



GCE

Chemistry B

H433/01: Fundamentals of chemistry

A Level

Mark Scheme for June 2025

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training: OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. There is a NR (**No Response**) option. Award NR (No Response):

- if there is nothing written at all in the answer space
- OR if there is a comment which does not in any way relate to the question (e.g., 'can't do', 'don't know')
- OR if there is a mark (e.g., a dash, a question mark) which is not an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by **levels of response**:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **32d and 35b**.

The only annotation on a level of response question should be the indication of the level.

A level annotation should be used where all marks for a level have been achieved e.g. a candidate has 6 marks, so they would have this annotation on their script:

L3

If a candidate has achieved 5 marks then they have reached Level 3 but with one mark omitted. They should have the following annotations on their scripts:

L3 

The same principle should be applied to Level 2 and Level 1.

No marks (0) should have a cross: 

Place the annotations alongside the mark for the question.

On additional pages, annotate using 

H433/01

Mark Scheme

June 2025

11. Annotations

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

H433/01

Mark Scheme

June 2025

Annotation	Meaning
	Blank page

12. Subject Specific Marking Instructions

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

H433/01

Mark Scheme
SECTION A

June 2025

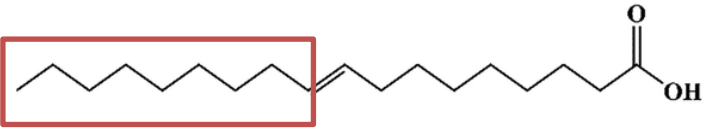
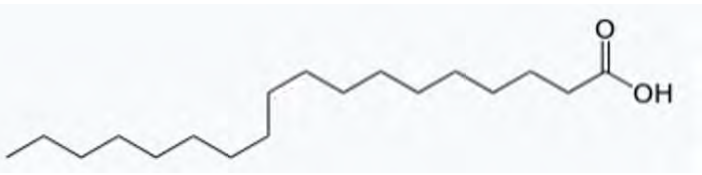
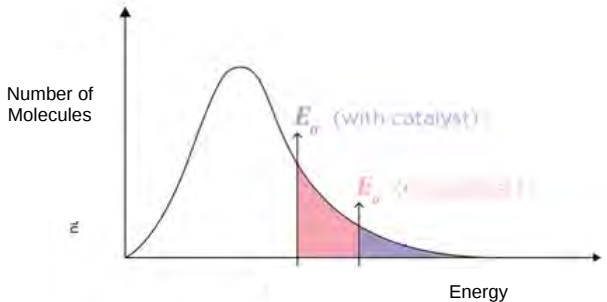
Question	Answer	Marks
1	B	1
2	A	1
3	B	1
4	B	1
5	C	1
6	C	1
7	C	1
8	D	1
9	A	1
10	C	1
11	C	1
12	A	1
13	C	1
14	B	1
15	C	1
16	B	1
17	D	1
18	D	1
19	C	1
20	D	1
21	D	1
22	C	1
23	C	1
24	A	1
25	C	1
26	C	1
27	A	1
28	B	1
29	B	1
30	C	1
	Total	30

Question			Answer	Mark	Guidance
31	(a)		Trigonal planar ✓ 3 bonding regions/areas of electron density (AW) ✓ <u>Electrons</u> repel as far apart as possible/ arranged to minimise repulsion (AW) ✓	3	DO NOT ALLOW incorrect bond angles IGNORE electron/bonding pairs ALLOW e ⁻ for electron throughout
	(b)	(i)	Sideways overlap of <u>p orbitals</u> ✓ OR Overlap of <u>p orbitals</u> above and below the plane/ line of atoms ✓	1	Can be scored from a correct diagram
	(b)	(ii)	Correct partial charges on Br–Br AND Arrow from double bond to δ^+ Br AND from Br–Br bond to δ^- Br ✓ Correct carbocation AND arrow from lone pair or negative charge on Br ⁻ to C ⁺ ✓ Correct final product ✓	3	

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
(b)	(iii)			1	
(c)	(i)			1	ALLOW any un-branched orientation of side chain with formula $C_{17}H_{35}COOH$
(c)	(ii)		reactants <u>adsorb</u> to the (catalyst) surface ✓ Weakens/break the (covalent) bonds in the reactants OR less energy needed to break the bonds in the reactants ✓ Products diffuse away/ desorbed (from the catalyst surface) ✓	3	ALLOW adsorption onto/ desorption from
(c)	(iii)		(Kinetic) energy on x axis AND Number of molecules on y axis ✓ 'E_a catalyst' and 'E_a no catalyst' lines added and correctly labelled ✓ <u>Area</u> under curve/graph (bigger for E_a catalysed) represents greater number of molecules with enough energy to react on collision (AW) ✓	3	 ALLOW answer linked to both shaded areas under the curve on graph

