



National  
Qualifications  
2019

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**2019 Chemistry**

**National 5**

**Finalised Marking Instructions**

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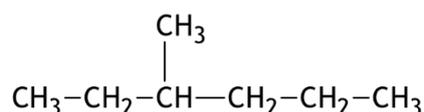
## General marking principles for National 5 Chemistry

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.

- (a) Marks for each candidate response must always be assigned in line with these general marking principles and the detailed marking instructions for this assessment.
- (b) If a specific candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.
- (c) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

A guiding principle in marking is to give credit for correct chemistry rather than to look for reasons not to award marks.

**Example 1:** The structure of a hydrocarbon found in petrol is shown below.



Name the hydrocarbon.

Although the punctuation is not correct, '3, methyl-hexane' should gain the mark.

**Example 2:** A student measured the pH of four carboxylic acids to find out how their strength is related to the number of chlorine atoms in the molecule.

The results are shown in the table.

<i>Structural formula</i>	<i>pH</i>
CH <sub>3</sub> COOH	1.65
CH <sub>2</sub> ClCOOH	1.27
CHCl <sub>2</sub> COOH	0.90
CCl <sub>3</sub> COOH	0.51

State how the strength of the acids is related to the number of chlorine atoms in the molecule.

Although not completely correct, an answer such as 'the more Cl<sub>2</sub>, the stronger the acid' should gain the mark.

- (d) There are no half marks awarded.
- (e) Candidates must respond to the 'command' word as appropriate and may be required to write extended answers in order to communicate fully their knowledge and understanding.

- (f) Marks should be awarded for answers that have incorrect spelling or loose language **as long as the meaning of the word(s) is conveyed**. **Example:** Answers like ‘distilling’ (for ‘distillation’) and ‘it gets hotter’ (for ‘the temperature rises’) should be accepted.

However, the example below would not be given any credit, as an incorrect chemical term, which the candidate should know, has been given.

**Example:** If the correct answer is ‘ethene’, and the candidate’s answer is ‘ethane’, this should not be accepted.

- (g) A correct answer followed by a wrong answer should be treated as a cancelling error and no marks should be awarded.

**Example:** State what colour is seen when blue Fehling’s solution is warmed with an aldehyde.

The answer ‘red, green’ gains no marks.

If a correct answer is followed by additional information which does not conflict, the additional information should be ignored, whether correct or not.

**Example:** State why the tube cannot be made of copper.

If the correct answer is related to a low melting point, ‘Copper has a low melting point and is coloured grey’ would not be treated as having a cancelling error.

- (h) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units if required) on its own.

The partial marks shown in the marking scheme are for use when working is given but the final answer is incorrect. An exception is when candidates are asked to ‘Find, by calculation’, when full marks cannot be awarded for the correct answer without working.

- (i) In most questions units are not required. However, if the candidate writes units then they must be correct. An incorrect unit would not be acceptable and one mark would not be awarded.

This marking instruction must only be applied a maximum of once per paper.

- (j) Where the marking instructions specifically allocate a mark for units in a calculation, this mark should not be awarded if the units are incorrect or missing. Missing or incorrect units at intermediate stages in a calculation should be ignored.

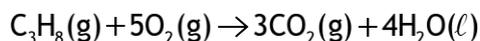
- (k) As a general rule, where a wrong numerical answer (already penalised) is carried forward to another step, credit will be given provided the result is used correctly. The exception to this rule is where the marking instructions for a numerical question assign separate ‘concept marks’ and an ‘arithmetic mark’. In such situations, the marking instructions will give clear guidance on the assignment of partial marks.

- (l) Ignore the omission of one H atom from a full structural formula provided the bond is shown or one carbon to hydrogen bond missing provided the hydrogen is shown.

- (m) A symbol or correct formula should be accepted in place of a name **unless stated otherwise in the marking instructions**.

- (n) When formulae of ionic compounds are given as answers it will only be necessary to show ion charges if these have been specifically asked for. However, if ion charges are shown, they must be correct. If incorrect charges are shown, no marks should be awarded.
- (o) If an answer comes directly from the text of the question, no marks should be awarded.

