Mark Scheme
(Results)

Summer 2022

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

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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.

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

*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme

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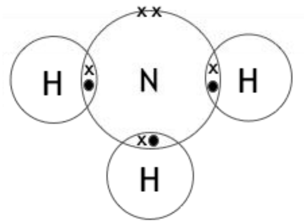
Question number	Answer	Additional guidance	Mark
1(a)	phosphorous (1) potassium (1)	allow phonetic spelling	**(2)** **AO1-1**

Question number	Answer	Mark
1(b)(i)	Haber (1)	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	(reaction is) {reversible / can go both ways / can go backwards and forwards}	allow (dynamic) equilibrium ignore ‘reversed’ alone	**(1)** **AO1-1**

Question number	Answer	Mark
1(b)(iii)	**B**  is the only correct answer **A** is incorrect as there are no shared pairs and the nitrogen atom shown only has 3 electrons **C** is incorrect as there are no shared pairs **D** is incorrect as the nitrogen atom shown only has 3 electrons	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
1(c)	ammonia + nitric acid (1) ammonium nitrate (1)	allow reactants in either order if symbol equation given, formulae must be fully correct if both word and symbol equations are given, ignore symbols	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
2(a)	**<u>Arrangement – 1 mark max</u>**	answer for one state will be taken to imply opposite for other; but if both given, both must be correct OR one correct and one an ignore	**(2) AO1-1**
	in a solid (particles are): • regularly arranged/ close(r) / in lattice / fixed (position) (1)	allow uniformly arranged / in a fixed shape / (tightly) packed together / in lines / in layers / in rows / ordered / organised ignore compact(ed) / attached / bonded / particles touching	
	OR		
	in a liquid (particles are): • randomly arranged / further apart (1)	allow spread out / space between particles	
	<u>Movement – 1 mark max</u>		
	in a solid (particles): • vibrate / do not move (around) (1)	reject do not move much	
	OR		
	In a liquid (particles): • move (1)	“They” is assumed to mean particles allow suitable diagrams allow answers in either space	

Question number	Answer	Mark
2(b)	**D** melting is the only correct answer **A** is not correct as condensing is gas to liquid **B** is not correct as evaporating is liquid to gas **C** is not correct as freezing is liquid to solid	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
2(c)	melting point (too) high / (temperature) below melting point / metals have high melting point / (water is) not hot enough	allow melting point higher (than chocolate) allow not enough {heat/ energy} / takes a lot of {heat / energy} allow metallic bonds are strong / no bonds have been broken (at temperature of water) ignore any statements referring to boiling point ignore ‘hard to melt’	**(1)** **AO3-2b**

Question number	Answer	Additional guidance	Mark
2(d)	An explanation linking: • (when heated) changes to a solid (1) • (when cooled) stays solid / doesn’t change back / change is permanent / change is irreversible (1)	 allow it does not {boil / form gas}/ colour change (must be goes white if specified) / new substance forms ignore ‘changes state’ / (chemical) reaction occurs allow doesn’t go back to liquid / cannot change back	**(2)** **AO2-1**

Question number	Answer	Mark
3(a)(i)	**C** sedimentation filtration chlorination is the only correct answer **A** and **B** are incorrect as sedimentation is the first step **D** is incorrect as chlorination is the last step	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(a)(ii)	to kill {bacteria / microorganisms / microbes / pathogens}	ignore germs / diseases allow viruses allow 'remove' / 'get rid of' / eliminate for kill allow to sterilise / disinfect (the water) ignore to clean / purify / bleach / make water clear	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(a)(iii)	A description including: • (put waste) water in tank / left to (stand / settle) (1) • {particles / dirt / impurities / sediment / solid} <u>fall</u> to bottom (1)	allow any put in suitable large or small container e.g. container / beaker allow for MP1 add a substance that causes clumping / aluminium sulfate must have idea that particles sink reject large(r) pieces e.g– sand / rocks / branches etc - that would be filtered ignore any references to filtration before or after sedimentation	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
3(a)(iv)	an explanation linking: • (the water) contains {chlor**ide** / fluor**ide**, nitr**ate** / sulf**ate** / copper / magnesium / ions / salts } (1) • (therefore) more than just water (molecules) / it does not contain just water / which are impurities / pure substances contain only one substance / pure water does not contain ions (1)	allow chemicals / minerals / substances ignore particles / metals / elements / molecules / things allow pure water is just H_2O / contains hydrogen and oxygen only reject pure substances contain only one element allow pure water does not contain any of {ions in the table / these ions / specifically named ions from table} for 2 marks	**(2)** **AO3** **2a – 1** **2b – 1**

