Markscheme

May 2025

Chemistry

On-screen examination

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.

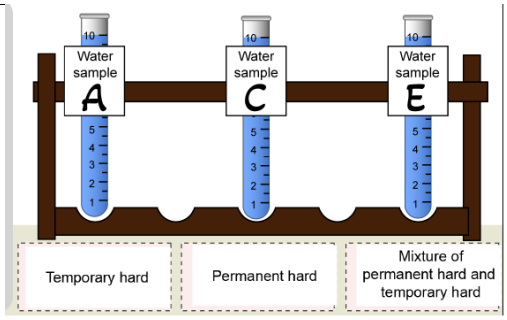
18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.

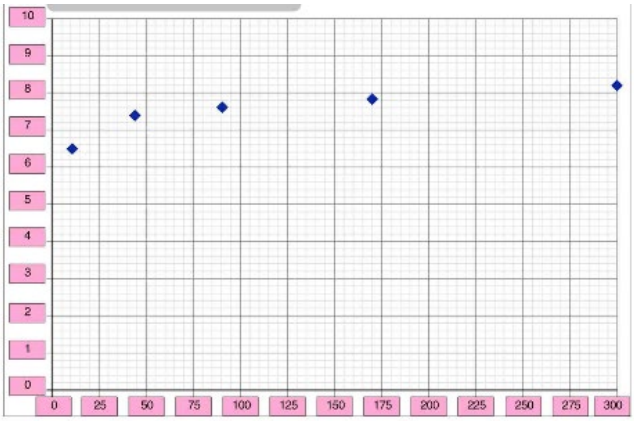
19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.

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.

Question		Answers	Notes	Total	
1	a	Group 6 Period 2	*Accept 16* *Ignore any minus signs*	2	A
	b	***Molecular mass of $NaAlSi_2O_6$:*** 23 + 27 + (28 x 2) +(16 x6) = 202 (g) Number of moles = m/Mr =75/202 =(0.37128 or 0.4) =0.37 (Moles)	*ECF from mp1 if working is shown and it is clear where the error has been made* *Do not award mp3 for 0.40*	3	A
	c	Transition metals		**1**	A
2	a	Endothermic		**1**	A
	b	Reversible		**1**	A
	c	CuI	*Allow Cu(I)I, accept formula CuI if in equation and not balanced*	**1**	A
	d	<table><tr><td>Room temperature</td><td>Brown</td></tr><tr><td>Cup of Coffee</td><td>Green</td></tr><tr><td>Fridge</td><td>Brown</td></tr></table>		**3**	A
	e	Carboxylic acid		**1**	A
3	a	The material has changed as the sign will last longer ***or*** it is more appealing	*WTTE*	**1**	D
	b	Fe_2O_3	*Correct subscripts must be seen*	**1**	A
	c	***Oxidised:*** Iron	*Accept symbols for elements*	**2**	A

		Reduced: Oxygen			
	d	<table><tr><td>Isotope</td><td>$^{82}_{36}Kr$</td><td>$^{84}_{36}Kr$</td></tr><tr><td>Electrons</td><td>36</td><td>36</td></tr><tr><td>Protons</td><td>36</td><td>36</td></tr><tr><td>Neutrons</td><td>46</td><td>48</td></tr></table> Electrons 36 for <u>both</u> isotopes 46 neutrons for $^{82}_{36}Kr$ 48 neutrons $^{84}_{36}Kr$		**3**	A
	e	Have full ***or*** complete outer shells (so do not react)	*WTTE Accept reference to 2 electrons for He, accept full octet*	**1**	A
	f	2.6 ***or*** $1s^2\ 2s^2\ 2p^4$ ***or*** $K^2\ L^6$		**1**	A
	g	<u>Covalent</u> bonding Electrons are shared between atoms	*Accept shared pair of electrons*	**2**	A
	h	Exosphere This layer has the highest temperature	*Accept the <u>top</u> of the thermosphere but not thermosphere alone*	**2**	C
	i	Thermosphere (because) this is where the most oxygen is found		**2**	A

4	**a**	49.(00 cm^3) 49.0 (cm^3) Correct value rounded to 1 decimal place	 *Award 2 marks if only 49.0 (cm^3) is seen*	2	C
	b	10.0 (cm^3) 24.0 (cm^3)	*Award maximum 1 mark if decimal places not included for but values are correct* *Mp2 ECF from part a*	2	C
	c	 One in correct location All in correct location ***Correct justification, from list [max 3]*** • Sample A is temporary hard because the volume is decreased (after boiling) • Sample C is permanent hard because the volume is unchanged (after boiling) • Sample E is a mixture because the volume decreases slightly (after boiling)	 *WTTE*	**5**	C

	d	Increase the mass ***or*** concentration of (sulphate) salts ***or*** ions increases	 *Accept increase in salts for mp2. WTTE*	**2**	B
	e	 Hardness on x axis ***and*** pH on y ***Labels:*** hardness / mg dm^{-3} ***and*** pH Scale of x and y axis have even increments At least 3 points plotted correctly		**4**	C
	f	Hard water is not acidic ***or*** is basic ***or*** is an alkali pH of hard water is above 7	*No mark for conclusion is valid or invalid* *ORA*	**2**	C