**Example:** A student found that 0.05 mol of propane, C<sub>3</sub>H<sub>8</sub> burned to give 82.4 kJ of energy.



Name the type of enthalpy change which the student measured.

No marks should be awarded for 'burning' since the word 'burned' appears in the text.

- (p) Unless the question is clearly about a non-chemistry issue, eg costs in industrial chemical process, a non-chemical answer gains no marks.

**Example:** Suggest why the (catalytic) converter has a honeycomb structure.

A response such as 'to make it work' may be correct but it is not a chemical answer and the mark should not be awarded.

### Marking instructions for each question

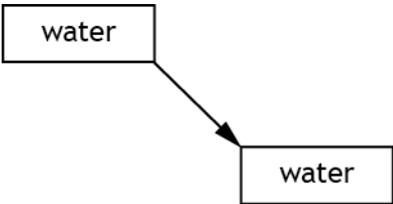
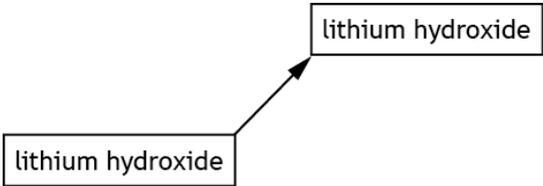
Question	Answer	Mark
1.	C	1
2.	B	1
3.	C	1
4.	D	1
5.	B	1
6.	D	1
7.	A	1
8.	B	1
9.	A	1
10.	B	1
11.	D	1
12.	A	1
13.	D	1
14.	C	1
15.	A	1
16.	B	1
17.	B	1
18.	D	1
19.	C	1
20.	C	1
21.	C	1
22.	A	1
23.	D	1
24.	C	1
25.	B	1

## Section 2

Question		Expected response	Max mark	Additional guidance
1.	(a)	(Covalent) Network	1	Award zero marks for - covalent on its own.
	(b)	(i)	1	
		(ii)	1	Award zero marks for -different mass in the nucleus -different number of particles in the nucleus
		(iii)	1	
	(c)	120 (g)	1	Unit is not required however zero marks are awarded for the correct value with an incorrect unit.  This marking instruction must only be applied a maximum of once per paper.
2.	(a)	Hydroxyl	1	Award zero marks for - OH however this does not negate the correct answer.
	(b)	Enzyme	1	Accept (Biological) Catalyst.
	(c)	Calcium oxalate	1	
	(d)	90 (g)	1	Unit is not required however zero marks are awarded for the correct value with an incorrect unit.  This marking instruction must only be applied a maximum of once per paper.

Question		Expected response	Max mark	Additional guidance		
3.	(a)	<p>Must show all outer electrons</p>	1	<p>Accept cross or dot or e or e- to represent electrons or a mixture of these.</p> <p>Accept petal diagram.</p> <p>Bonding electrons <b>MUST</b> be on the line or in the overlapping area.</p> <p>Element symbols do not need to be shown.</p> <p>If inner electrons are shown they must be correct.</p>		
	(b)	Blue/purple	1	Any colour that clearly represents an alkaline pH is acceptable.		
	(c)	(i)		<p>As the temperature increases yield/% decreases.</p> <p>As the temperature decreases the yield/% increases.</p> <p>The yield/% increases as the temperature decreases.</p> <p>The yield/% decreases as the temperature increases.</p>	1	Award zero marks for wrong cause and effect eg as yield of ammonia decreases, temperature gets higher etc.

Question			Expected response	Max mark	Additional guidance
3.	(c)	(ii)	<p>For appropriate format: points (not bars) (1 mark)</p> <p>The axis/axes of the graph has/have suitable scale(s). For the graph paper provided within the question paper, the selection of suitable scales will result in a graph that occupies at least half of the width and half of the height of the graph paper (1 mark)</p> <p>The axes of the graph have suitable labels and units (1 mark)</p> <p>All data points plotted accurately with a line of best fit (smooth curve/straight line) drawn. (1 mark)</p>	4	<p>Where the candidate has drawn a bar graph the format mark is not awarded, but the remaining three marks can still be accessed.</p> <p>For bar graphs, this mark is awarded for the selection of a suitable scale for percentage yield of ammonia only.</p> <p>Spelling mistakes or the use of abbreviations should not be penalised if the meaning of an axis label may be clearly understood.</p> <p>Where the candidate has drawn a bar graph, the mark for accurate plotting can be awarded if the heights of bars are plotted accurately but in this case no line of best fit should be used.</p> <p>If the scale is non-linear then the mark for accurate plotting can only be accessed if the error occurs out with the data-set.</p>
	(d)	(i)	<p>Electrolysis and lithium nitride Both required for (1 mark)</p>	1	

