

# **Markscheme**

**November 2021**








**Chemistry**








**On-screen examination**

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

The following are the annotations available to use when marking responses.

Annotation	Explanation
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.
	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Horizontal wavy line that can be expanded
	Highlight tool that can be expanded to mark an area of a response

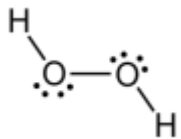

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Test box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

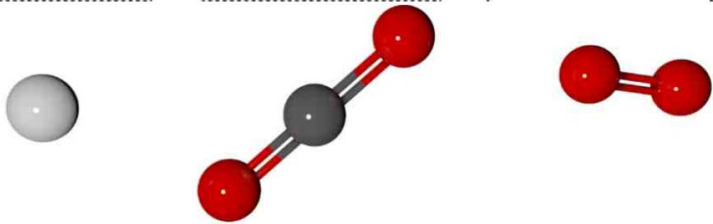
### Markscheme instructions

- 1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.
- 2 Follow the markscheme provided and award only whole marks.
- 3 Each marking point appears on a separate line.
- 4 The maximum mark for each subpart is indicated in the “Total” column.
- 5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.
- 6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.
- 7 A question subpart may have more marking points than the total allows. This will be indicated by the word “***max***” in the Answer column. Further guidance may be given in the Notes column.
- 8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.
- 9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 10 Alternative answers are indicated in the Answer column by “***or***”. Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.
- 11 If two related points are required to award a mark, this is indicated by “***and***” in the answer column.
- 12 Words in brackets ( ) in the Answer column are not necessary to gain the mark.
- 13 Words that are underlined are essential for the mark.
- 14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA (or reverse argument)* in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.
- 15 If the candidate’s response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE (or words to that effect)* in the Notes column.

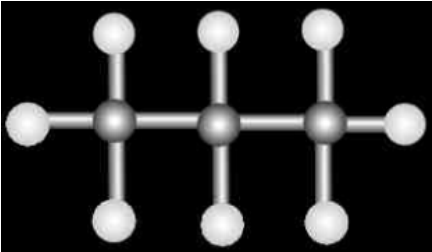
- 16** When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.
- 17** The order of marking points does not have to be the same as in the Answer column unless stated otherwise.
- 18** Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.
- 19** Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.
- 20** Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question		Answers	Notes	Total	Crit
1	a	CaCO <sub>3</sub>		1	A
	b	Group 1 Period 3		2	A
	c	2.7 <i>or</i> 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>5</sup> <i>or</i> K <sup>2</sup> L <sup>7</sup>		1	A
	d	less energy to remove the electron <i>or</i> the electron is easier to remove (because) outermost electron is further away from nucleus  <i>or</i> (because there is) less attraction from the nucleus (because there are) more electron shells/levels in sodium	ORA          <i>WTTE accept larger size</i>	3	A

2	a	covalent		1	A
	b	 C		1	A
	c	$2\text{H}_2\text{O}_2 (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + \text{O}_2(\text{g})$ formulae of products correct with superscripts correct correctly balanced state symbols correct	Accept any correctly balanced equivalent  Accept aqueous or liquid for $\text{H}_2\text{O}_2$	3	D
	d	 D		1	A
	e	more (hydrogen peroxide) particles are present at higher concentrations (hence) there are more successful collisions with stain particles (so) the teeth are being whitened more quickly <b>or</b> rate of reaction is faster	WTTE  ORA	3	A

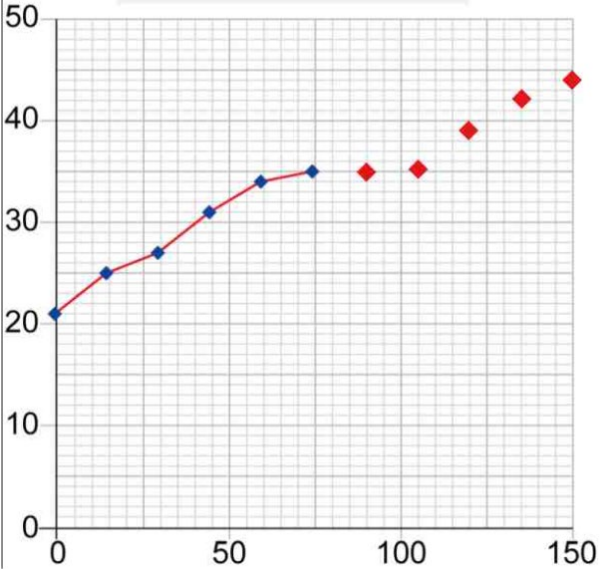
3	a	nitrogen <b>and</b> 78% oxygen <b>and</b> 20.9%	Accept in either order	2	C
	b	<div> <div>Monatomic gas</div> <div>Polyatomic gas</div> <div>Diatomic gas</div>  <div>Helium</div> <div>Carbon dioxide</div> <div>Oxygen</div> </div> <p>Correct row above or below the model</p> <p>Correct pairing and correct structure</p> <p>All correct</p>		3	A
	c	(noble gases are) unreactive <b>or</b> inert <b>or</b> have full outer shells (of electrons) <b>or</b> they don't share electrons with other atoms		1	A
	d	12 <b>and</b> 35.5 <b>and</b> 19 seen <b>or</b> correct method for calculation of RMM  correctly calculated 187.5	Ignore mass units if present, answer alone scores 2 marks	2	A



