

Cambridge IGCSE™

CHEMISTRY**0620/41**

Paper 4 Theory (Extended)

May/June 2026

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **29** printed pages.

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: - the specific content defined in the mark scheme - the specific skills defined in the mark scheme or in the level descriptions - the standard of response required as exemplified by the standardisation scripts.
2	Examiners must award whole marks (not half marks, or other fractions).
3	Examiners must award marks positively . This means that: - marks are not deducted for errors or omissions - marks are awarded for correct/valid answers as defined in the mark scheme and also for other valid answers which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate - the quality of spelling, punctuation and grammar are judged only when the mark scheme indicates that these features are specifically assessed in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must consistently apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the full range of marks defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and must not award marks with grade thresholds or grade descriptions in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require <i>n</i> responses (e.g. State two reasons ...): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked <i>ignore</i> in the mark scheme should not count towards <i>n</i>. • Incorrect responses should not be awarded credit but will still count towards <i>n</i>. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should not be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first <i>n</i> responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	information missing or insufficient for credit
BOD	benefit of doubt given
CON	contradiction in response, mark not awarded
	incorrect point or mark not awarded
	key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
ECF	error carried forward applied
I	incorrect or insufficient response, mark not awarded
NAQ	response has not answered question
NBOD	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied
R	incorrect point or mark not awarded
SEEN	blank page seen

Annotation	Meaning
	correct point of mark awarded

Mark Scheme Abbreviations	
;	separates marking points
/	alternative responses for the same marking point
R	reject the response
A	allow/accept the response
I	ignore the response
CON	contradiction in response, no mark
ecf	error carried forward
ora	or reverse argument
AW	alternative wording
<u>underline</u> or bold	actual word given must be used by candidate (grammatical variants excepted)
()	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks that can be given
MP / M	marking point

Question	Answer	Marks	Guidance
1(a) to 1 (f) ALLOW equations instead of letters A to J .			
1(a)	G	1	ALLOW calcium carbonate → calcium oxide + carbon dioxide
1(b)	I	1	ALLOW sulfur dioxide + oxygen → sulfur trioxide
1(c)	H	1	ALLOW $C_8H_{18} \rightarrow C_6H_{14} + C_2H_4$
1(d)	E	1	ALLOW $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
1(e)	F	1	ALLOW $N_2 + 3H_2 \rightarrow 2NH_3$
1(f)	B	1	ALLOW $2KBr + Cl_2 \rightarrow 2KCl + Br_2$
1(g)	D	1	ALLOW glucose → ethanol + carbon dioxide

Question	Answer	Marks	Guidance
Q2(a) REJECT wrong formulas in all parts e.g. chlorine / C is CON e.g. silver / AG is CON			
REJECT wrong names e.g. chloride / Cl_2 is CON			
2(a)(i)	Al / aluminium	1	
2(a)(ii)	Br ₂ / Br / bromine	1	
2(a)(iii)	V / vanadium	1	
2(a)(iv)	Cl ₂ / Cl / chlorine	1	
2(a)(v)	N ₂ / N / nitrogen	1	
2(a)(vi)	Si / silicon	1	REJECT silicone

Question	Answer	Marks	Guidance
2(b)(i)	M1 same number of protons(1) M2 different number of neutrons(1)	2	The word 'number' or equivalent need only be used once The word atom is not required in the answer(it is in the question) <u>SALVAGE MARK</u> IF number or equivalent is not seen 1 mark can score e.g. for same protons different neutrons IGNORE location of particles IGNORE if molecules / elements / substances etc. are given instead of atoms M1 ALLOW same proton number M2 ALLOW different neutron number REJECT different number of electrons