Question	Expected response	Max mark	Additional guidance
(ii)	<p>Arrow from water at top to water at bottom OR to the vertical line beneath the 'lithium nitride' box.</p>  <p>OR</p> <p>Arrow from lithium hydroxide at bottom to lithium hydroxide OR heat at top OR to the vertical line between lithium hydroxide and heat.</p> 	1	<p>Direction of arrow must be shown.</p> <p>Arrow to "molten lithium hydroxide" or the vertical line between "heat" and "molten lithium hydroxide" is awarded zero marks.</p>

Question		Expected response	Max mark	Additional guidance
4.	(a)	Nucleus	1	
	(b)	(i)	1	Radiation acceptable in place of radioactivity.  Any mention of reactivity - zero marks.
		(ii)	3	
		<p>87.5% / 0.875 / <math>\frac{7}{8}</math> (3 marks)</p> <p>-----</p> <p>Partial marking 3 half-lives (1 mark)</p> <p>OR</p> <p>Correct percentage or fraction left for a correct number of half-lives. (2 mark)</p> <p>OR</p> <p>Correct percentage or fraction left for an incorrect number of half-lives. Working must be shown. (1 mark)</p> <p>OR</p> <p>Correct percentage or fraction decayed with incorrect number of half-lives. Working must be shown. (2 marks)</p>		<p>If a candidate does not demonstrate the application of half-lives they cannot access the final mark for calculating the percentage/fraction decayed.</p> <p>eg  <math>\frac{8}{24} \times 100 = 33.3\%</math>  <math>100 - 33.3 = 66.7\%</math>            Zero marks.</p>
		(iii)	1	
		<p>When an iodine-131 solution is diluted,</p> <p>the half-life <math>\left\{ \begin{array}{l} \text{gets longer} \\ \text{stays the same} \\ \text{gets shorter} \end{array} \right\}</math></p>		

Question		Expected response	Max mark	Additional guidance	
5.	(a)	Bromine/Br <sub>2</sub> decolourised  OR  bromine/Br <sub>2</sub> goes colourless	1	Accept bromine/bromine water/bromine solution but do not accept bromide or Br.  Zero marks awarded for 'goes clear' however if given in addition to a correct answer it does not negate.  If starting colour is given it must be correct eg orange/yellow/red-brown or brown.  If candidate states correct answer followed by incorrect statement such as because it has a carbon to carbon single bond zero marks are awarded.	
	(b)	(i)	Hydrogenation	1	
		(ii)	Chlorine/Cl <sub>2</sub>	1	Award zero marks for Cl or chloride
		(iii)	Polypropene/Poly(propene)	1	Accept polypropylene

Question			Expected response	Max mark	Additional guidance
5.	(c)	(i)	<p>140 (g) <span style="float: right;">(3 marks)</span></p> <p>-----</p> <p>Partial marks</p> <p>Both GFMs ie 28 and 82 <span style="float: right;">(1 mark)</span></p> <p><b>OR</b></p> <p>Moles of cyclohexene ie <math>(410 \div 82) = 5 \text{ mol}</math> <span style="float: right;">(1 mark)</span></p> <p>-----</p> <p>1 concept mark for either:</p> $410 \times \frac{\text{Candidate's GFM of ethene}}{\text{Candidate's GFM of cyclohexene}}$ <p style="text-align: right;">(1 mark)</p> <p><b>OR</b></p> <p>Moles of cyclohexene <math>\times</math> Candidate's GFM of ethene <span style="float: right;">(1 mark)</span></p> <p>Where the candidate has been awarded either concept mark, a further mark can be awarded for correct follow through to a final answer <span style="float: right;">(1 mark)</span></p>	3	<p>Rounding in intermediate steps does not negate the award of 3 marks but working must be shown.</p> <p>No units required but a maximum of two marks can be awarded if an incorrect unit is given. This marking instruction must only be applied a maximum of once per paper.</p> <p><b>Award zero marks if the candidate's working does not use cyclohexene.</b></p> <p>A maximum of two marks can be awarded where the candidate has carried out the calculation using <b>cyclohexene</b> and butadiene provided working is shown.</p> <p>An incorrect GFM, with no working shown, cannot be used to gain the concept mark and therefore arithmetical follow through cannot be accessed.</p>