5	**a**	Corrosive		**1**	B
	b	How does the type of acid affect how quickly the limescale ***or*** calcium carbonate ***or*** deposit is removed ***or*** How does IV affect the change in mass of limescale ***or*** calcium carbonate over X time	*How does IV affect the time required to remove X quantity of limescale (or all limescale)* *Can either have time or mass as DV in RQ. Do not accept vague references to non-measurable DV.* *Need to link IV and DV*	**1**	B
	c	IV (type of) acid DV time ***or*** mass ***Any two CVs, [max 2]*** • volume of acid • concentration of acid • time (if DV is mass) • mass (if time is DV) • temperature • length of pipe	*Do **not** accept amount*	**4**	B
	d	***Accept any reasonable suggestion, for example [max 2]*** • include the unit of mass • give values to consistent decimal places • show the change in mass • add title to the table • give chemical name of shop-bought descaler		**2**	C
	e	Hydrochloric acid The mass changed the most		**2**	C

	f	Different masses of limescale were present ***or*** Different lengths of pipe were used		**1**	C
	g	***Accept reasons why the data is not valid, [max 1]*** • there should have been more trials • they should have calculated an average • outliers could be included (as there was only one trial) • outliers cannot be excluded (as there was only one trial)		**1**	C

6	a	***Accept any response from the list, [max 1]*** • HCl is not a common household chemical • don't have appropriate safety equipment at home • HCl might react with the metal rather than the limescale • ethanoic acid is a weak acid (or hydrochloric acid is a strong acid) • easier or less harmful to dispose of ethanoic acid	*WTTE and ORA, accept ethanoic acid for vinegar throughout* *Do not accept vague references to green chemistry as this is in the question*	1	A

6	b				18	B
	1 mark	**2 marks**	**3 marks**	**4 marks**	*Notes*	
V	Explicitly states appropriate: IV (vinegar concentration) ***or*** DV (mass of calcium carbonate or volume of carbon dioxide gas)	Explicitly states appropriate: IV ***and*** DV	Explicitly states appropriate: IV ***and*** DV ***and*** one CV	Explicitly states appropriate: IV ***and*** DV ***and*** two CVs	*Only requirement is to state using the terminology of IV, DV and CV. No need to explain further.* *Do not accept "keeping equipment the same" as a CV.* *Do not accept calculated values as DV unless explicitly shown how calculated from measured values.*	
E	Specified equipment considers IV (measuring cylinder/volumetric flask) ***or*** DV (balance or gas syringe or suitable method for measuring gas) ***or*** CV	Specified equipment considers IV ***and*** DV ***or*** IV ***and*** CV ***or*** DV ***and*** CV	Specified equipment considers IV ***and*** DV ***and*** one CV	Specified equipment considers IV ***and*** DV ***and*** two CVs	*Equipment needs to be correct for the given situation and stated CVs.* *Pipette can be used for volumetric measuring equipment*	
M	Method is linked to IV or DV	Method is linked to IV ***and*** DV but is incomplete	Method linked to IV ***and*** DV ***and*** can be followed	Method linked to IV ***and*** DV ***and*** can be followed ***and*** includes details on how to control main CVs	*A method that does not include how to vary the IV is incomplete.* *Limited information about CVs mean that data is unlikely to be relevant*	
D	Any reference made to different values of the IV	At least five variations of the IV ***or*** at least three trials	At least five values of the IV ***and*** at least three trials	At least five values of the IV ***and*** at least three trials ***and*** takes an average	*The values of the five or more variations should be explicitly stated for 3 or 4 marks*	
S	Relevant safety precaution or statement	Relevant justified safety precaution linked to a specific hazard or risk			*Do not accept general considerations not linked to the specific investigation, e.g. wear a mask, tie hair back*	

7	a	B		1	A

7	b			16	D

Properties of plastic needed in liquid soap packaging		
Mark	**Descriptor**	**Examples**
1	One property	• waterproof – can contain liquids • lightweight – cheaper to transport • flexible ***or*** malleable ***or*** pliable - easy to manufacture, pouches are easier to transport, efficient packing of pouches • durable – long lasting, can be refilled or reused • strong – will not break ***Do not accept*** • stretchy • cheap to produce as this this not a property
2	One property with justification ***or*** Two properties	
3	Two properties with justification for both	

