Mark Scheme (Results)

Summer 2022

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

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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.

Paper 1CH0_1H Higher Tier

Question number	Answer	Additional Guidance	Mark
1(a)	A description to include any two in the correct sequence from • starts bright (1) • becomes dimmer (1) • goes out (over time) (1)	Ignore gets brighter allow bulb stops working	**(2)** AO1-1

Question number	Answer	Mark
1(b)	**B** copper has a high melting point is the only correct answer **A**, **C** and **D** are incorrect as they are not typical properties of transition metals	**(1)** AO1-1

Question number	Answer	Mark
1(c)	**C** 2.56×10^{-10} is the only correct answer **A**, **B** and **D** are mathematically incorrect	**(1)** AO2-1

Question number	Answer	Additional Guidance	Mark
1(d)	Diagram showing • arrangement of labelled copper and zinc atoms to show disruption (1) • copper : zinc in (approximate) ratio 7 : 3 (1)	minimum 2 layers for mark allow lack of labelling if clear distinction between Zn & Cu (eg shading)	**(2)** AO1-1

Total for Question 01 = 6 marks

Question number	Answer	Mark
2(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	Additional guidance	Mark
2(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
2(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
2(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
2(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

Total for Question 02 = 9 marks

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

Question number	Answer	Additional guidance	Mark
3(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 M_r = 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	Answer	Additional guidance	Mark
3(c)	$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$ (1)	reject any number in front of $MgCl_2$ reject upper case {G / L} / lower case m allow non-subscript 2 but reject superscript 2. ignore correct charges	**(1)** AO2-1

Total for Question 03 = 8 marks

Question number	Answer	Additional guidance	Mark
4(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
4(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
4(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
4(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
4(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

Total for Question 04 = 11 marks

Question number	Answer	Additional guidance	Mark
5(a)	Diagram showing • two (copper) electrodes in {beaker / suitable container} of {copper sulfate / solution / electrolyte} (1) • connected to {power supply / battery / cell} (1)	diagram needs to be labelled to score full marks electrodes must go into solution for MP1 reject AC / mains supply	**(2)** AO1-2

Question number	Answer	Additional guidance	Mark
5(b)	An explanation linking • (electrodes) cleaned (using emery paper) (or similar) (1) • to remove {surface oxide / grease / impurities} (1)	 allow scrubbed allow dip / wash into named organic solvent allow dirt / other substances reject rust	**(2)** AO1-2

Question number	Answer	Additional guidance	Mark
5(c)(i)	An explanation linking • at anode copper / atoms {lose electrons / oxidised} / (copper) ions leave anode (– cause mass loss) (1) • (copper) ions (in solution) move to cathode (1) • At cathode (copper) **ions** {gain electrons / reduced} (- cause mass increase) (1)	 allow $Cu \rightarrow Cu^{2+} + 2e^{(-)}$ reject mass loss is due to loss of electrons ignore copper dissolves allow $Cu^{2+} + 2e^{(-)} \rightarrow Cu$ reject mass gain is due to gain of electrons if no other mark scored allow oxidation at anode and reduction at cathode (1)	**(3)** AO3-2

Question number	Answer	Additional guidance	Mark
5(c)(ii)	An explanation linking • mass of copper increased by {3x / calculated 2.34/0.78} (=3) (1) • (so) need (3x) / more {current / voltage} passing through solution (1)	allow need (3 x) {greater surface area of electrode / larger electrode / greater concentration (of copper sulfate solution)} / reduce distance between electrodes allow power in place current or voltage 3x { current / voltage / power }= 2 marks	**(2)** AO2-2

Total for Question 05 = 9 marks

Question number	Answer	Additional guidance	Mark
6(a)	An explanation linking • aluminium is (very) high in the reactivity series / very reactive (1) • needs a lot of energy (to remove oxygen from the oxide) (1)	allow aluminium more reactive than carbon allow cannot be {extracted by heating with / extracted by / reduced by} carbon allow cannot be displaced by carbon	**(2)** AO1-1

Question number	Answer	Additional guidance	Mark
6(b)(i)	An explanation linking • (redox involves both) reduction **and** oxidation (1) • magnesium (atoms) loses electrons (and are oxidised) (1) • titanium **ions** accept electrons (and are reduced) (1)	ignore references to loss and gain of oxygen allow $Mg \rightarrow Mg^{2+} + 2e^{(-)}$ allow $Ti^{4+} + 4e^{(-)} \rightarrow Ti$ If no other mark awarded, then allow description of what happens to both reactant particles without mention of electrons (1) OR allow titanium gains electrons and magnesium loses electrons (1)	**(3)** AO1-1