Question			Expected response	Max mark	Additional guidance
5.	(c)	(ii)	<p>(Cyclopentene) has smaller/weaker/less forces (of attraction) <b>(1 mark)</b></p> <p>Between molecules or mention of intermolecular attractions <b>(1 mark)</b></p> <p>If neither of these two points are given, a maximum of 1 mark can be awarded for - cyclopentene is smaller/has fewer carbons or hydrogens or atoms/smaller carbon chain</p>	<b>2</b>	<p>The term bond is only acceptable if it is specifically identified as between the molecules or used with the term intermolecular.</p> <p>Mention of breaking:</p> <ul style="list-style-type: none"> <li>- (more) bonds</li> <li>- bonds within molecule/chain</li> <li>- carbon to carbon bonds</li> <li>- carbon to hydrogen bonds</li> </ul> <p>cannot gain the second mark but does not negate the first mark.</p> <p>Fewer bonds in the compound is not sufficient to imply a smaller molecule but does not negate.</p> <p>Candidates can be awarded the full/partial-marks if they explain why the cyclohexene has a higher boiling point. It must be clear from the candidate's response that they are referring to cyclohexene.</p>

Question		Expected response	Max mark	Additional guidance
6.		<p>This is an open ended question</p> <p><b>1 mark:</b> The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) that is/are relevant to the situation, showing that at least a little of the chemistry within the context is understood.</p> <p><b>2 marks:</b> The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) that is/are relevant to the situation, showing that the context is understood.</p> <p><b>3 marks:</b> The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the context. This does not mean the answer has to be what might be termed an “excellent” answer or a “complete” one.</p>	3	

Question		Expected response	Max mark	Additional guidance
7.	(a)	They have the same general formula <b>AND</b> similar/same chemical properties  Both required for (1 mark)	1	Award zero marks for - molecular formula - structural formula - chemical formula  Award zero marks for - physical properties in place of chemical properties however, it does not negate if given in addition to chemical properties.
	(b)	(i) Alkane	1	
		(ii) C <sub>35</sub> H <sub>72</sub>	1	Numbers must be smaller than symbol or subscript Symbols must be correct Zero marks awarded for: C35 H72 C <sub>35</sub> H <sub>72</sub> C35 h72 c35 h72
	(c)	Accept 391 to 394 inclusive.	1	Unit is not required; however zero marks are awarded for the correct value with an incorrect unit.  This marking instruction must only be applied a maximum of once per paper.
8.	(a)	Supernova (explosions)	1	
	(b)	Beryllium, aluminium, silicon and oxygen Be/Al/Si/O  All 4 required for (1 mark)	1	Accept O <sub>2</sub> and loose spelling of element names.
	(c)	BeCl <sub>2</sub> + K $\longrightarrow$ Be + KCl	1	Equation does not need to be balanced but if balanced it must be correct: BeCl <sub>2</sub> + 2K $\rightarrow$ Be + 2KCl
	(d)	Reduction	1	Redox not acceptable
	(e)	${}^1_0\text{n}$	1	Do not accept ${}^1_0\text{N}$ , ${}^1\text{n}$ ${}^1\text{neutron}$

