Markscheme

May 2023

Chemistry

On-screen examination

12 pages

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
	Underline tool 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
	Text 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. Do not deduct marks for spelling errors.

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.

<table>
<tr><th colspan="2">Question</th><th>Answers</th><th>Notes</th><th>Total</th><th>Crit.</th></tr>
<tr><td rowspan="4">1</td><td>a</td><td>Exothermic</td><td></td><td>1</td><td>A</td></tr>
<tr><td>b</td><td>C_3H_8 + 5 O_2 → 3 CO_2 + 4 H_2O

Reactants correct
Products correct</td><td></td><td>2</td><td>A</td></tr>
<tr><td>c</td><td>(Molecule) A: Alcohol or alkanol

(Molecule) B: Carboxylic acid or organic acid</td><td>Correctly named molecules: ethanol and methanoic acid

Both alcohols= CON award 0</td><td>2</td><td>A</td></tr>
<tr><td>d</td><td>Particles of powdered coal have a greater surface area (than when using lumps)

Rate of reaction is faster

Energy is released more quickly (than when using lumps)</td><td>ORA

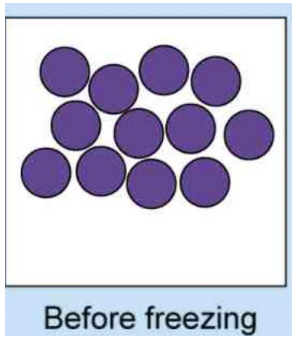
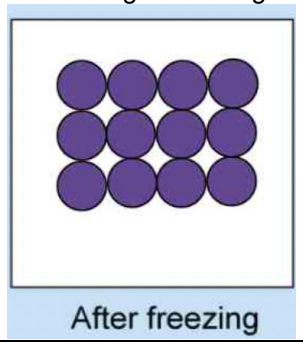
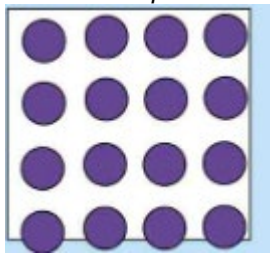
WTTE</td><td>3</td><td>A</td></tr>
<tr><td rowspan="4">2</td><td>a</td><td><table><tr><td></td><td>Ga</td><td>As</td></tr><tr><td>Group</td><td>3</td><td>5</td></tr><tr><td>Period</td><td>4</td><td>4</td></tr></table></td><td></td><td>2</td><td>A</td></tr>
<tr><td>b</td><td>No emissions from solar (compared with fossil fuels)

Accept any additional reasonable point, for example [max 1]
• solar is renewable and fossil fuels are finite
• no mining is needed for solar (unlike fossil fuels)
• solar panels are available worldwide (and fossil fuels are not)
• local legislation promotes use of renewable fuel source</td><td></td><td>2</td><td>A</td></tr>
<tr><td>c</td><td>A</td><td></td><td>1</td><td>A</td></tr>
<tr><td>d</td><td>Both have same number of electrons in the outer/valence shell/energy level or are in the same group

(Valence) electrons pair up or share electrons

to form 4 <u>covalent</u> bonds</td><td></td><td>3</td><td>A</td></tr>
</table>

3	**a**	More reactive metals will produce hydrogen more quickly ***or*** higher rates The metals react differently because they have different reactivities	*ORA*	**2**	**A**
	b	Speeds up the rate of reaction By lowering the activation energy ***or*** providing an alternative pathway Without being used up		**3**	**A**
	c	Molar mass of methane = 16 seen anywhere 8kg methane = 500 moles 1 mole methane reacts to produce 3 moles of H_2 Moles of hydrogen produced= 1500 (mol)	*ECF* *Marking point 3 can be implied*	**4**	**A**
	d	***Accept any reasonable suggestion, for example [max 1]*** • Ammonia is not flammable • Ammonia is less reactive • Ammonia has a distinct smell so leaks can be detected • No more carbon dioxide is used in the (transportation) process/ carbon neutral	*ORA for answers correctly referencing hydrogen*	**1**	**D**
	e	***Accept any reasonable benefit*** • reduction in environmental damage from mining • reduction in effects of climate change • reduced risk of leaks of carbon dioxide ***Accept any linked justification*** • the calcium carbonate – non-renewable material – is produced instead of quarried. • carbon dioxide is not released into the atmosphere • the CO_2 from the production of H_2 is being used instead of stored underground		**2**	**D**

4	**a**	***Liquid:*** irregular arrangement of at least 9 molecules fairly close together with at least two in contact  Before freezing ***Solid:*** Regular arrangement of at least 9 molecules in contact  After freezing	*Do **not** accept the following for a solid* 	**2**	**A**
	b	Measurement 55 (μm) +/- 5 Conversion 5.5 x 10^{-5} (m)	*Do **not** allow perimeter or circumference* *No ECF for second marking point* *Do **not** accept 55 x 10^{-6}*	**2**	**C**
	c	X axis label: Temperature ***and*** °C Y axis label: Percentage of ice cream frozen Two points plotted correctly All data plotted correctly		**4**	**C**

	d	-6 ±0.5 ^{o}C	*Minus sign must be included to award the mark*	**2**	**C**
	e	If the temperature is lower Then the texture will be smoother Because the ice crystals are smaller ***or*** because the ice crystals have formed more quickly	*WTTE, ORA* *Marking points 2 and 3 must be correctly linked to temperature*	**3**	**B**
	f	***Accept any reasonable suggestion, for example [max 1]*** • use same units are used (for different liquids) • all data should have a consistent precision • include the units in the heading • include mean value		**1**	**C**
	g	Milk does not melt the quickest ***or*** water is the quickest So the hypothesis is invalid	*Do **not** award the second mark unless the first is awarded, ORA*	**2**	**C**

