

Mark Scheme (Results)

Summer 2024

Pearson Edexcel GCSE
In Chemistry (1CH0)
Paper 1F

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

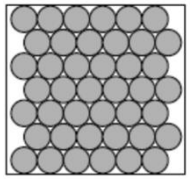
Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2024
Question Paper Log Number P74421A
Publications Code 1CH0_1F_2406_MS
All the material in this publication is copyright
© Pearson Education Ltd 2024

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.

Paper 1F Foundation Tier

Question number	Answer	Additional guidance	Mark
1(a)		all particles should be arranged regularly allow overlapping circles should be at least 3 rows/columns, each row can be directly over the one below	**(1)** **AO1-1**

Question number	Answer	Mark
1(b)(i)	**C** freezing is the only correct answer **A** is incorrect as condensing is gas to liquid **B** is incorrect as evaporating is liquid to gas **D** is incorrect as melting is solid to liquid	**(1)** **AO1-1**

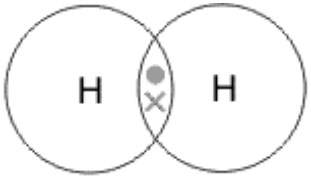
Question number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation linking: • it is reversible (1) • no new substance is made (1)	 allow a description of reversible / not a permanent change allow the {substance / compound} does not change /it is only a change of state / not a chemical <u>reaction</u> / it is the same product ignore no {bonds/intermolecular forces} are broken	**(2)** **AO2-1**

Question number	Answer	Mark
1(c)(i)	**D** fast random is the only correct answer **A** is incorrect as particles move fast and are random in a gas **B** is incorrect as particles move fast in a gas **C** is incorrect as particles are random in a gas	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
1(c)(ii)	the boiling point of wax is higher than the boiling point of water / the boiling water is not hot enough	comparison needed allow (water) not {heated/hot} enough / temperature not hot enough	**(1)** **AO2-1**

Total for Question 1 = 6 marks

Question number	Answer	Additional guidance	Mark
2(a)(i)	⇌ / ⇋ / two single headed arrows in opposite directions	allow double headed arrows: ⇄ / ⇆ / ignore ↔	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
2(a)(ii)		allow all dots or all crosses or a mixture of both allow dots/crosses with overlapped area OR on lines of the shells where overlapped	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
2(b)(i)	ammoni**a** + sulfuric acid → (1) → ammoni**um** sulfate (1)	reject ammonium reject ammonia sulfate	**(2)** **AO2-1**

Question number	Answer	Mark
2(b)(ii)	**C** $(NH_4)_2SO_4$ is the only correct answer **A, B** and **D** are incorrect as they are not the formula for ammonium sulfate	**(1)** **AO2-1**

Question number	Answer		Mark
2(b)(iii)	an explanation linking • as a fertiliser (1) • to help their crops grow (1)	allow to help plant production / increase yield allow to put (fixed) nitrogen back into the soil / source of nitrogen for the plants / provides nutrients (for the plants) reject protects from disease / kills pests for MP2	**(2)** **AO1-1**

Total for Question 2 = 7 marks

Question number	Answer		Mark
3(a)	sedimentation → filtration → chlorination (2) first or last step correct (1)		**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(b)(i)	An explanation linking • gain of electron(s) (1) • one electron (1)	 MP2 depends on MP1 gains an electron (2)	**(2)** **AO1-1**

Question number	Answer	Mark
3(b)(ii)	**D** to kill any bacteria in the water is the only correct answer **A**, **B**, **C** are not reasons why chlorine is added	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(b)(iii)	any one from • ions {present / make test invalid} • the water is impure • tap water would interfere with analysis	 allow named substances that could be present in tap water eg calcium ions / chlorine / chloride ions / magnesium ions / minerals allow (water) is not pure ignore 'sterile' / 'contains chemicals' / 'not clean' / 'contains bacteria' ignore any substances not found in tap water	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(c)(i)	An explanation linking either • remove (delivery) tube from below water line (1) • so that {gas / water vapour / steam} can move through (delivery) tube / to prevent water being pushed up the delivery tube (1) or • (delivery) tube is too low (1) • {gas / water vapour / steam} not being able to get into the tube (1)	allow alternative description of delivery tube allow error circle on Figure 5 allow move delivery tube higher in conical flask ignore change the delivery tube (alone) MP2 depends on MP1 allow error circle on Figure 5 MP4 depends on MP3	**(2)** **AO3-3**

