

Markscheme

May 2018

Chemistry

On-screen examination

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

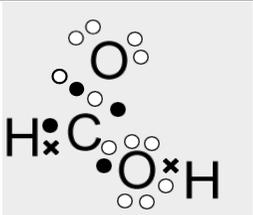
It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

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

Annotation	Explanation	Shortcut	Annotation	Explanation	Shortcut
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark	Alt+1		No benefit of the doubt	Alt+4
AEr	Arithmetic error		NEX	No explanation given	
	Benefit of the doubt	Alt+3		Not good enough	
	Omission, incomplete	Alt+7		Not worthy of any marks	
CON	Contradiction	Alt+6	NWS	No working shown	
	Valid part (to be used when more than one element is required to gain the mark)			Test box used for additional marking comments	
	Error carried forward	Alt+8		Unclear	Alt+2
	Dynamic annotation, it can be expanded to surround work			Seen; must be stamped on all blank response areas	Alt+9
	Horizontal wavy line that can be expanded			Vertical wavy line that can be expanded	
	Highlight tool that can be expanded to mark an area of a response			Words to that effect	
	Not answered the question			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* (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	Criterion
1	<p>a</p> <p style="text-align: center;">Group Period</p> <p>Carbon: <input type="text" value="4"/> <input type="text" value="2"/></p> <p>Hydrogen: <input type="text" value="1"/> <input type="text" value="1"/></p> <p>Oxygen: <input type="text" value="6"/> <input type="text" value="2"/></p>	<p><i>Award only 1 mark if groups and periods are interchanged</i></p> <p><i>Award 1 mark only if all groups are correct</i></p> <p><i>Award 1 mark only if all periods are correct</i></p>	3	A
	<p>b</p> <p>methanoic (acid)</p>		1	A
	<p>c</p>  <p>correct bonds shown or all lone pairs correct</p> <p>structure fully correct</p>	<p><i>Accept dots or crosses or any combination</i></p>	2	A
	<p>d</p> <p>$HCOOH(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HCOO^-(aq)$</p> <p>reactant(s) correct</p> <p>products correct</p> <p>states all correct</p> <p>correct use of equilibrium arrow</p>	<p><i>Allow</i></p> <p>$HCOOH(aq) \rightleftharpoons H^+(aq) + HCOO^-(aq)$</p> <p><i>Accept incorrect order for example, H₂CO₂, CHOOH</i></p> <p><i>Accept l for HCOOH</i></p> <p><i>Allow any double-headed arrow</i></p>	4	A
	<p>e</p> <p>add/react with a base/alkali</p>		1	A

C	<div style="background-color: #00a0c0; color: white; padding: 2px; margin-bottom: 5px;">Table Object</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Animal Part</th> <th colspan="3" style="text-align: left;">Volume of carbon dioxide produced (ml) when reacting to hydrochloric acid</th> </tr> <tr> <th></th> <th style="text-align: center;">Trial 1</th> <th style="text-align: center;">Trial 2</th> <th style="text-align: center;">Trial 3</th> </tr> </thead> <tbody> <tr><td>Elephant tooth</td><td></td><td></td><td></td></tr> <tr><td>Elephant bone</td><td></td><td></td><td></td></tr> <tr><td>Horse tooth</td><td></td><td></td><td></td></tr> <tr><td>Horse bone</td><td></td><td></td><td></td></tr> <tr><td>Human tooth</td><td></td><td></td><td></td></tr> <tr><td>Human bone</td><td></td><td></td><td></td></tr> <tr><td>Monkey tooth</td><td></td><td></td><td></td></tr> <tr><td>Monkey bone</td><td></td><td></td><td></td></tr> <tr><td>Dolphin tooth</td><td></td><td></td><td></td></tr> <tr><td>Dolphin Bone</td><td></td><td></td><td></td></tr> </tbody> </table>	Animal Part	Volume of carbon dioxide produced (ml) when reacting to hydrochloric acid				Trial 1	Trial 2	Trial 3	Elephant tooth				Elephant bone				Horse tooth				Horse bone				Human tooth				Human bone				Monkey tooth				Monkey bone				Dolphin tooth				Dolphin Bone				4	C
	Animal Part	Volume of carbon dioxide produced (ml) when reacting to hydrochloric acid																																																	
	Trial 1	Trial 2	Trial 3																																																
Elephant tooth																																																			
Elephant bone																																																			
Horse tooth																																																			
Horse bone																																																			
Human tooth																																																			
Human bone																																																			
Monkey tooth																																																			
Monkey bone																																																			
Dolphin tooth																																																			
Dolphin Bone																																																			
<p>indication of more than one trial</p> <p>column for independent variable: type of bone</p> <p>column for dependent variable: volume of CO₂</p> <p>unit for volume</p>	<p><i>ECF from part (b)</i></p> <p><i>Accept dm³ or cm³ or mL or ml or l or L for units</i></p>																																																		