Question	Answer	Marks	Guidance
2(b)(ii)	M1 $[(80 \times 24) + (10 \times 25) + (10 \times 26)]$ OR 2430(1) M2 $2430 \div 100 = 24.3(1)$	2	IGNORE units M1 is for multiplication of correct (mass $\times$ abundance) for ALL 3 isotopes (addition sign is not necessary and IGNORE any other mathematical operations e.g. division or subtraction) ALLOW $[(24 \times 0.8) \text{ and } (25 \times 0.1) \text{ and } (26 \times 0.1)]$ or $[(24 \times 8) \text{ and } (25 \times 1) \text{ and } (26 \times 1)]$ or $[(24 \times 8) \text{ and } 25 \text{ and } 26]$ or 243 ALLOW if the 3 expressions are not added IGNORE missing brackets / brackets used incorrectly e.g. $(80 \times 24) + 10 \times 25 + (10 \times 26) \div 24 \times 0.8 + 25 \times 0.1 + 26 \times 0.1$ both score M1 M2 ALLOW ECF ONLY for correct division of a transcription error.

Question	Answer	Marks	Guidance
3(a)(i)	M1 magnesium ion 2,8 all crosses(1) M2 both fluoride ions 2, 8 outer shell 7 dots and 1 cross(1) M3 2+ on Mg and 1- on both F (1)	3	IGNORE arrows going from one atom to another IGNORE any empty outer shells M2 ALLOW ECF for M2 for magnesium with 8 dots in outer shell AND both fluorides with 8 dots in outer shell ALLOW • and o as interchangeable for dots M3 ALLOW Mg²⁺ and two F - ALLOW ++ / +2 and – / –1 ALLOW Mg⁺⁺ / Mg²⁺ / Mg⁺² and F¹⁻ / F⁻¹ written in the spaces left blank for charges

Question	Answer	Marks	Guidance
3(a)(ii)	M1 strong forces of attraction / strong bonds(1) M2 (between) oppositely charged ions OR (between) positive and negative ions OR (between) cations and anions OR (between) Mg^{2+} and F^{-}(1)	2	ALLOW strong attraction / strong holding (together) ALLOW stronger or strongest or high or higher attraction instead of strong attraction ALLOW need large or larger or more or high or higher amounts of heat or energy to break or overcome or weaken bonds or weaken attraction or to separate particles IGNORE strong forces (must be forces of attraction) IGNORE no weak bonds / bonds difficult to break IGNORE high temperature needed to break bonds(must be heat or energy) IGNORE need large or larger or more or high or higher amounts of heat or energy to break or overcome the lattice(it must be to break bonds or attraction) REJECT between bonds (therefore strong attraction between bonds does not get M1) M2 ALLOW wrong charges on ions as long as they are oppositely charged e.g. Mg^{+} and F^{2-} / Mg^{-} and F^{2+} / positive anions and negative cations ALLOW (between) +ve and –ve ions ALLOW (between) magnesium ions and fluoride ions ALLOW fluorine ions instead of fluoride ions IGNORE (between) ions (must be qualified by reference to charges etc.) IGNORE reference to lattice / giant structure IGNORE bond between metal and non-metal IGNORE oppositely charged particles (must be ions etc.) IGNORE charged atoms REJECT (between) atoms / molecules / electrons (unless reference to ionic bonding by electron transfer) / elements / covalent / metallic / intermolecular(for M2)

Question	Answer	Marks	Guidance
3(a)(iii)	Ions move (when molten not when solid)	1	ALLOW move = flow = mobile = pass(through) = slide = migrate = travel ALLOW the ions become mobile ALLOW mobile ions are formed (taken to mean the ions become mobile BOD) REJECT moving electrons REJECT any idea that new ions are formed when magnesium fluoride becomes molten
3(b)(i)	M1 one shared dot and cross(1) M2 6 non-bonding dots on one fluorine atom and 6 non-bonding crosses on the other fluorine atom to complete both octets (1)	2	If the number of shared electrons is anything other than 2 there are no marks for the question ALLOW • and o as interchangeable for dots Non-bonding electrons need not be drawn in pairs ALLOW 1 mark only for otherwise correct diagram of all dots or all crosses or an incorrect mixture or use of a different symbol e.g. triangle M1 REJECT any other symbols except dots and crosses (e.g. triangles) M2 can score if M1 does not score ONLY if the shared pair is two dots or two crosses If the shared pair is two dots or two crosses ALLOW M2 for 6 non-bonding electrons of any type (dots or crosses) on both atoms