Question number	Answer	Additional guidance	Mark
3(b)(i)	(delivery) tube	allow {glass / rubber / plastic} tube	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	an explanation linking: add bung / cork (to top of flask) (1) (so) {water / vapour / gas / steam} cannot escape (from top of flask) / will go into {(delivery) tube/ X} (1)	 ignore seal / block / lid / cover etc allow stopper allow incorrect naming of flask ignore ‘so water is collected’ allow incorrect naming of delivery tube mark independently for max 1 allow replacement of X with a (Liebig) condenser / cooling of delivery tube / ice bath around test tube (1)	**(2)** **AO3 - 3b**

Question number	Answer	Additional guidance	Mark
4(a)	so the student knows where to slow the flow (of acid) on the second and third attempt / so that the student has an {estimate / idea} of the volume (of acid needed)	ignore to make it more accurate / to see if method works ignore to make it a fair test ignore as a practice run allow {how much / amount} for volume	**(1)** **AO1-2**

Question number	Answer	Mark
4(b)	**B** 27.60 is the only correct answer **A** is incorrect as this is the initial reading on the burette **C** is incorrect as this is the final reading on the burette **D** is incorrect as the values have been added rather than subtracted	**(1)** **AO2-1**

Question number	Answer	Additional guidance	Mark
4(c)	a description including any four from:		**(4)** **AO1-1**
	• read the (initial) volume on the burette (1)	allow initial burette reading	
	• open the tap / add acid to {alkali/flask} (1)	allow add HCl to LiOH allow open tap ignore dropwise / drop by drop	
	• swirl the mixture (1)		
	• until end point / until indicator changes colour (1)	allow any change of colour given	
	• (close tap then) read (final) volume of acid in burette (1)	allow final burette reading	

Question number	Answer	Mark
4(d)	**C** methyl orange is the only correct answer A is incorrect as it tests for carbon dioxide/not an acid-alkali indicator. B is incorrect as no distinct/discrete change of colour D is incorrect as the colour change is not clear enough	**(3)** **AO2-2**

Question number	Answer	Additional guidance	Mark
4(e)	an explanation linking: • neutralisation reaction (1) • {hydrogen ions / H^+) react with {hydroxide ions / OH^-} (1) • to form water (1)	allow reaction between an acid and a {base/alkali} allow acid + alkali (1) → salt + water (1) $H^+ + OH^-$ (1) → H_2O (1)	**(3)** **AO2-1**

Question number	Answer	Additional guidance	Mark
5(a)	number of electrons = 13 (1) number of neutrons = 14 (1) number of protons = 13 (1)	allow 27-13 (=14)	**(3)** **AO1-1**

Question number	Answer	Additional guidance	Mark
5(b)	**fractions** $\frac{1.35}{27}$ and $\frac{12.00}{80}$ (1) **ratios <u>derived from two fractions</u> into simplest <u>whole number</u> ratio** (0.05 0.15) 1 3 (1) **<u>whole number</u> ratio to formula** $AlBr_3$ (1)	answer with no working scores 0 MP2 depends fractions being shown to give ratio allow ECF for MP2 and MP3 inverted fractions correctly followed through to Al_3Br scores 2 allow Al_1Br_3 allow errors in case or using superscript e.g. $albr^3$	**(3)** **AO2-1**