Question number	Answer	Mark
6(b)(ii)	**C** $Ti(SO_4)_2$ is the only correct answer **A**, **B** and **D** are incorrect formulae	**(1)** AO1-1

Question number	Answer	Additional guidance	Mark
6(c)	slow process / large area of land required / only extracts metal from the ground surface / metals need further extraction	ignore expensive / cost implications ignore { carbon dioxide / greenhouse gases } evolved ignore references to bioleaching allow {harmful / toxic} gas released on burning plants allow specific environmental effect	**(1)** AO1-1

Question number	Answer	Additional guidance	Mark
6(d)	A method to include • mix copper oxide with {carbon / powdered charcoal} (in a suitable container) (1) • heat (with carbon) (strongly until no further change) (1) OR • react copper oxide with dilute {sulfuric / hydrochloric} acid (1) • electrolyse the solution formed (1) OR • pass hydrogen (or methane) (1) • over heated copper oxide (1)	In each the 2nd MP depends on the 1st reject burn / combust allow {react/displace} with carbon (alone) (1) allow heat with more reactive metal (1) suitable method to isolate copper from other oxide (1)	**(2)** AO3-3a

Total for Question 06 = 9 marks

Question number	Answer	Additional guidance	Mark
7(a)	from yellow (1) to orange (1)	Allow to pink	**(2)** AO1-2

Question number	Answer	Additional guidance	Mark
7(b)	$2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ (2) MP1 : formula of product (1) MP2 : balancing (of correct formulae) (1)	 MP2 dependent on MP1 allow correct multiples throughout	**(2)** AO2-1

Question number	Answer	Additional Guidance	Mark
7(c)	An explanation linking two practical steps with reasons • use of white tile (1) • easier to see precisely when indicator changes colour (1) • (near to end point) {add (acid) slowly / in small quantities each time} (1) • easier to stop excess acid being added (when indicator changes colour) (1) • swirl flask when adding acid (1) • ensures complete mixing of both reactants (1) • touch tip of burette on inside wall of flask and/or rinse walls of flask (1) • ensures all acid takes part in reaction (1) • rinse burette (with acid)/ pipette (with ammonia)/flask (with water) beforehand (1) • no impurities to affect result (1) ▪ remove funnel from burette (1) ▪ to stop any extra drop of acid falling into burette (1)	 ignore any improvements to measuring volumes of solution. only allow drop by drop if near end point ignore stir allow wash final drop from end of burette.	**(4)** AO1-2

Question number	Answer	Additional guidance	Mark
7(d)	A plan to include (stand alone marks) • heat solution (in an evaporating basin) (to concentrate) (1) • (cool and) crystallise (1) • **dry** ammonium sulfate crystals (between filter papers) (1)	 do not accept crucible reject heat to dryness allow leave in a warm place (to crystallise) allow other suitable methods of drying, e.g. **warm** in an oven to **dry**	**(3)** AO3-3a

Total for Question 07 = 11 marks

Question number	Answer	Mark
8(a)	**C** -7 63 is the only correct answer **A** and **B** have boiling points showing a gas at room temperature **D** has a boiling point that of a giant structure	**(1)** AO2-1

Question number	Answer	Additional guidance	Mark
8(b)	An explanation linking • carbon has 4 outer shell electrons (1) • 3 electrons used in bond with other carbon atoms / each carbon forms 3 bonds (1) • (one) electron free to move / delocalised (1)	 allow each carbon atom has 1 electron not involved in bonding (1) allow delocalised electron**s** reject reference to movement of ions	**(3)** AO1-1

Question number	Answer	Additional guidance	Mark
8(c)	An explanation linking **EITHER** • {ionic / giant / lattice} structure (1) **OR** • strong forces of attraction (between ions of opposite charge) / strong (ionic) bonds (1) **AND** • (so) needs large amount of energy to overcome ionic forces (1)	 reject covalent / molecular / intermolecular / atoms in the wrong context allow 'more energy' instead of 'large amount of energy' ignore temperature / heat	**(2)** AO2-1