Question number	Answer	Additional guidance	Mark
3(c)(ii)	Bunsen (burner) / spirit burner	allow electric heater ignore other forms of heat and equipment	**(1)** **AO2-2**

Total for Question 3 = 9 marks

Question number	Answer	Mark
4(a)(i)	**B** burette is the only correct answer **A**, **C** and **D** are not correct as X is a burette	**(1)** **AO1-2**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	A description to include • use a pipette (1) then any **one** from • rinse (pipette) with dilute hydrochloric acid (1) • draw solution up to line (of pipette) (1) • touch tip (of pipette) on side of conical flask (1)	allow use of syringe - max 1 allow burette (1) and any one from then any one from • rinse with dilute hydrochloric acid (1) • fill burette with acid using a funnel (1) • fill jet below tap with acid (1) • manipulation of tap to deliver exact volume (of acid) (1) • adding acid slowly (to the flask) (1) • read burette volumes from bottom of meniscus (1) ignore use of measuring cylinder	**(2)** **AO1-2**

Question number	Answer	Additional guidance	Mark
4(b)(i)	29.15 – 1.50 = 27.65 (cm^3)		**(1)** **AO1-2**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	24.7(0) with or without working scores 2 24.70 + 24.80 + 24.60 = 74.1 (1) $\frac{74.1}{3}$ = 24.7(0) (1)	 allow 27.65 + 24.70 + 24.80 + 24.60 = 101.75 (0) then $\frac{101.75}{4}$ = 25.4375 (1) / or correctly rounded to a min of 3 sig figs	**(2)** **AO3-1**

Question number	Answer	Mark
4(c)	**C** red to orange is the only correct answer **A**, **B** and **D** are incorrect as the colour change is red to orange	**(1)** **AO1-2**

Question number	Answer	Additional guidance	Mark
4(d)(i)	$LiOH + HCl \rightarrow LiCl + H_2O$ LHS (1) RHS (1)	allow reactants and products in either order allow multiples incorrect balancing max 1	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
4(d)(ii)	neutralisation	allow acid-base / exothermic	**(1)** **AO1-1**

Total for Question 4 = 10 marks

Question number	Answer	Additional guidance	Mark
5(a)	number of protons = 17 (1) number of neutrons = 18 (1) number of electrons = 17 (1)	Accept ONLY whole numbers If no marks scored then maximum 1 mark for number of electrons = number of protons OR p + n = 35	**(3)** **AO1-1**

Question number	Answer	Additional guidance	Mark
5(b)	empirical formula alone without working scores 0 silicon: $\frac{1.4}{28}$ and chlorine $\frac{7.1}{35.5}$ (1) or 0.05 and 0.2 simplest whole number ratio: 1 4 (1) empirical formula $SiCl_4$ / Cl_4Si (1)	allow ecf throughout inverted division: silicon: $\frac{28}{1.4}$ and chlorine $\frac{35.5}{7.1}$ (0) or 20 5 simplest whole number ratio: 4 1 (1) empirical formula Si_4Cl / $ClSi_4$ (1) error in step 2: MP1 still scores, MP2 (0), allow ecf for MP3 division other relative atomic mass: silicon: $\frac{1.4}{35.5}$ and chlorine $\frac{7.1}{28}$ (0) 0.0394 / 0.04 and 0.254 / 0.25 or 1 6.43 / 6.25 simplest whole number ratio: 5 / 4 32 / 25 (1) empirical formula Si_5Cl_{32} / Si_4Cl_{25} (1) division by atomic number: MP1 – 0, correctly calculated, can still score MP2 and MP3	**(3)** **AO2-1**