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

Question number	Answer	Additional guidance	Mark
5(c)(ii)	A description including: • compared to the elements in same {group / period} (1) • (and used the) {trend/pattern} going {down the group / across a period} (1)	*MP1 is for idea of which other elements to consider* allow elements {above and below / to left and right / around} reference to reactivity can score MP2 but not MP1 e.g elements get more reactive down the group (1) reject incorrect alternatives to 'element' (allow 'metals') but mark on *MP2 is for idea of how properties predicted from elements selected in MP1* allow {'averaged' / value between} surrounding elements reject compare Ga with elements with similar properties/ reactions	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
6(a)	12.56 with or without working scores 2 $\frac{3.14}{250}$ (1) (= 0.01256) 0.01256 x 1000 (1) (= 12.56) OR $\frac{250}{1000}$ (1) (= 0.250) $\frac{3.14}{0.250}$ (1) (= 12.56)	0.01256 / 0.0126 / 0.013 scores 1 ECF for MP2 final answer of: 12.6 scores 2 13 **with working** scores 2 200.96 scores 1 0.0796 scores 1 2.0096 x 10^{-4} scores 1 2.0096 x 10^{-7} scores 0	**(2)** **AO2-1**

Question number	Answer	Additional guidance	Mark
6(b)(i)	solid (forms) / (goes) cloudy / {solution/ liquid/ mixture} will go **colourless**	ignore crystals ignore any colour given for solid ignore liquid changes colour / colour change ignore precipitate reject any answer including fizzing/ bubbles/ effervescence	**(1)** **AO2-2**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	2$NaOH + CuSO_4 \rightarrow Cu(OH)_2 + Na_2SO_4$	reject answer if numbers before any other substance	**(1) AO2-1**

Question number	Answer	Additional guidance	Mark
6(b)(iii)	A description to include: • filter (1) • (residue is) rinsed / washed / has distilled water added (1) • leave in warm place / put in oven (1)	if heating with Bunsen to evaporate all water **before** filtration, score 0 for whole answer if heating to warm reaction mixture ignore if no filtering score 0 marks for whole answer allow leave for water to evaporate / pat dry (with filter paper/ paper towel) / leave on windowsill allow heat (with Bunsen) ignore just 'leave' / leave to dry ignore 'crystallisation'	**(3) AO2-2**

Question number	Answer	Additional guidance	Mark
6(c)(i)	H^+ **and** Na^+ **only** circled		**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
6(c)(ii)	so that they do not react (with the electrolyte/sodium sulfate solution / products formed)	allow graphite is unreactive allow so they do not corrode	**(1)** **AO1-1**

Question number	Answer	Additional guidance	Mark
6(c)(iii)	An explanation linking: • **electrons** (1) • move (through graphite) / are {delocalised / free / sea of electrons} (1)	ignore 'charged particles' for MP1 but allow for MP2 reject ions for MP1 and MP2 'electrons in bonds/ electrons in outer shell' scores MP1 only MP2 depends on **electrons** or charged particles being mentioned ignore any other material about structure of graphite, correct or otherwise	**(2)** **AO1-1**

Question number	Answer	Mark
7(a)(i)	**C** it is oxidised is the only correct answer **A**, **B** and **D** are not correct as the reaction of iron with oxygen is an oxidation reaction	**(1)** **AO1-1**

Question number	Answer	Mark
7(b)(i)	Volume of gas in Figure X in cm^3: 50 Volume of gas in Figure Y in cm^3: **45**	**(1)** **AO3-1b**

Question number	Answer	Additional guidance	Mark
7(b)(ii)	10(%) scores 3 with or without working 50 – 45 (1) (= 5) $\frac{5}{50}$ (1) (= 0.1) 0.1 x 100 (1) (= 10%)	allow ECF from (b)(i) 90% gains 2 marks	**(3)** **AO3** **2a-1** **2b-2**