Question number	Indicative content	Mark
***8(d)**	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) and AO2 (3 marks)** • they show methane contains carbon and hydrogen • structure **A** only shows the ratio of C:H (as 1:4) • structure **A** gives no information about bonding in molecule • structure **A** gives no information about shape of molecule • dot & cross diagram, **B**, shows the covalent bonding between the C and H atoms • single bonds, show in structures **B**, **C** and **D** • inner shell not involved in bonding • structure **B** does not show the 3-D positions of atoms • single lines used to show single covalent bonds in structure **C** • only a 2-D representation and not positions in space • ball & stick model, **D**, shows position in space / 3-D arrangement • atoms not actually connected by the sticks • space-filling, structure **E**, model shows 3-D arrangement of atoms • **E** shows approximate relative sizes occupied by separate atoms • no information about type of bond between atoms in structure **E**	**(6)** AO1-1 AO2-1

Level	Mark	Additional Guidance	General additional guidance – the decision between levels
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1-2	<u>Additional Guidance</u> Makes simple statements about the models that are not explained or linked. OR Gives a description of at least one model OR Identifies limitations of at least one model	<u>Possible Candidate Responses</u> • the models show that methane contains 1 carbon and 4 hydrogen atoms • model A gives no information about the structure of the molecule • model B is a dot and cross diagram showing shared pairs of electrons between carbon and hydrogen • a detailed description of one model scores the upper part of the level
Level 2	3-4	<u>Additional Guidance</u> Gives different descriptions of at least three models OR Gives a description of at least two models and links at least one model to its limitations OR Identifies different limitations of at least three models	<u>Possible Candidate Responses</u> • model B is a dot and cross diagram showing the covalent bonds. Model D is a ball and stick model showing a 3D model. All models show that methane contains one carbon and four hydrogen atoms. • model E shows the relative sizes of carbon and hydrogen atoms but gives no detail about the bonding between the atoms. Model C shows single covalent bonds. • model A gives no information about how the atoms are arranged in methane, and models B and C give no information about how the atoms are arranged in space and model E gives no information about the bonds. • detailed descriptions in all cases score the upper part of the level
Level 3	5-6	<u>Additional Guidance</u> Gives a description of at least three models AND three limitations OR Gives a description of all five models AND at least one limitation for one of the models	<u>Possible Candidate Responses</u> • model C shows the displayed formula and single bonds in methane but is only a 2D model and does not show the position of the atoms in space. Model A is the molecular formula and tells us how many carbon and hydrogen atoms are in the molecule but gives no information about how these are arranged. Model D shows the 3D arrangement of atoms, but model E does not show how the atoms are bonded.

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
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) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Total for Question 08 = 12 marks

Question number	Answer	Additional guidance	Mark
9(a)(i)	least most X – W – Y – Z (2)	X – Y – W – Z (1)	**(2)** AO3-1

Question number	Answer	Additional guidance	Mark
9(a)(ii)	An explanation linking • metal sulfate {insoluble / coats the metal / forms a barrier} (1) • prevents further reaction of metal with acid (1)	ignore tarnish	**(2)** AO2-2

Question number	Answer	Additional guidance	Mark
9(a)(iii)	An explanation linking • partially {dissociated / ionised} (1) • {concentration of H^+ ions lower / fewer H^+ ions} than expected (1)	concentration of H^+ ions lower than concentration of acid (1) ignore references to pH	**(2)** AO1-1

Question number	Answer	Additional guidance	Mark
9(b)	formula mass $Al_2(SO_4)_3$ = 2x27 + 3x(32 + 16x4) (1) (= 342) moles of $Al_2(SO_4)_3$ = $\frac{5.13}{342}$ (1) (= 0.015) no of atoms in formula $Al_2(SO_4)_3$ = 17 no of atoms in 0.015 moles = 17 x 0.015 x 6.02 x 10^{23} (1) = 1.5351 x 10^{23} (1)	final answer of 1.5351 x 10^{23} scores full marks allow ECF from formula mass 0.015 scores 2 marks allow any number of sig figs except one 3.1 x 10^{24} scores 1 (mass x *L*) 1.0234 x 10^{25} scores 1 (no of atoms x *L*) 2.05884 x 10^{26} scores 2 (M_r x *L*) 9.03 x 10^{21} scores 3 (moles x *L*)	**(4)** AO2-1

