allow $Cu^{2+} + 2e^{-} \rightarrow Cu$ allow more copper **ions** react if give copper ion symbol, allow any positive charge ignore more copper (atoms) form	**AO2 1 (3)**

Question number	Answer	Additional Guidance	Mark
4(b)(ii)	A description including: • (rinse and) dry {electrode / cathode} (1) • measure mass of {electrode/ cathode} (on a balance) (and subtract original mass) (1)	MP1 and MP2 independent allow anode/ electrodes allow rinse electrode with solvent/ propanone (and leave for solvent to evaporate) ignore clean/ wipe electrode allow weigh electrode at start and end allow subtract original mass from final mass allow 'find increase in mass of electrode' ignore measure mass of copper before and after scrape off copper and weigh scores 0 marks	**AO2 2 (2)**

Question number	Answer	Additional Guidance	Mark
4(c)	7.015×10^{20} with or without working scores 3 • mass copper in g = $\frac{74}{1000}$ = 0.074 / 7.4×10^{-2} g (1) • amount of copper = $\frac{0.074}{63.5}$ = 0.001165…./ 1.165…. x 10^{-3} mol (1) • number of atoms = 0.001165… x 6.02×10^{23} = 7.015×10^{20} (1)	allow ecf for MP2 and MP3 allow **correct** rounding at each stage MP2 for $\frac{\text{mass}}{63.5}$ MP3 for number using 74 **and** 63.5 x Avogadro correctly worked out allow 1 or more sig fig. 7.015×10^{23} scores 2 7.015×10^{26} scores 2 2.829×10^{24} scores 2 2.829×10^{27} scores 1	**AO2 1 (3)**

Question number	Answer	Additional Guidance	Mark
5(a)	water	allow H_2O 2 must be subscript H and O must be capitals ignore copper sulfate/ $CuSO_4$	**AO1 1 (1)**

Question number	Answer	Additional Guidance	Mark
5(b)	An explanation including OBSERVATION • when some powder remains in the beaker (after stirring) (1) COPPER OXIDE • there is an **excess** of copper oxide (1) ACID • all the acid {is neutralised/ has reacted}/ no acid remains (1)	MP1, 2 and 3 are independent allow {mixture/ solution} turns black/ copper oxide does not 'dissolve'/ copper oxide remains / solution gets no darker blue ignore fizzing stops ignore copper oxide precipitate allow acid used up allow acid is the limiting reactant ignore reaction complete	**AO1 2 (3)**

Question number	Answer	Mark
5(c)	**C** heat the solution with a water bath is the only correct answer. **A** is incorrect because the solution will not be separated. **B** is incorrect because a powder forms instead of crystals. **D** is incorrect because the method would be very slow.	**AO1 2 (1)**

Question number	Answer	Additional guidance	Mark
5(d)	A description including any three from: SOLUTION • (the ions) are (freely) moving (1) • (the ions) are randomly arranged (1) SOLID • (the ions) are fixed/ not moving/ vibrating (1) • (the ions) are in a regular arrangement/ lattice/ giant structure (1)	allow atoms or particles for ions reject molecules once allow suitable diagrams (could score MP2, MP4) ignore any reference to bonding allow liquid for solution ignore flowing ignore have less energy allow in rows/ tightly packed/ close together	**AO1 1 (3)**

Question number	Answer	Additional Guidance	Mark
5(e)	An explanation including: • the copper (ions are) neither oxidised nor reduced (1) • the copper (ions) do not lose **or** gain electrons/ Cu^{2+} present at start and end (1)	mark independently with no ecf allow copper oxide not oxidised or reduced allow 'neither' allow copper (ions) have **same** number of electrons/ have **same** charge ignore references to spectator ions	**AO1 1 (2)**

Question number	Answer	Additional Guidance	Mark
5(f)	11.9625 with or without working scores 1 11.9625	11.963/ 11.96/ 12.0/ 12 scores 1	**AO2 2 (1)**