Question number	Answer	Mark
5(c)	group = 4 (1) period = 3 (1)	**(2)** **AO3-1**

Question number	Answer	Additional guidance	Mark
5(d)	A description to include any two from : • left gaps / incomplete (1) • fewer elements / not all elements discovered (1) • elements ordered by atomic mass (1) • no group 0 (/8/18)) / fewer groups (1) • no atomic numbers (1) • some elements in different positions (1) • names of **some** elements were different (1)	allow reverse arguments for modern periodic table for all these points, except: modern periodic table ordered by atomic number allow gaps left for undiscovered elements (on Mendeleev's table) (2)	**(2)** **AO1-1**

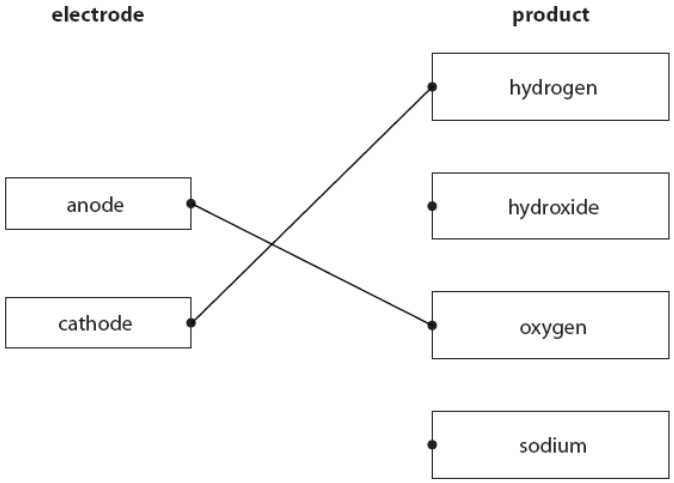
Total for Question 5 = 10 marks

Question number	Answer	Additional guidance	Mark
6(a)	26.08 with or without working scores 2 marks $\frac{6.52}{250}$ = 0.02608 / 0.026 / 0.0261 (1) [MP1] MP1 x 1000 = 26.08 /26(.0) / 26.1 (1)	allow ecf on all methods ignore 0.03 OR $\frac{1000}{250}$ = 4 (1) 4 x 6.52 = 26.08 (1) OR $\frac{250}{1000}$ = 0.25 (1) $\frac{6.52}{0.25}$ = 26.08 (1)	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
6(b)	A description to include any two for each substance copper hydroxide • filter (off the copper hydroxide) (1) • wash the copper hydroxide with distilled water (1) • dry the solid (1) sodium sulfate • pour {sodium sulfate solution /filtrate} into evaporating basin (1) • heat to evaporate water from solution (1) • dry the solid (1)	 ignore sieve allow any suitable means of drying except heating allow 'crystallisation' allow any suitable means of drying eg leave on side to evaporate (1)	**(4)** **AO2-2**

Question number	Answer	Additional guidance	Mark
6(c)(i)	does not react / chemically stable (1) conducts (electricity) / a conductor (1)	allow inert (1) ignore cheap / not soluble	**(2)** **AO1-1**

Question number	Answer	Mark
6(c)(ii)	**D** SO_4^{2-} and OH^- ions is the only correct answer **A** is not correct as H^+ would be attracted to the negative electrode **B** is not correct as SO_4^{2-} and OH^- ions would be attracted to the positive electrode **C** is not correct as H^+ and Na^+ would be attracted to the negative electrode	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
6(c)(iii)		do not award answers with more than one line from any of the boxes on the left	**(2)** **AO1-1**

Total for Question 6 = 11 marks

Question number	Answer	Additional guidance	Mark
7(a)(i)	8 (%) with or without working (3) change in mass = 7.56 - 7.00 = 0.56 (1) $\frac{0.56}{7.00}$ = 0.08 (1) 0.08 x 100 (1) (= 8%)	ecf throughout	**(3)** **AO3-2**