	<b>e</b>	<p>scent or deodorant (particles) move</p> <p>diffuse or move until equally spread out more quickly</p> <p>higher temperatures mean that the <u>particles</u> move faster</p> <p><i>or</i></p> <p>higher temperatures mean that the kinetic energy of the <u>particles</u> is greater</p>	ORA	3	A
	<b>f</b>			1	A

4	a	28.1 (°C)		1	C
	b	29.7 (°C)		1	C
	c	Student B <b>and</b> measured T when all of gallium had melted <b>or</b> Student B <b>and</b> the change of state had occurred  (and) the temperature was steady	<i>Do not accept ref to equipment, do not accept ref to more than one measurement</i>	2	C
	d	(as the % of zinc increases, the melting point) decreases	ORA	1	C
	e	(if) the percentage of zinc increases in an alloy  (then) the density of that alloy will decrease  (because) zinc has a lower density than copper		3	B
	f	1000 ± 10  °C		2	C
	g	Type A  the melting point is 1066 (°C ) so it will not melt <b>or</b> has a melting point that is above 1050 (°C)		2	C

5	a	Carbon dioxide <b>or</b> CO <sub>2</sub>		1	A
	b	<b>Independent variable:</b> (type of) solute  <b>Dependent variable:</b> <u>freezing point</u> <b>or</b> <u>freezing temperature</u>	WTTE  <i>Do not accept melting point</i>	2	B
	c	<b>Any two reasonable control variables, for example [max 2]:</b> <ul style="list-style-type: none"> <li>• volume / size of ice cube</li> <li>• amount/mass/concentration of solute</li> <li>• temperature of freezer</li> <li>• (shape /material of) container</li> <li>• starting temperature (of solution)</li> <li>• time</li> </ul>		2	B
	d	how does the (IV from 5b) of solute  affect the freezing point / temperature of the solution	ECF from incorrect IV in 5b	2	B

6	a	 <p>two data points plotted correctly</p> <p>all data point plotted correctly</p> <p>title links temperature change with time</p> <p>X axis label: time <b>and</b> s</p> <p>Y axis label: temperature <b>and</b> °C</p>		5	C
	b	<p>B because the graph shows a steady plateau at 35 °C</p> <p>this is the melting point/temperature of Form V</p>		2	C

	<b>c</b>	evidence of a calculation of an average  36.6(6666...)  36.7	<i>Does not have to be correct answer for this first mark</i>  <i>Award two marks if only 36.6 is shown</i>  <i>Award three marks if only 36.7 is shown</i>	<b>3</b>	C
	<b>d</b>	43±0.5  °C		<b>2</b>	C
	<b>e</b>	<b><i>Any reasonable suggestion, for example [max 1]:</i></b> <ul style="list-style-type: none"> <li>• melting point not measured correctly</li> <li>• incorrect % of cocoa used</li> <li>• not all of the sample was melted</li> <li>• water bath was at incorrect temperature</li> <li>•</li> </ul>		<b>1</b>	C
	<b>f</b>	investigate samples with intermediate % between 30 and 60		<b>1</b>	C