5	**a**	RQ linking surface area of the ice ***and*** time taken for the ice to melt (with salt)	*Do **not** accept form of ice for surface area*	**1**	**B**
	b	**IV:** The surface area of the ice **DV:** The time taken for the ice to melt ***Accept any two reasonable control variables, for example [max 2]*** • mass of salt • type of salt used • mass of ice • size of test tube • room temperature	*Do **not** accept amount*	**4**	**B**
	c	***Accept any reasonable suggestion, for example [max 1]*** • the student could use the same mass of ice • the student should use the same surface area • use more values of IV • carry out more trials		**1**	**C**
	d	Percentage of ice remaining 53(.33%) Percentage of ice melted 31(.03%) Both values correctly rounded to 31.03(%) ***and*** 53.33(%)		**3**	**C**
	e	This was the control ***or*** reference to which all the other substances could be compared	*WTTE*	**1**	**C**
	f	***Any substance above -45°C on the scale:*** • urea • sodium chloride • calcium magnesium acetate • magnesium chloride Because if temperatures reach -45°C the ice would not melt and so remain on the runway.		**2**	**C**
	g	Potassium acetate Only substance which does not include chloride ***and*** works below -45°C		**2**	**C**

<table>
<tr><td></td><td>h</td><td>Accept any two relevant points, for example [max 2]
• surface area differences
• airports use natural snow
• structures are different

Accept any reasonable, linked justification [max 1]
• machine-made snow is more compact compared to natural
• de-icers might pass through natural snow but act on the surface of machine-made snow</td><td></td><td>3</td><td>C</td></tr>
<tr><td>6</td><td>a</td><td>Toxic</td><td></td><td>1</td><td>D</td></tr>
<tr><td></td><td>b</td><td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Variables</td><td>some variables implied</td><td>salt as IV or DV as time to melt or mass of ice melted or
one CV identified</td><td>salt as IV and DV as time to melt or mass of ice melted and one CV identified</td><td>salt as IV and DV as time to melt or mass of ice melted and mass of salt or ice as CV and one additional CV identified</td></tr>
<tr><td>Equipment</td><td>equipment to measure DV or monitor one CV</td><td>equipment to measure DV and monitor one CV</td><td></td><td></td></tr>
<tr><td>Sufficient data</td><td>reference to different salts</td><td>all five salts or three trials</td><td>all five salts and three trials</td><td>all five salts and three trials and calculates mean</td></tr>
<tr><td>Method</td><td>attempt at method but may be not relevant</td><td>attempt at method but time of melting or mass of ice melted is not measured so is not likely to give relevant data</td><td>method for measuring time of melting or mass of ice melted is described, could be followed, will produce relevant data</td><td>complete method for measuring time of melting or mass of ice melted is fully explained and could be replicated</td></tr>
<tr><td>Safety</td><td>a safety concern is mentioned</td><td>a safety concern is mentioned and linked to a specific hazard</td><td></td><td></td></tr>
</table>
</td><td>16</td><td>B</td></tr>
</table>

<table>
<tr><td>7</td><td>a</td><td>B</td><td></td><td>1</td><td>A</td></tr>
<tr><td></td><td>b</td><td colspan="3"><table>
<tr><td></td><td>1 mark</td><td>2 marks</td><td>3 marks</td></tr>
<tr><td>Properties</td><td>One property is stated</td><td>Two properties are stated
or
one property is stated with further explanation linked to sportswear</td><td>Two or more properties are stated with further explanation linked to sportswear for at least two</td></tr>
<tr><td>Comparison</td><td>Comparison of 2 fabrics</td><td>Comparison of 3 or more fabrics</td><td></td></tr>
<tr><td>Opinion</td><td>A choice is stated</td><td><u>One</u> choice is stated with justification for use as sportswear</td><td></td></tr>
</table></td><td>7</td><td>D</td></tr>
</table>

<table>
<tr>
<td>8</td>
<td>a</td>
<td>
<table>
<tr><th></th><th>1 mark</th><th>2 marks</th><th>3 marks</th><th>4 marks</th></tr>
<tr><td>Environment</td><td>A statement of an advantage of reclaiming</td><td>A statement of an advantage of reclaiming with justification
or
A statement of two advantages of reclaiming</td><td>A statement of two advantages of reclaiming, both with justification</td><td></td></tr>
<tr><td>Economy</td><td>A statement of one impact</td><td>A statement of two impacts
or
A statement of one impact with justification</td><td>A statement of two impacts with further justification for one</td><td>A statement of two or more impacts with justifications for at least two</td></tr>
<tr><td>Individual</td><td>A statement of one impact</td><td>A statement of two impacts
or
A statement of one impact with justification</td><td>A statement of two impacts with further justification for one</td><td></td></tr>
<tr><td>Appraisal</td><td>Appraisal</td><td>Appraisal with evidence</td><td></td><td></td></tr>
</table>
</td>
<td>12</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td colspan="2">Accept any reasonable suggestions, for example [max 2]
• extending the lifetime
• can make new clothing to suit personal preference
• less likely to discard clothing

Do not accept clothing can be repaired</td>
<td>2</td>
<td>D</td>
</tr>
</table>