Question number	Answer	Mark
7(a)(ii)	**D** oxygen is the only correct answer **A**, **B** and **C** are not correct as these gases would not react with the iron	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
7(a)(iii)	an explanation linking any two from: • (sacrificial) protection by magnesium (1) • magnesium is more reactive (than iron) (1) • so magnesium reacts rather than the iron (1)	allow magnesium is a sacrifice barrier (for the iron) ignore magnesium prevented rusting/oxidation allow magnesium {reacts with oxygen / corrodes} (instead of iron)	**(2)** **AO3-2**

Question number	Indicative content	Mark
*7(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • copper can be used in wiring • because it is ductile • so can be pulled into wires • copper can also conduct electricity • allows (delocalised) electrons to move • copper has a high melting point • so wire will not melt • when heat is produced from the transfer of charge • copper is malleable • so the wire is flexible without breaking • copper is used in water pipes • because it is malleable • tubes can be bent • copper has a low reactivity so will not react with the water • copper can be used for coins • as it has low reactivity • and is malleable • so can be pressed into shape • copper can be used in cooking pans • as it has a high melting point • so will not melt when cooking • and is a good conductor of heat • so heat is transferred from the hob/stove to the food inside • it is also malleable • so can be hammered/pressed into shape • and will not break if dropped	**(6)** **AO1-1**

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 and any references to other metals / discard any contradictory material then:
Level 1	1–2	Additional Guidance Correctly identifies a use of copper / a property of copper Correctly identifies several uses of copper but not linked to any properties Correctly links a correct property of copper to its use	Possible candidate response (all examples, not a definitive list) copper is used to make wires/cables (1) copper is used to make wires, pipes, coins and cooking utensils (2) copper is used to make wires because it conducts electricity (2)
Level 2	3–4	Additional Guidance Correctly identifies at least two uses of copper and links a property to one of the uses / correctly identifies at least one use of copper and links at least two properties to that use Correctly identifies at least two uses of copper and links those uses to a correct property for each Correctly identifies at least three uses of copper and links at least one of those uses with a correct property Correctly identifies at one use of copper with a range of suitable properties	Possible candidate response copper is used to make pipes and to make wires as it conducts electricity (3) copper is used to make wires as it conducts electricity and is flexible (3) copper is used to make pipes as it is malleable and is also used to make wires as it conducts electricity (4) copper is used to make pipes as it is malleable and is also used to make wires and coins (4) copper is used to makes wires as it conducts electricity, is flexible, has a high melting point and copper is ductile (drawn into wires) (4)
Level 3	5–6	Additional Guidance Correctly identifies at least two uses of copper and links a range of properties for each use Correctly identifies at least three uses of copper and links a range of properties for each use	Possible candidate response copper is used to makes wires as it conducts electricity, is flexible, has a high melting point and copper is ductile (drawn into wires); copper is also used to make coins as it is unreactive, and is malleable so can be pressed into shape (5) copper is used to makes wires as it conducts electricity, is flexible, has a high melting point; copper is ductile (drawn into wires); copper is also used to make coins as it is unreactive, and is malleable so can be pressed into shape and copper is used to make pipes as it can be bent into shape, does not react with water (6)

Total for Question 7 = 12 marks

Question number	Answer	Mark
8(a)(i)	$Ba(OH)_2(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + 2H_2O(l)$	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	barium hydroxide {disappears / gets smaller} / (it) becomes clear	allow 'solid' for barium hydroxide allow barium hydroxide dissolves ignore any colours mentioned / colour change/ any incorrect observations ignore becomes a {liquid / solution} reject bubbles	**(1)** **AO2-2**

Question number	Answer	Additional guidance	Mark
8(b)(i)	pH meter	allow pH probe ignore pH paper / data logger / pH scale	**(1)** **AO3-3**

Question number	Answer	Additional guidance	Mark
8(b)(ii)	An explanation linking: • to ensure that the mixture is evenly spread (1) • to make substances {react / dissolve} / to speed up the {reaction / dissolving} (1)	 allow to mix the reactants allow so pH (in mixture) is uniform / concentration is uniform / to get an accurate pH ignore more accurate / valid / fair test allow 'so the reaction is complete' / 'to dissociate all the hydroxide ions'	**(2)** **AO2-2**