<b>7</b>	<b>a</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		15	B
		<b>1.V (Variables)</b>	either independent <b>or</b> dependent variable is identified	independent <b>and</b> dependent variables are identified					
		<b>2.CV (Control variables)</b>	one control variable is stated	two control variables are stated					
		<b>3.E (Equipment)</b>	equipment to measure temperature <b>or</b> equipment to monitor one CV	equipment to measure temperature <b>and</b> equipment to monitor one CV					
		<b>4. Meth (Method)</b>	<ul style="list-style-type: none"> <li>put chocolate in boiling tube and measure melting temperature</li> </ul>	<ul style="list-style-type: none"> <li>put chocolate in boiling tube and measure melting temperature</li> <li>all samples are measured</li> </ul>	<ul style="list-style-type: none"> <li>put chocolate in boiling tube and measure melting temperature</li> <li>all samples are measured</li> <li>all samples are same size/mass</li> </ul>	<ul style="list-style-type: none"> <li>put chocolate in boiling tube and measure melting temperature</li> <li>all samples are measured</li> <li>all samples are same size/mass</li> <li>heat until temperature is stable</li> </ul>			
		<b>5. D (Sufficient data)</b>	at least three trials for one chocolate	at least three trials for all chocolates	at least three trials for all chocolates <b>and</b> plans to calculate average				
		<b>6. S (Safety)</b>	a safety precaution is mentioned	a safety precaution is mentioned linked to a specific named hazard					

8	a	Li <sup>+</sup>			Accept no superscript Do not accept Li <sup>1+</sup> or Li <sup>+1</sup>	1	A																			
	b	1714.28 (moles)			Award 1 mark for 1.7	2	C D																			
		1714.3 (to 1 dp)																								
	c	<table><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Env (Environmental)</td><td>comment about lithium-ion batteries <b>or</b> crude oil</td><td>comment about lithium-ion batteries <b>and</b> crude oil</td><td>statement of advantage <b>and</b> disadvantage for lithium-ion <b>or</b> petrol  <b>or</b> statement of advantage <b>or</b> disadvantage for lithium-ion <b>and</b> petrol</td><td>statement of advantage <b>and</b> disadvantage of lithium-ion <b>and</b> crude oil</td></tr><tr><td>Soc (Social impacts)</td><td>a social impact of lithium-ion batteries <b>or</b> crude oil</td><td>a social impact of lithium-ion batteries <b>and</b> crude oil</td><td>a social impact of lithium-ion batteries <b>and</b> crude oil <b>and</b> an additional impact of either</td><td></td></tr><tr><td>App (Appraisal)</td><td>a choice is stated</td><td>a choice is stated with further justification</td><td></td><td></td></tr></table>					1	2	3	4	Env (Environmental)	comment about lithium-ion batteries <b>or</b> crude oil	comment about lithium-ion batteries <b>and</b> crude oil	statement of advantage <b>and</b> disadvantage for lithium-ion <b>or</b> petrol  <b>or</b> statement of advantage <b>or</b> disadvantage for lithium-ion <b>and</b> petrol	statement of advantage <b>and</b> disadvantage of lithium-ion <b>and</b> crude oil	Soc (Social impacts)	a social impact of lithium-ion batteries <b>or</b> crude oil	a social impact of lithium-ion batteries <b>and</b> crude oil	a social impact of lithium-ion batteries <b>and</b> crude oil <b>and</b> an additional impact of either		App (Appraisal)	a choice is stated	a choice is stated with further justification			9
	1	2	3	4																						
Env (Environmental)	comment about lithium-ion batteries <b>or</b> crude oil	comment about lithium-ion batteries <b>and</b> crude oil	statement of advantage <b>and</b> disadvantage for lithium-ion <b>or</b> petrol  <b>or</b> statement of advantage <b>or</b> disadvantage for lithium-ion <b>and</b> petrol	statement of advantage <b>and</b> disadvantage of lithium-ion <b>and</b> crude oil																						
Soc (Social impacts)	a social impact of lithium-ion batteries <b>or</b> crude oil	a social impact of lithium-ion batteries <b>and</b> crude oil	a social impact of lithium-ion batteries <b>and</b> crude oil <b>and</b> an additional impact of either																							
App (Appraisal)	a choice is stated	a choice is stated with further justification																								

9						12	D	
			1	2	3			4
		Economic aspects	a comment about an economic impact	a statement about an economic impact linked to the linear economy <b>or</b> the circular economy	a statement about an economic impact linked to the linear economy <b>or</b> the circular economy with justification			a statement about an economic impact linked to the linear economy <b>and</b> the circular economy with justification
		Use of resources	a comment about use of resources	a statement about use of resources linked to the linear economy <b>or</b> the circular economy	a statement about use of resources linked to the linear economy <b>or</b> the circular economy with justification			a statement about use of resources linked to the linear economy <b>and</b> the circular economy with justification
		Social impacts	a comment about a social impact	a statement about social impacts linked to the linear economy <b>or</b> the circular economy	a statement about social impacts linked to the linear economy <b>and</b> the circular economy			
		A concluding appraisal	a concluding appraisal is given					