Question	Answer	Marks	Guidance
3(b)(ii)	M1 solid(1) M2 because -240°C is lower than the melting point / melting point is above -240°C (1)	2	Marks are independent e.g. M1 liquid $\times$ M2 -240 is lower than -220 gets M2 NO ECF on wrong state e.g. M1 liquid $\times$ M2 -240 is higher than $-220 \times$ It is not necessary to refer to the boiling point / -188 but any reference must be correct M2 ALLOW $-220 (^{\circ}\text{C})$ as alternative to melting point ALLOW $-240(^{\circ}\text{C})$ is lower than $-220(^{\circ}\text{C})$ ALLOW $-240(^{\circ}\text{C}) < -220(^{\circ}\text{C}) / -220(^{\circ}\text{C}) > -240(^{\circ}\text{C})$ ALLOW temperature or it as alternative to -240°C e.g. it is lower than -220 gets M2 ALLOW temperature is colder than the melting point ALLOW temperature not hot enough to melt ALLOW number lines that show $-240(^{\circ}\text{C})$ is lower than $-220(^{\circ}\text{C})$ ALLOW (it is) before or below or under the melting point ALLOW (it has) not reached the melting point/ melting point not exceeded REJECT -240°C is higher than boiling point REJECT -240°C is beyond the melting point

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Question	Answer	Marks	Guidance
4(a)	$2\text{H}_2\text{O}_2(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$ M1 all three formulas correct(1) M2 equation correct(1) M3 state symbols(1)	3	M1 REJECT any other species except H_2O_2 , H_2O and O_2 (also means M2 cannot score) IGNORE attempted formula of catalyst over the arrow (means M1 is available) M2 ALLOW multiples M3 REJECT AQ / Aq / aQ instead of aq REJECT G instead of g
4(b)	M1 increases the rate of a reaction(1) M2 unchanged at the end of the reaction(1)	2	Marks are independent IGNORE any reference to enzymes or proteins(anywhere) IGNORE if catalyst is described as an element or compound or molecule anywhere M1 ALLOW speeds up a reaction / reaction faster IGNORE alters speed of reaction / alters rate of reaction REJECT decreases the rate M2 ALLOW unchanged (at the end of the reaction) / unchanged (chemically) / unaffected / lowers activation energy (or any phrase that means activation energy e.g. minimum energy required for reaction to occur) / remains unchanged / remains unaffected / mass(of catalyst) doesn't change / reforms at the end of the reaction ALLOW Ea / EA / AE / energy needed to start reaction as alternatives to activation energy REJECT increase / decreases the yield(M2 not available)

Question	Answer	Marks	Guidance
4(c)(i)	Answers must be based on EITHER concentration OR distance between particles OR collision frequency concentration (of hydrogen peroxide or reactant) is highest (at the start) OR particles or molecules (of hydrogen peroxide or reactant) are closest (at the start) OR collision frequency (of hydrogen peroxide particles or molecules or reactant) is highest (at the start)	1	Hydrogen peroxide need not be mentioned ALLOW reactant(s) or reagent(s) or particles or molecules or ions or atoms as alternatives to hydrogen peroxide Comparatives can be used instead of superlatives ie ALLOW higher = highest / closer = closest / more = most = highest BUT IGNORE high / close ALLOW moles(of hydrogen peroxide) per unit volume is highest(at the start) ALLOW maximum concentration (of hydrogen peroxide) (at start) / - Concentration(of hydrogen peroxide) decreases(with time) IGNORE Highest number of (hydrogen peroxide) particles or molecules(at start) IGNORE mass or amount or volume instead of concentration OR ALLOW atoms or ions as alternatives to molecules ALLOW minimum distance between (hydrogen peroxide) particles (at start) / distance between(hydrogen peroxide) particles increases(with time) / more (hydrogen peroxide) particles per unit volume or per cm³ (ALLOW per unit area instead of per unit volume) OR ALLOW rate of collisions (of hydrogen peroxide particles) highest (at start) most collisions between (hydrogen peroxide) particles per unit time / collisions between (hydrogen peroxide) particles occur most often/ more frequent collisions between (hydrogen peroxide) particles / frequency of collisions (between particles) decreases