Question		Expected response	Max mark	Additional guidance
9.	(a)	Exothermic/exothermal	1	Do not accept combustion.
	(b)	(i) 0.05 (kg) <b>(3 marks)</b> ----- Partial marking Using the correct concept of $m = \frac{E_h}{c\Delta T}$ with $c=4.18$ <b>(1 mark)</b> (To be awarded this concept mark candidates do not have to specifically write $m = \frac{E_h}{c\Delta T}$ .)  For values 8.36 and 40 <b>(1 mark)</b>  A further mark can be awarded for arithmetical follow through to the candidate's answer <b>only if the mark for the concept has been awarded.</b> <b>(1 mark)</b>	3	No units required but a maximum of two marks can be awarded if an incorrect unit is given. This marking instruction must only be applied a maximum of once per paper.  8360 and 4180 can be used to together in the calculation.  8360 and 40 can be awarded one mark provided $c = 4180$ .
		(ii) Copper can: copper is a better conductor (of heat) (than glass) <b>(1 mark)</b>  Heat shield: prevent/less heat loss (to the surroundings) or insulate the experiment. <b>(1 mark)</b>	2	These two marks are independent of each other.  A comparison of energy transfer to the water must be made however zero marks are awarded for a comparison in terms of easier/quicker/faster.  Link must be made to heat/energy.
	(c)	(i) If the OH/functional group is at the end/start/carbon number 1 (of the alcohol), an aldehyde is produced. <b>OR</b> If the OH/functional group is not at the end/in the middle (of an alcohol), a ketone is produced.	1	
		(ii) $  \begin{array}{ccccccc}  & \text{H} & \text{H} & \text{H} & \text{H} & & \text{O} \\  &   &   &   &   & & // \\  \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - & \text{C} \\  &   &   &   &   & & \backslash \\  & \text{H} & \text{H} & \text{H} & \text{H} & & \text{H}  \end{array}  $	1	

Question		Expected response	Max mark	Additional guidance	
10.	(a)		Ion bridge/salt bridge	1	
	(b)	(i)	From right to left either on the wire or nearer the wire/voltmeter than the ion-bridge.	1	Zero marks awarded if <ul style="list-style-type: none"> <li>- arrow goes into solution</li> <li>- arrow is drawn on wire and ion bridge</li> <li>- arrow is drawn closer to the ion bridge than the wire/voltmeter</li> </ul>
		(ii)	Oxidation	1	
		(iii)	$2\text{Fe}^{3+} + 2\text{I}^{-} \rightarrow 2\text{Fe}^{2+} + \text{I}_2$	1	Accept correct multiples.  Zero marks awarded for -electrons shown in the equation, unless clearly scored out.  State symbols are not required and should be ignored.
	(c)		Conducts (electricity)	1	Additional correct properties do not negate.  Accept a correct description of electrical conductivity eg electrons free to move or has delocalised electrons.

Question		Expected response	Max mark	Additional guidance
11.	(a)	$\text{Ca}^{2+}\text{CO}_3^{2-}$	1	
	(b)	Propanoic acid.	1	Accept propanoic or propionic acid.
	(c)	<p>until...</p> <p>no more solid reacts/until it no longer reacts</p> <p>solid remains/is left (at the bottom of the beaker)</p> <p>a gas is no longer produced no more fizzing/bubbling</p> <p>no more calcium carbonate reacts/ calcium carbonate left (at the bottom)</p> <p>neutral/neutralised <b>with a description of testing pH.</b></p>	1	<p>Award zero marks for</p> <ul style="list-style-type: none"> <li>- any mention of dissolving</li> <li>- saturated solution</li> </ul> <p>neutral/neutralised on its own - zero marks.</p>
	(d)	<p>1<sup>st</sup> technique - Filtration</p> <p>2<sup>nd</sup> technique - Evaporation</p> <p>Both required in correct order for one mark.</p>	1	<p>Accept a correct description of filtration.</p> <p>Do not accept 'use filter paper' on its own as a description of filtration.</p> <p>Accept heat it/warm it/boil it/leave by a window/leave for some time/ distillation.</p> <p>The term 'dry' for the 2<sup>nd</sup> technique is awarded zero marks but does not negate a correct answer.</p>