Question number	Answer	Additional guidance	Mark
7(b)(iii)	incomplete reaction / has not been left long enough / insufficient iron	allow iron has fully reacted / no more iron to react allow there was an excess of oxygen allow oxygen cannot reach all of the iron	**(1)** **AO3** **2b – 1**

Question number	Indicative content	Mark
*7(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 (6 marks)** • in an alloy another metal is added / a mixture of metals • in a pure metal, all atoms are of the same size • layers of atoms can slide over one another easily • so a pure metal is malleable / soft • alloys are stronger • because atoms of different sizes • disrupt layers of atoms in the alloy • layers cannot slide • alloys can be used e.g. in metal beams / airplanes parts / bridges • because the alloy is stronger than the pure metal • electroplating means that a (corrosion resistant) metal {coating / layer} is added on top of the (pure) metal / alloy • (more reactive) metals can corrode when exposed to air and water • (corrosion resistant) metal coating does not react with oxygen in air • therefore pure metal object does not corrode • object remains shiny • object looks more attractive • base metal is often cheaper e.g. copper plated with gold in jewellery • therefore object may be cheaper • electroplating involves creating a circuit • object to be plated is made the cathode • plating metal is the anode • electrolyte made from plating metal salt solution	**(6)**

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	Possible candidate response
Read whole answer. Ignore all incorrect material and discard any contradictory material.			
	0	No rewardable material.	
Level 1	1–2	Candidate gives basic ideas about the uses of structure of alloys or electroplated materials: OR	Possible candidate responses alloys can be used for car parts (1) alloys are stronger than pure metals and cutlery is electroplated (2)
Level 2	3–4	Candidate gives basic ideas about both processes: OR Candidate gives a detailed explanation about one processes:	Possible candidate responses alloys make items stronger because the layers of atoms cannot slide, electroplating helps prevent items corroding (3) electroplating is used to coat cheaper metals in more expensive metals to make them look shiny, alloys are a mixture of metals they are more resistant to corrosion (4) alloys used in construction means that they are stronger as different sized atoms in the structure disrupt the layers of atoms so that they can no longer slide so that the metal is now stronger (4) Cutlery can be electroplated with a less corrosive metal so that the metal remains shiny, the layer of metal stops the iron coming into contact with oxygen and water so that it does not rust (4)
Level 3	5–6	Candidate explains ideas about both processes:	Possible candidate responses alloys used in construction means that they are stronger as different sized atoms in the structure disrupt the layers of atoms so that they can no longer slide so that the metal is now stronger. Electroplating coats a cheaper metal in an expensive metal (5) Cutlery can be electroplated with a less corrosive metal so that the metal remains shiny, the layer of metal stops the iron coming into contact with oxygen and water so that it does not rust. Alloys can be used in car parts and in metal beams for construction as it makes them stronger (6)

Question number	Answer	Mark
8(a)	**A** solid aqueous aqueous liquid is the only correct answer **B** is incorrect because hydrochloric acid is aqueous **C** and **D** are incorrect as barium hydroxide is a solid	**(1)** **AO1-1**

Question number	Answer		Mark
8(b)(i)	burette / (volumetric/graduated) pipette	allow syringe ignore any form of measuring cylinder / volumetric flask / dropping pipette	**(1)** **AO3-3b**

Question number	Answer	Additional guidance	Mark
8(b)(ii)	A description to include • (observe / look at) colour produced on (universal indicator) paper (1) • compare to pH {chart / scale} (1)	allow (paper/solution/mixture) changes colour / specific colours given of UI ignore incorrect linking colour to acidity ignore reference to other indicators ignore reference to pH meters	**(2)** **AO2-2**

Question number	Answer	Additional guidance	Mark
8(b)(iii)	An explanation linking • litmus paper only shows if the solution is {acidic / alkaline} (1) • does not show <u>how</u> acidic or alkaline the solution is (1)	allow litmus goes red in acid, blue in alkali / litmus only has 2 colours / only UI gives a wide range of colours / litmus paper does not have a gradual change in **colour** ignore references to purple and neutral ignore litmus is not {precise / accurate} allow does not give the pH / litmus does not give accurate pH allow litmus paper does not show a gradual change in **pH** / ORA allow litmus does not give ‘strength’ of acid/alkali allow litmus paper is qualitative not quantitative (1) reject answers referring to use in test for chlorine	**(2)** **AO3** **2a** **2b**