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Question	Answer	Marks	Guidance
4(c)(i)			IGNORE more collisions / most chance of collisions / most probability of collisions / most collisions / reference to collisions with container / successful / effective/ high frequency of collisions(must be higher or highest) REJECT any reference to catalyst changing e.g. catalyst concentration highest at start REJECT any reference to surface area / particles size / temperature / energy / speed of particles
4(c)(ii)	the hydrogen peroxide is used up OR ALL the hydrogen peroxide has reacted or decomposed	1	Hydrogen peroxide or H₂O₂ must be mentioned to score ALLOW all the hydrogen peroxide is used / the hydrogen peroxide has fully reacted IGNORE the hydrogen peroxide has stopped reacting or the hydrogen peroxide has finished reacting (neither means there is none left) or the hydrogen peroxide has reacted / hydrogen peroxide is limiting / reagents or reactants are used up etc. (there must be a reference to hydrogen peroxide or H₂O₂) REJECT any reference to catalyst / surface area / particle size / temperature changing / energy changing

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Question	Answer	Marks	Guidance
4(d)	M1 kinetic energy of particles is lower(1) M2 frequency of collisions between particles is lower(1) M3 fewer or lower percentage or lower proportion or lower fraction of particles have energy greater than / equal to activation energy OR fewer of the collisions or lower percentage or lower fraction of collisions have energy greater than or equal to activation energy(1)	3	IGNORE statements about equilibrium IGNORE comments about higher temperature Comparisons are needed for all marking points M1 Particles / molecules / atoms / ions must be seen somewhere in the answer for M1 to be awarded ALLOW particles have less (kinetic or heat) energy / particles move slower / particles collide slower/ particles lose(kinetic or heat) energy / (kinetic or heat) energy of particles decreases / particles lose(kinetic or heat) energy / less energy between particles / particles gain less energy IGNORE vibrate slower REJECT particles produce less energy M2 ALLOW frequency of collisions is lower or decreases / rate of collisions is lower or decreases / fewer collisions per unit time / collisions occur less often(particles don't have to be mentioned for M2) / collisions decrease per unit time / less frequent collisions IGNORE less chance of collisions / less probability of collisions / fewer collisions / reference to collisions with container M3 Activation energy or a phrase meaning activation energy must be mentioned ALTERNATIVES to activation energy / E_a / E_A / A_E / energy needed to start reaction / sufficient energy to react / energy to overcome activation energy ALLOW fewer or less particles have energy greater than activation energy / Fewer or less particles have energy equal to activation energy IGNORE energy to break bonds if PARTICLES are referred to the phrase less of the / reference to lower percentage of etc. is NOT essential for M3

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Question	Answer	Marks	Guidance
4(d)			ALLOW MORE (of the) particles have energy LESS than activation energy ALLOW MORE of the collisions have energy LESS than activation energy IGNORE fruitful / successful / effective REJECT decrease / increase in no of particles REJECT activation energy is decreased / increased if COLLISIONS are referred to the phrase less of the / reference to lower percentage of etc. IS essential for M3

Question	Answer	Marks	Guidance
5(a)(i)	electrolysis	1	IGNORE redox / decomposition REJECT thermal decomposition/ electrolyte

Question	Answer	Marks	Guidance
5(a)(ii)	M1 inert(1) M2 good conductor of electricity(1)	2	Only use CON if more than two answers are given Answers can be in any order M1 ALLOW not reactive / unreactive / does not react/does not react with the electrolyte / does not react with the solution / does not react with the products (of electrolysis) / does not take part in the reaction IGNORE not very reactive / low reactivity / quite unreactive / does not break down / does not corrode / does not affect the reaction / does not dissolve in the electrolyte M2 ALLOW (good) conductor of electricity / allows electricity to pass through ALLOW electric current or electrical energy as alternatives to electricity IGNORE conductor (alone) / conductive / increases conductivity / conducts heat / carries electric charge / carries or conducts current (must be electrical current) IGNORE any reasons given for conductivity e.g. electrons or ions IGNORE high melting point / high boiling point IGNORE cost REJECT conducts electricity when molten or aqueous REJECT graphite is a metal