	d	Allow ECF from part (b)			17	B		
			1	2			3	4
		Additional equipment (E)	Equipment suggested but is not relevant	Equipment to measure mass or volume or one control variable			Equipment to measure mass and volume and one control variable	Equipment to measure mass and volume and two control variables
		Method (M)	Attempt at a method but may not be relevant	Attempt at a method but detail is insufficient for another student to follow and is not likely to give relevant data			Method is described, could be followed by another student producing relevant data	Complete method is described, fully explained and could be repeated by another student
		Data (D)	Plans to test one type of tooth/bone	Plans to test each type of tooth/bone			Plans to use at least three samples of each type of tooth/bone	Plans to use at least three samples of each type of tooth/bone and calculates a mean
		Assumptions (A)	Assumptions that all bone/teeth/CaCO ₃ has reacted or temperature or pressure remain constant	Assumptions that all bone/teeth/CaCO ₃ has reacted and temperature or pressure remain constant			Assumptions that all bone/teeth/CaCO ₃ has reacted and temperature and pressure remain constant	
	Safety (S)	Use of relevant safety equipment	Use of relevant safety equipment linked to corrosive hazard from acid					
4	a	these points are outliers/anomalies or reason why an outlier was obtained		eg incorrect amount of CaCO ₃ was used, amount of CaCO ₃ was too high and too low	2	C		
		repeat		Do not accept interpolation				
	b	use of graph to give mass of 2.40 g		seen or implied	4	C		
		evidence of calculation of % by mass		ECF marking point 2				
		correct value of 24.7		ECF marking point 3 – do not award this mark alone				
		correct identification of horse bone						

5	a	Image 1: <input type="text" value="Corrosive"/> Image 2: <input type="text" value="Flammable"/> Image 3: <input type="text" value="Toxic"/>	Award 1 mark for each	3	B
	b	Image 1		1	B
	c	appropriate average = 56 (cm ³) it is not appropriate to include an outlier in the average	Award 1 mark only for inappropriate average of 60. Do not award 2 nd marking point even if justification is correct.	2	C
	d	Limestone = 1.33 ± 0.03 (cm ³ s ⁻¹) Crushed oyster shell = 0.28 ± 0.03 (cm ³ s ⁻¹)		2	C
	e	limestone particles are smaller than crushed oyster shell (so) rate of reaction is greater for limestone correct use of terms <u>surface area</u> and <u>rate of reaction</u>	ORA ORA	3	C D
	f	the crushed oyster shell takes longer to be broken down allowing more time for the hen to absorb or use the calcium carbonate for eggshell production	Accept "digest"	2	C
	g	limestone <u>data</u> is less reliable (because) greater variability in data between trials or poor consistency crushed oyster shell <u>data</u> is more reliable (because) data have good agreement or low variability or good consistency		4	C
	h	increase number of trials or use same size particles of limestone and oyster shell		1	C

6	a	A				1	A																			
	b	more than two compounds or mixtures of compounds can be separated boiling point (depends on size of molecules) or change in state from liquid to gas molecules with smallest mass or length will have the lowest boiling point				WTTE ORA	3 D																			
	c	<table border="1"> <thead> <tr> <th></th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Method (M)</td> <td>Comment about removal</td> <td>Comment about more than one method of removal</td> <td>Describes removal using all three methods</td> <td>Describes removal using all three methods linked to science Skimmer – oil and water are immiscible Burning – fumes, smoke Dispersion – components remain in water, affect aquatic life</td> </tr> <tr> <td>Advantages/disadvantages (AD)</td> <td>One advantage or disadvantage implied</td> <td>One advantage and one disadvantage for one method implied or One advantage or one disadvantage for more than one method implied</td> <td>Advantages and disadvantages identified for all three methods</td> <td></td> </tr> <tr> <td>Appraisal (A)</td> <td>“Best method identified” and supported by scientific evaluation</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					1	2	3	4	Method (M)	Comment about removal	Comment about more than one method of removal	Describes removal using all three methods	Describes removal using all three methods linked to science Skimmer – oil and water are immiscible Burning – fumes, smoke Dispersion – components remain in water, affect aquatic life	Advantages/disadvantages (AD)	One advantage or disadvantage implied	One advantage and one disadvantage for one method implied or One advantage or one disadvantage for more than one method implied	Advantages and disadvantages identified for all three methods		Appraisal (A)	“Best method identified” and supported by scientific evaluation				8
	1	2	3	4																						
Method (M)	Comment about removal	Comment about more than one method of removal	Describes removal using all three methods	Describes removal using all three methods linked to science Skimmer – oil and water are immiscible Burning – fumes, smoke Dispersion – components remain in water, affect aquatic life																						
Advantages/disadvantages (AD)	One advantage or disadvantage implied	One advantage and one disadvantage for one method implied or One advantage or one disadvantage for more than one method implied	Advantages and disadvantages identified for all three methods																							
Appraisal (A)	“Best method identified” and supported by scientific evaluation																									

7							
		1	2	3	4		
	Pipeline (distribution of oil) (P)	A comment about a pipeline	One advantage or one disadvantage of a pipeline implied	One advantage and one disadvantage of a pipeline implied	More than one advantage and more than one disadvantage of a pipeline		
	Alternative methods (AM)	A comment about an alternative method	One advantage or one disadvantage of one alternative method	One advantage or one disadvantage of both alternative methods or More than one advantage and more than one disadvantage of one alternative method	More than one advantage and more than one disadvantage of a both alternative methods		
	Environmental considerations (E)	An environmental impact	More than one environmental impact	More than one environmental impact with at least one supported by science			
	Social considerations (S)	A social impact of transporting oil	More than one social impact of transporting oil				
Appraisal (A)	A concluding appraisal linking the issues discussed						
						14	D