Question number	Answer	Additional Guidance	Mark
8(b)(iii)	all points plotted correctly (± half a small square) (2) OR 7/8 points plotted correctly (1) S-shaped line of best fit (1)	 line of best fit must go through 7 points if the points are not visible a line going through **all** correct values scores 3 reject dot-to-dot line / line starting from origin tramlines allowed here but rejected in 8(b)(iv) bar chart scores 0	**(3)** **AO2-1**

Question number	Answer	Additional guidance	Mark
8(b)(iv)	pH reading at 4.5 spatula measures from their line on graph	allow ± half a small square on **y**-axis ignore any candidate working allow ECF from 8(b)(iii) but if no graph line or multiple lines, cannot score. if bar chart has been drawn for 8biii, then mark for 8biv cannot be awarded	**(1)** **AO3-2**

Question number	Answer	Mark
8(c)	**A** corrosive is the only correct answer **B**, **C** and **D** are incorrect as this is the symbol for a corrosive substance	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
8(d)	measure the {mass / amount} of the barium hydroxide / use known {masses / amounts} rather than a spatula full each time use a balance / scale**s**	allow weighing / weigh before and after ignore scale	**(1)** **AO3-3**

Total for Question 8 = 11 marks

Question number	Answer	Mark
9(a)(i)	**B** 2.8 is the only correct answer **A** is incorrect as there are too few electrons **C** and **D** are incorrect as there are too many electrons	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
9(a)(ii)	an explanation linking SOLID • is an (ionic) lattice / (ions are) held by strong (electrostatic) attractions (1) • so the **ions** {cannot move / are fixed / just vibrate} (1) SOLUTION • in solution the **ions** {can move / are free} (1)	 allow giant structure / regular arrangement / regular structure for lattice allow atoms / (charged) particles in MP1 only ignore electrons for MP1 reject molecules / elements reject electrons allow liquid for solution reject electrons reject intermolecular forces	**(3)** **AO2-1**

Question number	Answer	Additional guidance	Mark
9(b)	43(.4) with or without working scores 3 2x23 + 12 + 3x16 = 106 (1) 46 = 0.4339622642 (1) 106 0.4339622642 x 100 = 43.4 (1)	43.39622642 rounded correctly to 2 or more sig. fig. scores 3 if M_r incorrect, must show working to allow ecf on MP2 and MP3 $\frac{46}{\text{attempt of } M_r\ Na_2CO_3}$ $\frac{23 \text{ or } 46}{\text{attempt of } M_r\ Na_2CO_3} \times 100$ the following common answers with working are awarded 21.69811321 rounded correctly to 2 or more sig. fig. scores 2 76.6666667 rounded correctly to 2 or more sig. fig. scores 2 48.11320755 rounded correctly to 2 or more sig. fig. scores 1	**(3)** **AO2-1**