Question	Answer	Marks	Guidance
5(a)(iii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ M1 $\text{H}^+ + \text{e}$ on LHS of equation(1) M2 equation fully correct(1)	2	ALLOW e or e^- or es for electrons IGNORE state symbols ALLOW multiples SALVAGE MARK ALLOW 1 mark for $2\text{H}^+ \rightarrow \text{H}_2 - 2\text{e}^-$ M1 ALLOW ANY number of positive hydrogen species with ANY positive charge + ANY number of electrons on LHS e.g. $\text{H}_2^{2+} + 4\text{e}^- \rightarrow$ scores M1 M2 REJECT H_2^0 (M1 still can score) Special case $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{OH}^- + \text{H}_2$ M1 for $\text{H}_2\text{O} + \text{electrons}$ on LHS of equation(1) M2 equation fully correct(1)

Question	Answer	Marks	Guidance
5(a)(iv)	M1 hydroxide ion is negative OH⁻ is negative(1) M2 There are 4 alternatives that can get M2 based on: • movement of negative ions to anode • concentration • process of hydroxide(ions) forming oxygen • oxygen formed and not chlorine hydroxide ion is attracted to electrode of opposite charge or positive charge/ hydroxide ion is attracted to positive anode(1)	2	4OH⁻ → O₂ + 2H₂O + 4e or 4OH⁻ – 4e → O₂ + 2H₂O both get 2 marks even if unbalanced or if water is absent e.g. OH⁻ → O₂ + e would score 2 If there are any other errors in the equation OH⁻ can get M1 on LHS of equation M1 ALLOW hydroxide ions / OH ions / OH⁻ / hydroxide or OH is an anion IGNORE hydroxide(alone) / chloride ion / Cl REJECT wrong negative ions e.g. oxide ions / oxygen ions / negatively charged oxygen REJECT hydroxide ions produced by electrolysis M2 ALLOW attraction of or movement of ANY negative ion (named or unnamed) this includes wrong negative ions e.g. oxide ion / oxygen ion or (any) anion or hydroxide ion or OH⁻ or OH anion to the positive electrode or positive anode IGNORE oxygen has negative charges (without ion) OR M2 ALLOW (the solution is) dilute or diluted / the solution is not concentrated ALLOW concentration (of sodium chloride or chloride ions) is not (high) enough ALLOW concentration of hydroxide (ion) is high / concentration of chloride(ion) is low ALLOW concentration of hydroxide(ion) is higher than chloride (ion) ALLOW concentration of chloride(ion) is lower than hydroxide (ion) / more hydroxide(ion) than chloride(ion) IGNORE any comments about concentrations of oxygen / chlorine OR M2 ALLOW hydroxide(ion) / OH (ion) / OH⁻ discharged or decompose or oxidised or lose electrons(forming oxygen and water or forming oxygen alone OR instead of chloride (ions)) IGNORE hydroxide (ion) forms oxygen(essentially this is repeating the question) IGNORE electrolysed

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Question	Answer	Marks	Guidance
5(a)(iv)			OR M2 ALLOW oxygen forms and not chlorine ALLOW hydroxide (ion) react or form products instead of chloride (ion) IGNORE any statements about reactivity of oxygen and chlorine IGNORE electrolysed
5(a)(v)	electron(s)	1	IGNORE e / e(s) / e ⁻ / free / delocalised / sea / mobile
5(a)(vi)	M1 anode: chlorine(1) M2 cathode: hydrogen(1)	2	
5(b)(i)	bauxite	1	
5(b)(ii)	aluminium oxide	1	ALLOW aluminium(III)oxide REJECT wrong oxidation state e.g. aluminium(II)oxide does not score REJECT e.g. aluminium(II)oxide + Al ₂ O ₃ does not score
5(b)(iii)	(molten)cryolite	1	