Question number	Answer	Additional Guidance	Mark
8(b)(iv)	• linear scales on both axes (1) • {plotted points / best fit line} must cover at least half graph paper in both directions (1) • 7 or more points plotted correctly (± half a square) (1)	axes must be numbered (pH can start at 1) allow MP2 and MP3 if axes reversed must have numbered scale to score MP3 allow MP1 only for bar chart / histogram reject plotting on scale that uses the values from the table on Y axis (1, 1, 1, 1, 2, 7, 12, 13, 13)	**(3)** **AO2-1**

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

Question number	Answer	Additional guidance	Mark
8(c)(ii)	(safety) goggles / gloves	allow safety glasses / eye protection ignore glasses and all other suggestions	**(1)** **AO1-1**

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	ignore charged particles throughout	**(3) AO2-1**
	• **ions** (in magnesium carbonate) {cannot move / in a fixed position / <u>held</u> in a lattice / <u>held</u> together by strong electrostatic forces} (1)	allow magnesium carbonate does not have {delocalised / free} electrons reject references to covalent bonding in magnesium carbonate for MP1	
	• magnesium contains {delocalised/free} **electrons** (1)	allow sea of electrons ignore ions in magnesium	
	• electrons (in magnesium) can {flow / move} / are mobile (1)	ignore carry a {charge / current}	

Question number	Answer	Additional guidance	Mark
9(b)	MP1 – relative formula mass $MgCO_3$ 24.0 + 12.0 + 3x16.0 (1) (= 84.0) MP2 – division $\frac{24(.0)}{84(.0)}$ (1) (= 0.28571429) MP3 – conversion to percentage (0.28571429) x 100 (= 28.57 / 28.6 / 29) (1)	28.57 / 28.6 / 29 with or without working gains 3 marks. allow ECF for MP2 and MP3 must have 2 or more sig figs for MP2 e.g Mr = 52 (0) $\frac{24}{52}$ = 0.4615 (1) x 100 = 46.2 (1) MP3 - x 100 mark only if using all 3 pieces of data in calculation allow any number of sig figs except 1 correctly rounded allow $\frac{84(.0)}{24(.0)}$ x 100 = 350 (2)	**(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)** **magnesium carbonate** • bubbles / fizzing / effervescence • magnesium carbonate gets smaller / disappears (allow 'dissolves') • metal carbonate + acid → metal salt + carbon dioxide + water • magnesium carbonate + sulfuric acid → magnesium sulfate + carbon dioxide + water • therefore, gas is carbon dioxide • test using limewater • limewater will turn cloudy **magnesium** • bubbles / fizzing / effervescence • metal gets smaller / disappears (allow 'dissolves') • gas is hydrogen • metal + acid → salt + hydrogen • test gas with a lit splint • (lit splint) burns with a squeaky pop • magnesium + sulfuric acid → magnesium sulfate + hydrogen Credit symbol equations. Incorrect/ incomplete equations could be partially credited for identifying product(s).	**(6)** **A01** **A03**

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Analyses the scientific information but understanding and connections are flawed. (AO3)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. (AO3)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Analyses the scientific information and provide logical connections between scientific enquiry, techniques and procedures throughout. (AO3)