Question			Expected response	Max mark	Additional guidance
12.	(a)	(i)	Standard (solution)	1	
		(ii)	<p>21.2 or 21 (g) <b>(3 marks)</b></p> <hr/> <p>Partial Marks can be awarded for a maximum of two of the following three steps:</p> <p>1 mark for correctly calculating the number of moles of sodium carbonate.</p> <p>ie <math>n = CV = 1 \times 0.2 = 0.2 \text{ mol}</math> <b>(1 mark)</b></p> <p>1 mark for correctly calculating the GFM of sodium carbonate</p> <p>ie <math>GFM = 106</math> <b>(1 mark)</b></p> <p>1 mark for calculating the mass of sodium carbonate</p> <p>ie <math>m = n \times GFM</math> using candidates calculated moles of sodium carbonate and candidates calculated GFM <b>(1 mark)</b></p>	3	<p>No units required but a maximum of two marks can be awarded if an incorrect unit is given. This marking instruction must only be applied a maximum of once per paper.</p> <p><b>An incorrect number of moles or GFM of sodium carbonate must be supported by working.</b></p>
	(b)	(i)	<p>Any from:</p> <p>Move burette/sodium carbonate (reading) to eye level.</p> <p>Reduce distance between flask and burette</p> <p>Use white tile/paper</p> <p>Clamp the burette towards the centre.</p>	1	Award zero marks for - repeat the experiment
		(ii)	To show the end-point/point of neutralisation/completion of the reaction	1	
		(iii)	Concordant	1	

Question			Expected response	Max mark	Additional guidance
12.	(b)	(iv)	<p>1.5 (mol l<sup>-1</sup>) (3 marks)</p> <p>-----</p> <p><b>Partial marks can be awarded for a maximum of two of the following three steps:</b></p> <p><b><u>Method A</u></b></p> <p>1 mark for the correct number of moles of sodium carbonate. ie <math>n = CV = 1 \times 0.015 = 0.015</math> mol (1 mark)</p> <p>1 mark for calculating the moles of hydrochloric acid by correctly applying the molar ratio ie 2 x candidate's calculated number of moles of Na<sub>2</sub>CO<sub>3</sub> (1 mark)</p> <p>0.03 mol HCl on its own (2 marks)</p> <p>1 mark for calculating the concentration of the hydrochloric acid. ie <math>C = n/V</math> using candidate's calculated number of moles of HCl and 0.02 (1 mark)</p> <p>-----</p> <p><b><u>Method B</u></b></p> <p><math>\frac{C_1 \times 20}{2} = \frac{1 \times 15}{1}</math> (1 mark) (1 mark)</p> <p><math>C_1 \times 20 = 30</math> or <math>C_1 \times 10 = 15</math> (this step on its own gets 2 marks)</p> <p><b>Or</b></p> <p><math>\frac{C_1 \times 0.02}{2} = \frac{1 \times 0.015}{1}</math> (1 mark) (1 mark)</p> <p><math>C_1 \times 0.02 = 0.03</math> (this step on its own gets 2 marks)</p>	3	<p>No units required but a maximum of two marks can be awarded if an incorrect unit is given. This marking instruction must only be applied a maximum of once per paper.</p> <p>Accept mol l<sup>-1</sup> or mol/l but not mol/l<sup>-1</sup> or mol<sup>-1</sup> or mol l</p> <p><b>Award zero marks if the candidate's working makes it clear that they have not used sodium carbonate.</b></p> <p>If candidate does not attempt to calculate the number of moles of Na<sub>2</sub>CO<sub>3</sub> then partial marks can be awarded for applying the molar ratio using 1 mol of sodium carbonate requires 2 moles of hydrochloric acid and/or using 2 moles of hydrochloric acid and V=0.02. ie 1:2 (1 mark) 2/0.02 = 100 (1 mark)</p> <p>For method B using relationship shown in the data book</p> <p>1 mark is awarded for the correct pairings of volume (in the same unit) and concentration. 1 mark is awarded for the correct mole ratio <b>being applied</b>.</p> <p>1 mark is awarded for the correct arithmetic. This mark can only be awarded if an appropriate method has been used.</p>

Question	Expected response	Max mark	Additional guidance
13.	<p><b>1 mark:</b> The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) that is/are relevant to the situation, showing that at least a little of the chemistry within the context is understood.</p> <p><b>2 marks:</b> The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) that is/are relevant to the situation, showing that the context is understood.</p> <p><b>3 marks:</b> The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the context. This does not mean the answer has to be what might be termed an “excellent” answer or a “complete” one.</p>	3	

[END OF MARKING INSTRUCTIONS]