Question	Answer	Marks	Guidance
5(b)(iv)	M1 anodes or carbon react with oxygen(1) M2 (form) carbon dioxide(1)	2	Marks are independent AWARD BOTH MARKS for $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ or $(2)\text{O}^{2-} + \text{C} \rightarrow \text{CO}_2 (+ 4\text{e}^-)$ It or they refer to anodes / carbon M1 ALLOW electrode(s) or graphite as alternatives to anode or carbon ALLOW oxidised or bond with or burns or forms product as alternatives to reacts with ALLOW $\text{O}_2 / \text{O}^{2-} / \text{O} /$ oxide ions / oxygen atoms / oxygen ions / oxygen in the electrolyte as alternatives to oxygen ALLOW any chemical or word equation which shows carbon reacting with oxygen (irrespective of products e.g. carbon monoxide) REJECT oxygen from air M2 IGNORE anything that happens to the anodes after formation of CO_2 e.g. dissolve / wear away / corrode / erode / burn / decay / decompose / used up

Question	Answer	Marks	Guidance
6(a)(i)	amphoteric(oxides)	1	REJECT atmospheric
6(a)(ii)	Na_2ZnO_2	1	REJECT symbols in wrong order ZnO_2Na_2 REJECT any numbers in front e.g. $2\text{Na}_2\text{ZnO}_2$ unless part of an attempted 'equation' REJECT any formulas with charges e.g. $\text{Na}^+_2\text{ZnO}_2^{2-}$
6(a)(iii)	$\text{ZnO} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2\text{O}$ M1 $\text{ZnSO}_4(1)$ M2 equation correct(1)	2	ALLOW multiples IGNORE state symbols M1 ZnSO_4 must be a product of an equation
6(a)(iv)	$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ M1 correct ionic equation(1) M2 state symbols(1)	2	M1 only BaSO_4 on the right and only $\text{Ba}^{2+} + \text{SO}_4^{2-}$ on the left in a balanced ionic equation REJECT ionic charges on BaSO_4 / BaSO_4^0 REJECT spectator ions / electrons as reactants or products M2 ALLOW for state symbols on any positive barium ion and any negative sulfate ion and any uncharged barium sulfate formula (as the only product) eg $\text{Ba}^{3+}(\text{aq}) + \text{SO}_4^-(\text{aq}) \rightarrow \text{Ba}(\text{SO}_4)_2(\text{s})$ gets M2 REJECT AQ / Aq / aQ instead of aq BUT do NOT penalise this error if EXACTLY THE SAME error is already penalised in 4(a) (response is clipped)
6(a)(v)	white	1	REJECT cream / colourless / off white

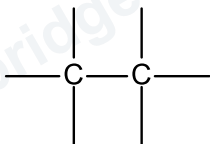
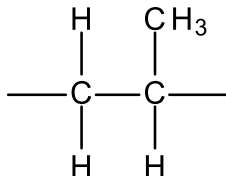
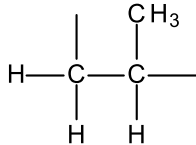
Question	Answer	Marks	Guidance
6(b)(i)	M1 0.04(1) M2 0.02(1) M3 3.04 (1)	3	3.04 does not automatically get all 3 marks, need working IGNORE any units anywhere IGNORE presence or absence of trailing zeros anywhere Penalise fractions once only e.g. M1 $1/25 \times$ M2 $1/50$ ✓ ECF M3 $76/25$ ✓ ECF M2 ALLOW ECF M1 $\div 2$ correct to at least 3 significant figures IGNORE rounding/ truncating errors after 3rd SF M3 ALLOW ECF M2 $\times 152$ correct to at least 3 significant figures IGNORE rounding / truncating errors after 3rd SF