Question number	Answer	Additional guidance	Mark
9(c)	moles Fe = $\frac{4.48}{56.0}$ (1) (= 0.08) moles Pb = $\frac{24.84}{207}$ (1) (= 0.12) ratio moles Fe : moles Pb = 2 : 3 or 1 : 1.5 so equation 2 (1) **OR** mass ratio ratio equation 1 = 56 : 207 (1) ratio equation 2 = 112 : 621 (1) 112 : 621 = 4.48 : 24.84 so equation 2 (1) **OR** equation 1 mass of Pb (207/56) x 4.48 = 16.56 (2) OR equation 2 mass of Pb (621/112) x 4.48 = 24.84 (2) so equation 2 is correct (1)	There may be other methods – need to check calculation carefully allow shows that it is not 1:1 for final mark stating Equation 2 with no calculation to justify, scores 0	**(3)** AO3-1

Total for Question 09 = 13 marks

Question number	Answer	Additional guidance	Mark
10(a)(i)	both forward and back(ward) reactions take place at same time	allow forward and back(ward) reactions occur at same rate	**(1)** AO1-1

Question number	Indicative content	Mark
***10(a)(ii)**	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) AO2 (3 marks)** • use of suitable catalyst (any suitable metal eg Pt) • helps increase rate of forward reaction • and helps increase rate of back reaction • so increases rate of attainment of equilibrium • but has no effect on equilibrium yield • increase temperature would increase rate of reaction • shifts equilibrium to right hand side • so increases equilibrium yield • so use a high temperature (range 200–600 ^{o}C – anything would be reasonable) • use of very high temperatures increases energy use • so makes product more expensive • as fewer molecules on left hand side than right • so use low pressures • moves equilibrium to right hand side • so increases equilibrium yield • high pressure increases rate but decreases yield OR low pressure increases yield but decreases rate • pressure used is a compromise between rate and yield	**(6)** AO1-1 AO2-1

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
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) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Level	Mark	Additional Guidance	General additional guidance - the decision between levels
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1-2	<u>Additional Guidance</u> • One factor is discussed with a statement of effect on yield and/or rate (1) • One factor is discussed with explanation of yield and/or rate (2) • Two or three factors are discussed with statement of effect on yield and/or rate (2)	<u>Possible Candidate Responses</u> High temperature gives high yield of propene as equilibrium moves to products side. A low pressure gives a higher yield because there are more gas molecules on the right-hand side (ORA) Addition of catalyst increases rate of attainment of equilibrium Factor and reason – 2 marks
Level 2	3-4	<u>Additional Guidance</u> • One factor is fully discussed with explanation of yield and rate (3) • Two factors are discussed with explanation of yield and/or rate in one case and just statement of yield and/or rate in one case (3) • Two factors are discussed with explanation of yield and/or rate in each case (4) • Three factors are discussed with statement of effect on yield and/or rate with explanation for at least one (4)	<u>Possible Candidate Responses</u> A higher pressure gives a lower yield because there are more gas molecules on the right-hand side. A higher temperature gives a higher yield because the forward reaction is endothermic. 2 factors both with reasons – 4 marks
Level 3	5-6	<u>Additional Guidance</u> To get into level 3 yield and rate must be both discussed at least once. • All three factors are discussed, with explanation of yield and/or rate in each case (6) • All three factors are discussed, with explanation of yield and/or rate in two cases (5)	<u>Possible Candidate Responses</u> use of catalyst increases rate of forward reaction and increases rate of back reaction so increases rate of attainment of equilibrium but has no effect on equilibrium yield; increase temperature increases rate of reaction and shifts equilibrium to product side so use a high temperature; use low pressures as fewer molecules on reactant side than products so moves equilibrium to right hand side & yield increases but high pressure increases rate but decreases yield 3 factors detailed with at least 2 reasons – 6 marks

Question number	Answer	Mark
10(b)	300 (dm^3)	**(1)** AO2-1

Question number	Answer	Additional guidance	Mark
10(c)	1 mol C_3H_8 produces 1 mol H_2 (1) no moles propane = $\frac{900}{24}$ (1) (= 37.5) = no moles H_2 mass of H_2 = 37.5 x 2 g (1) (= 75.0 (g)) = 7.50 x 10^{-2} (kg) (1) (= 0.075)	Answer of 0.075 with or without working scores full marks Allow ECF throughout allow 37.5 (moles) for 2 marks Allow 75.0 x 10^{-3} (kg) as a correct final answer 0.0375 scores 3 75(.0) scores 3	**(4)** AO2-1

Total for Question 10 = 12 marks