Comparison of suitability for liquid soap packaging		
Mark	**Descriptor**	**Notes**
1	A comparison of at least two types	***Comparisons*** • is it biodegradable • can it be recycled ***Do not accept*** a list or physical properties or environmental or economic impacts ***Further support*** • biodegradability may reduce shelf life • can be repurposed into new containers – circular
2	A comparison of all three types ***or*** A comparison of at least two types with further support for one	
3	A comparison of all three types with further support for at least two types	

<table>
<tr><th colspan="3">Economic impacts</th></tr>
<tr><th>Mark</th><th>Descriptor</th><th>Examples</th></tr>
<tr><td>1</td><td>An economic impact of one specified type of plastic</td><td rowspan="4">Accept any valid economic impact and relevant supporting statement, for example

Crude oil
• production costs are low – cheap to produce
• no need to invest in new technology – cheap to produce
• can be recycled – resources can be reused, no need to buy new raw materials
• raw materials need to be transported from refineries – transport costs are high

Plant-based non-biodegradable
• cheaper raw materials – lower raw materials cost
• new technology needed – production costs are higher

Plant-based biodegradable
• biodegradable – reduced costs for recycling facilities or waste management
• cheaper raw materials – lower raw materials cost
• new technology needed – production costs are higher</td></tr>
<tr><td>2</td><td>An economic impact of two specified types of plastic with support for at least one</td></tr>
<tr><td>3</td><td>An economic impact of all three types of plastic with support for at least two</td></tr>
<tr><td>4</td><td>An economic impact of all three types of plastic with support for all types</td></tr>
</table>

Environmental impacts		
Mark	**Descriptor**	**Examples**
1	An environmental impact of one specified type of plastic	***Accept any valid environmental impact and relevant supporting statement, for example*** ***Crude oil*** • can be recycled or reused - so less plastic needs to be manufactured • high greenhouse gas emissions – contributes to climate change • crude oil needs to be drilled – destroys ecosystems ***Plant-based non-biodegradable*** • low greenhouse gas emissions – less impact on climate change • locally available raw materials – reduced need for transport • fields to grow raw materials – land might be needed for food production • fertilizer or pesticides used – negative impact on ecosystems ***Plant-based biodegradable*** • least strong so it can be used fewer times than the others – more needs to be manufactured • can biodegrade – limited long-term impact on the environment
2	An environmental impact of two specified types of plastic with support for at least one	
3	An environmental impact of all three types of plastic with support for at least two	
4	An environmental impact of all three types of plastic with support for all types	

Conclusion (Concluding appraisal)		
Mark	**Descriptor**	**Examples**
1	A choice made	***Justification***
2	A choice with justification	The choice of plastic balanced using factors discussed earlier

8			D	7

Comparison of production processes for soap made with recycled plastic and one other type of soap		
Mark	**Descriptor**	**Examples**
1	One production aspect is identified	***Production aspects*** • Mentions raw materials for one type of soap • Mentions crude oil feedstocks for one type of soap • Mentions antimicrobial properties for one type of soap ***Production aspects comparisons*** • Raw materials – recycled plastic are renewable vs fossil fuels that are non-renewable • Crude oil feedstocks more widely available than recycled plastics • Naturally occurring antimicrobial properties in natural additives needed for recycled plastic soap or crude oil soap ***Justification*** • (so) crude oil has a lower cost • Crude oil extraction harms environment whereas recycled plastic soap uses materials that would otherwise be pollutants • Fewer additives needed during production
2	One production aspect identified and compared for soap made with recycled plastic and one other type of soap	
3	Two production aspects are identified and compared for soap made with recycled plastic and one other type of soap	
4	Two production aspects are identified and compared with soap made with recycled plastic and one other type of soap with further justification	

Social impacts to consider when choosing between soap made with recycled plastic and other types of soap		
Mark	**Descriptor**	**Examples**
1	One social impact is identified	***Social impacts – no comparison needed*** • Crude oil soap has high toxic potential as additives are needed • Natural soaps need no additives • Crude oil soaps are cheaper than recycled plastic soaps • Religious groups or vegans may not like animal-based products • Recycled plastic unknown toxicity to skin could be an issue for children and babies • Less crude oil needed, less extraction linked to healthier society • Allergic reaction to additives high for crude oil or recycled plastic soap ***Justification*** • People may chose a cheaper soap over a recycled plastic one based on cost • People may chose a recycled soap even though it is more expensive based on environmental impacts
2	Two social impacts are identified	
3	Two social impacts are identified with further justification	