Level	Mark	Descriptor	Possible candidate response
Read whole answer. Ignore all incorrect material and discard any contradictory material.			
	0	No rewardable material.	
Level 1	1–2	Candidate gives about one substance: brief description of observations / an observation and gas test /identification of two products for one reaction OR two bare facts about one or both substances	Possible candidate responses One / both bubble (1) Magnesium fizzes (1) Magnesium gives off hydrogen (1) Magnesium gives off hydrogen which gives a squeaky pop when lit (2) One correct word equation (2) Magnesium gives hydrogen and magnesium carbonate gives carbon dioxide (2) Test hydrogen: lit splint, squeaky pop; test carbon dioxide: limewater milky (2)
Level 2	3–4	Candidate gives about both substances: brief description of observations / an observation and gas test / the word equation OR Candidate gives about one substance: detailed description of observations with either gas test or the word equation	Possible candidate responses Magnesium gives hydrogen and magnesium carbonate gives carbon dioxide which turns limewater milky (3) Magnesium bubbles and disappears. The test for hydrogen is a lit splint which gives a squeaky pop. (3) Magnesium bubbles and disappears, the bubbles are hydrogen, the test for hydrogen is a lit splint which gives a squeaky pop. (4) magnesium produces hydrogen because metal + acid → salt + hydrogen, test hydrogen with lit splint which will give a squeaky pop (4) Two fully complete word equations (4)
Level 3	5–6	Candidate gives about both substances: at least two from: two observations gas test complete word equation OR a detailed description of observations with either gas test or the word	Possible candidate responses magnesium produces hydrogen and fizzes, magnesium + sulfuric acid → magnesium sulfate + hydrogen ; Magnesium carbonate produces carbon dioxide because it is a carbonate, so test the carbon dioxide with limewater and the limewater will turn cloudy (5) magnesium produces hydrogen and fizzes, magnesium + sulfuric acid → magnesium sulfate + hydrogen ; Magnesium carbonate disappears and

		equation for one and observations, gas test or word equation for the other	produces carbon dioxide because it is a carbonate, so test the carbon dioxide with limewater and the limewater will turn cloudy (6)

Question number	Answer	Additional guidance	Mark
10(a)(i)	Actual yield – {mass/amount/yield} (of product) formed in the {reaction / experiment} (1) Theoretical yield – calculated {mass/amount/yield} of product formed (using the balanced equation) / {mass/amount/yield} of product formed if all reactant used to form product only with no losses (1)	allow how much (product) formed ignore 'actual' allow maximum {mass / amount/yield} of product that could be formed (with no losses) ignore estimated / predicted / expected mass formed ignore what would form theoretically	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
10(a)(ii)	$\frac{8.07}{53.80}$ (1) (= 0.15) 0.15 x 100 (1) (= 15)	award correct answer of 15(%) with or without working (2) allow $\frac{53.80}{8.07}$ x100 / 666.7/667/666.6 for 1 mark	**(2)** **AO3-1a**

Question number	Answer	Additional guidance	Mark
10(a)(iii)	Any two from: • Some reactant remained unreacted (1) • Some product is lost during {the reaction /processes/extraction/purification} (1) • Side reactions occur (1)	allow reaction not left long enough allow above 15% ethanol, enzymes in yeast denature allow oxidation of ethanol ignore reactants are lost in experiment ignore yield is lost / loss of yield do not allow self-deprecating answers allow impurities in the reactants ignore reversible reaction	**(2)** **AO1-1**

Question number	Answer	Additional guidance	Mark
10(b)(i)	342 + 18 = 360 / 4x46 + 4x44 = 360 **and** 4 x 46 (1) (=184) $\frac{(4 \times 46)}{360} \times 100$ (1) (= 51.111…) 51(%) (to 2 sig figs) (1)	award full marks for 51 with or without working 0.5111 scores 1 mark 12.8 or 12.78 or 12.778 scores 1 mark 13 scores 2 51.1 / 51.11 (or more sig figs) scores 2 marks 25.555 scores 1 26 scores 2 marks sig fig mark can still be awarded if answer from an incorrect calculation has been given to 2 sig figs if using numbers from question	**(3)** **AO2-1**

Question number	Answer	Additional guidance	Mark
10(b)(ii)	An explanation linking • carbon dioxide becomes {useful/a desired product /no longer a waste product} (1) • so atom economy increases (to 100%) (1)	ignore any increased atom economy less than 51%	**(2)** **AO2-1**