Question	Answer	Marks	Guidance			
6(b)(ii)	M1 oxidation number of chromium / oxidation number of Cr(1) M2 oxidation number = + 6(1)	2	Marks are independent If CHARGE on chromium is referred to 0/2 IGNORE references to electrons M1 ALLOW oxidation state or oxidation number or oxidisation state or oxidising number as alternatives to oxidation number ALLOW chromium atom / chromium isotope / chromium(VI) / Cr atom / Cr(VI) as alternatives to chromium REJECT oxidation number of compound/ potassium chromate / chromate / K₂CrO₄ for M1 REJECT oxidation number of chromium molecule/ chromium ions / CHARGE on chromium M2 ALLOW oxidation number of the ion = +6 REJECT oxidation number = + six / six + / plus 6 / 6 plus / plus six / six plus / + VI / VI+ REJECT CHARGE is +6 / 6+ / Cr⁺⁶ / Cr⁶⁺			
6(b)(iii)	Cr / chromium	1				
6(c)	<table><tr><td>M1 decreases(1)</td></tr><tr><td>M2 decreases(1)</td></tr><tr><td>M3 no change(1)</td></tr></table>	M1 decreases(1)	M2 decreases(1)	M3 no change(1)	3	
M1 decreases(1)						
M2 decreases(1)						
M3 no change(1)						

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Question	Answer	Marks	Guidance
7(a)(i)	compound(s) containing hydrogen and carbon only	1	ALLOW (compound(s) or molecule(s) containing hydrogen / H and carbon / C only ALLOW purely / solely / exclusively / just as alternatives to only ALLOW hydrogen / carbon identified as atoms or elements e.g. compound only containing carbon and hydrogen atoms scores 1 REJECT carbon and / or hydrogen identified as molecules REJECT hydrocarbons identified as mixtures / elements / atoms REJECT contain only carbon and / or hydrogen bonds REJECT additional incorrect phrases e.g. contains single bonds
7(a)(ii)	any two from (same) chemical properties (same) functional group (same) general formula	2	CON can be used once or twice ONLY if more than two answers are given ALLOW characteristic(s) or reaction(s) as alternatives to properties ALLOW similar chemical properties ALLOW the reactive part of the molecule or compound or substance as alternatives to functional group ALLOW function / functioning as alternatives to functional ALLOW functional group has same structure / functional group has same bonds ALLOW share or belongs to (the same) functional group ALLOW (same or similar) chemical behaviour REJECT similar functional group / same physical properties REJECT same general molecular formula
7(a)(iii)	C ₁₀ H ₂₂	1	Subscripts must be smaller than symbols

Question	Answer	Marks	Guidance
7(b)(i)	needs or uses light	1	ALLOW needs or uses: UV/ ultra violet / sunlight / light / infra-red / UV energy ALLOW suitable equivalents to needs or uses e.g. absorbs REJECT produces UV / produces ultra violet (light) REJECT catalyst / lowers E _a
7(b)(ii)	M1 displayed formula of 1-chloropropane e.g. <pre> H H H H — C — C — C — Cl H H H </pre> (1) M2 displayed formula of 2-chloropropane e.g. <pre> H H H H — C — C — C — H H Cl H </pre> (1)	2	If 3 displayed formulas are attempted and one or two are repeats of the same isomer, candidates can only score a maximum of 1 mark If 4 displayed formulas are attempted 0 marks for the question REJECT lower case h
7(c)(i)	CH ₂	1	
7(c)(ii)	M1 but-1-ene(1) M2 but-2-ene(1) Names can be in any order	2	Only use CON if more than 2 answers are given REJECT butene / butan-1-ene / butan-2-ene

Question	Answer	Marks	Guidance
7(c)(iii)	M1 two carbon atoms joined by a single bond and an extension bond on either side  (1) M2 repeat unit  (1)	2	If the bond between the two carbon atoms is missing or shown as a multiple bond 0 marks for the question M1 The extension bonds will normally be drawn horizontally but can be vertical e.g. this gets both marks  M2 CH₃ can be at the end of any of the bonds CH₃ can be displayed If the CH₃ is undisplayed ignore connectivity errors i.e. ALLOW CH₃– and –CH₃ or –H₃C <u>SALVAGE MARK</u> - If both extension bonds are missing and there are no other errors award 1 salvage mark OR - If 2 or more repeating units are fully correct ALLOW 1 mark