Question number	Answer	Additional guidance	Mark
6(a)(i)	$C_6H_8N_2SO_2$	Letters can be in any order e.g $C_6N_2H_8O_2S$ (1) must be written as a formula numbers do not have to be subscripts ignore any formula with brackets	**AO2 1 (1)**

Question number	Answer	Additional Guidance	Mark
6(a)(ii)	A description including: • B is pure **and** A is impure **and** C is impure (1) • B has a sharp/ single melting point (1) • A **and** C have melting points {over a range / lower than (the sharp melting point of) B} (1)	ignore repeats the stem e.g. melting point is 160-164 ignore suggestions about composition e.g B is an element mark independently (can score MP2 and MP3 even if MP1 incorrect) allow fixed / specific / definite/ one/ exact/ no range ignore accurate/ precise melting point allow the melting points vary /gradual change/ not sharp/ not exact ignore these have two melting points/ different melting points (i.e idea that melts at 160 and at 164) reject boiling point only once in MP2 or MP3	**AO3 1 (3)**

Question number	Answer	Additional Guidance	Mark
6(b)	0.528/ 0.53 with or without working scores 2 • distance = R_f x solvent front distance/ 0.22 x 2.4 (1) • = 0.528/ 0.53 (cm) (1)	 MP1 for **rearranged** equation or values note : any unambiguous wording accepted in formula If additional calculation steps used, score 0 for whole question. 0.5 scores 2 only with working No ecf for MP2	**AO2 1 (2)**

Question number	Indicative content	Mark
***6(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Do not credit separation techniques other than distillation (e.g. crystallisation/ simply evaporating off the water) or additional steps to distillation that would not work. Allow distil off (some) water and then crystallise the remaining (concentrated) sodium chloride solution. Allow fractional distillation. AO1 (6 marks) **SODIUM CHLORIDE** • ionic compound • giant lattice • positive (sodium) ions and negative (chloride) ions • strong electrostatic attraction between ions • lots of energy to overcome attraction/ bonds **WATER** • simple covalent/ molecular • strong covalent bonds between atoms in a molecule • weak forces between molecules • little energy needed to overcome the intermolecular forces **SEPARATION** • use distillation – with condenser or simple apparatus: delivery tube into test tube in ice water • water has much lower boiling point • water will distil but sodium chloride will not • water collected after being condensed • sodium chloride remains in flask	**(6)** **AO1 1** **AO1 2**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1–2	Additional Guidance a basic description of one of the types of bonding or the separation technique	Possible candidate response sodium chloride is ionic (1) use distillation (1) sodium chloride has ionic bonding and water has covalent bonding (2) sodium chloride has strong ionic bonds which take a lot of energy to break (2) heat the mixture and condense the water (2)
Level 2	3–4	Additional Guidance a description of two of the aspects: bonding in NaCl/ intermolecular forces in water/ distillation	Possible candidate response water is a simple molecular covalent compound, there are weak intermolecular forces which take little energy to break but sodium chloride is ionic (3) sodium chloride has ionic bonding, there are strong electrostatic forces of attraction between oppositely charged ions, which take a lot of energy to break and the solution is separated by distillation (3) use distillation because water has a lower boiling point than sodium chloride so water will distil but sodium chloride will not, water can be collected after it has been condensed and the sodium chloride will remain in the flask. This is because sodium chloride is ionic with strong bonds. (4)
Level 3	5–6	Additional Guidance An explanation of **both** of the types of bonding **and** of the separation technique	sodium chloride has strong ionic bonds which take a lot of energy to break whereas water has intermolecular forces which does not take a lot of energy to break. Heat the mixture and condense the water, sodium chloride is left in the flask (5) Sodium chloride is ionic, the electrostatic attractions between ions take a lot of energy to break. Water is covalent, not a lot of energy is used to overcome the intermolecular forces. Use distillation because water has a lower boiling point than sodium chloride so water will distil but sodium chloride will not, water can be collected after it has been condensed and the sodium chloride will remain in the flask. (6)