Question number	Indicative content	Mark
9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) AO3 (3 marks)** • solid **A** is powdered zinc • metal + acid → metal salt + hydrogen • zinc + sulfuric acid → zinc sulfate + hydrogen • bubbles seen so gas is produced • does not turn limewater cloudy so gas is not carbon dioxide • test for hydrogen is lit splint • lit splint makes squeaky pop • so gas produced is hydrogen • solid **B** is copper oxide • metal oxide + acid → metal salt + water • copper oxide + sulfuric acid → copper sulfate + water • no gas is produced • copper oxide is black • some left in excess at bottom of test tube • copper sulfate solution is blue • solid **C** is sodium carbonate • metal carbonate + sulfuric acid → metal sulfate + carbon dioxide + water • sodium carbonate + sulfuric acid → metal sulfate + carbon dioxide + water • bubbles seen so gas is produced • test for carbon dioxide is limewater • limewater turned cloudy so gas produced is carbon dioxide • no reaction with lit splint • so no hydrogen gas produced	**(6)** **AO1;** **AO3**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• The plan attempts to link knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO1) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	• The plan is mostly supported through linkage knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO1) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises (AO3)
Level 3	5–6	• The plan is supported throughout by linkage knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO1) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material and any references to other metals / discard any contradictory material then:
Level 1	1–2	Additional Guidance Correctly identifies at least 1 solid or product Identifies product with correct test Gives at least 1 general observation Gives at least 1 general word equation Identifies all 3 substances	Possible candidate response (all examples, not a definitive list) solid A – zinc (1) reaction with solid A gives off hydrogen (1) limewater cloudy so is carbon dioxide (1) gas is released so must be bubbles (1) metal + acid → salt + hydrogen (2) solid A is zinc and the gas given off is hydrogen (2) A – zinc, B – copper oxide, C – sodium carbonate (2)
Level 2	3–4	Additional Guidance Correctly identifies at least 2 solids with at least one linked explanation Correctly identifies at least 1 solid and 1 product with at least one linked explanation Gives at least one correct word equation Identifies one solid with correct word equation Correctly identifies all 3 solids with linked explanations for just 1 solid	Possible candidate response solid A is zinc and solid B is copper oxide. Copper oxide is black (3) solid C is sodium carbonate as carbon dioxide turned limewater cloudy (3) solid B is copper oxide, which is black. It produces copper sulfate, which is blue (4) zinc + sulfuric acid → zinc sulfate and hydrogen (3) Solid B: copper oxide + sulfuric acid → copper sulfate + water (4) A – zinc, B – copper oxide, C – sodium carbonate; and hydrogen is produced when zinc reacts with an acid as zinc is a metal (4)
Level 3	5–6	Additional Guidance Correctly identifies 2/3 solids with linked explanations for at least two Fully identifies one solid with all products and a linked explanation Identifies all 3 solids backed by relevant information	Possible candidate response solid A is zinc as hydrogen is produced. Solid B is copper oxide as it is black. (5) Solid B: copper oxide + sulfuric acid → copper sulfate (blue solution) + water (5) solid A is zinc because hydrogen is produced. Solid B is copper oxide, which forms blue copper sulfate solution. Solid C is sodium carbonate as it is the only solid that could produce carbon dioxide (6)

Total for Question 9 = 13 marks

Question number	Answer	Additional guidance	Mark
10(a)(i)	75.4 with or without working scores 3 marks 45.26 = 0.7543 (1) 60.00 (0.7543) x 100 = 75.43 (1) = 75.4 (1 dp) (1)	75.43 / 75.40 with or without working scores 2 marks allow ecf using numbers from the question allow 1 mark for correct rounding to 1 dp of an incorrectly calculated value only if **using numbers from the question** 91.2 with working scores 2 marks	**(3)** **AO3-1**

Question number	Answer	Additional guidance	Mark
10(a)(ii)	any two reasons valid for this process • not enough magnesium used (1) • not all titanium oxide reacted (1) • magnesium reacts with something else (1) • some titanium lost during {separation / purification} (1)	 allow impurities in reactants allow not all reactants used allow incomplete reaction allow side reactions allow practical losses during {separation / purification} allow left on equipment ignore spillages ignore reactants /products lost	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
10(a)(iii)	38 with or without working scores 3 marks 48 + (2x16) + (2x24) = 128 (1) $\frac{\mathbf{48}}{128}$ x 100 = 37.5 (1) 38 % (1)	37.5 with or without working scores 2 marks to score MP1, 128 must have working or appear as denominator in MP2 allow ecf from MP1 as long as working is shown allow MP3 for correct rounding of an incorrectly calculated value to 2 sig figs, only if **using numbers from the question**	**(3)** **AO2-1**

Question number	Answer	Additional guidance	Mark
10(b)(i)	only one product / ethanol is the **only** product	allow this is an addition reaction allow there are no unwanted products / no waste produced / no by-products allow all atoms from reactants in product allow mass of reactants = mass of desired product ignore it is a balanced equation ignore same number of atoms on each side of the equation reject no gas given off	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
10(b)(ii)	An explanation linking • find use for {carbon dioxide / waste product} (1) • so carbon dioxide becomes a useful product / increase mass of useful product (1)	allow a named use of carbon dioxide e.g in fizzy drinks allow sell the {carbon dioxide / waste product}	**(2)** **AO2-1**

Total for question 10 = 11 marks