H433/01

Mark Scheme

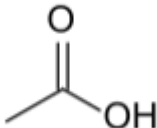
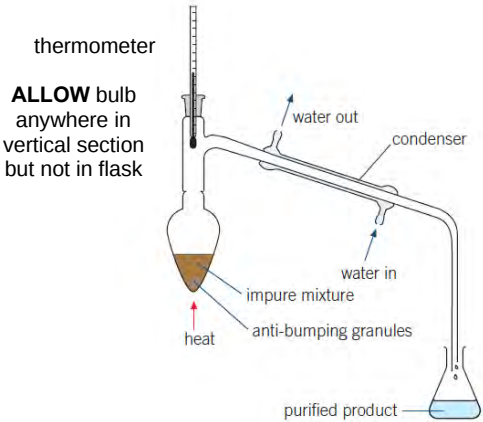
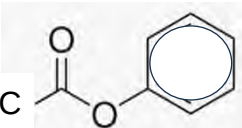
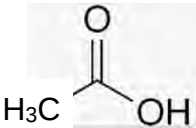
June 2025

Question			Answer	Mark	Guidance
	(d)	(i)	Esterification / Condensation ✓	1	
	(d)	(ii)	Correct number of carboxylic acid AND water molecules $3\text{C}_{17}\text{H}_{33}\text{COOH} + \text{C}_3\text{H}_5(\text{OH})_3 \rightarrow 3\text{H}_2\text{O} \checkmark +$ Structure of ester $\text{C}_3\text{H}_5(\text{C}_{17}\text{H}_{33}\text{COO})_3 \checkmark$	2	ALLOW any unambiguous structural formulae Allow one mark for structure of mono or diglyceride ester AND correct number of water molecules
	(d)	(iii)	Saturated fats (molecules) can pack more closely together than the unsaturated fats/oils (AW) ✓ There are more/stronger instantaneous dipole-induced dipole forces (in fats) ✓ (so) more energy is needed to overcome them ✓	3	ORA throughout ALLOW more points of contact ALLOW between (fatty acid) chains DO NOT ALLOW different chain lengths or repulsion ALLOW Van der Waals and 'id-id'. DO NOT ALLOW other intermolecular forces or bonding
				21	

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
32	(a)	(i)	 ✓ conc. H ₂ SO ₄ /sulfuric acid ✓	2	ALLOW concentrated /conc /c.
	(a)	(ii)	Labelled flask AND water bath/ electric heating mantle/ heat source ✓ A thermometer with bulb opposite exit tube and not sealed where distillate collected ✓ A condenser connected without leaks to the flask with correctly labelled water connections ✓	3	IGNORE fractionating column DO NOT ALLOW Bunsen burner alone 
	(b)	(i)	✓ $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{O}-\text{C}(=\text{O})-\text{CH}_3$  	3	ALLOW any unambiguous formulae ALLOW correct products that do not match incorrect acid anhydride or ECF if products match incorrect acid anhydride

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
	(b)	(ii)	(Sodium hydroxide should be used because) Phenol is a very weak/not a strong enough acid to react with carbonates OR Phenol is a very weak /not a strong enough acid so only reacts with NaOH ✓	1	
	(c)	(i)	Reflux AND concentrated H ₂ SO ₄ OR Reflux AND concentrated H ₃ PO ₄ OR Heat AND Al ₂ O ₃ ✓	1	ALLOW conc / c. IGNORE pressure If temperature specified it must be above 250°C
	(c)	(ii)	Elimination ✓	1	
	(c)	(iii)	Butan-1-ol AND only but-1-ene /one product ✓ If Butan-2-ol used both but-1-ene & but-2-ene produced/ a mixture is produced ✓ So there would be greater yield /atom economy OR So there would be fewer substances to separate /separation not required ✓	3	ALLOW equations/ diagrams for MP1 and MP2 ORA for MP3

H433/01

Mark Scheme

June 2025

	Question	Answer	Mark	Guidance
	(d)	<i>Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.</i> Level 3 (5–6 marks) Identifies correct ester $\text{C}_6\text{H}_5\text{COOCH}_2\text{CH}_3$ with a wide range of evidence from calculation AND IR AND NMR. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3-4 marks) Identifies an ester with the formula $\text{C}_9\text{H}_{10}\text{O}_2$ giving some evidence from IR OR NMR OR Identifies an ester from a calculation AND some evidence from both IR AND NMR <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1-2 marks) Does not necessarily identify an ester or give a structure but gives some evidence from TWO of calculation, IR, NMR. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.	6	Indicative scientific points include <i>(fine detail in italic)</i> Calculation of formula • $\begin{matrix} \text{C} & & \text{H} & & \text{O} \\ 72/12 = 6 & 6.7/1 = 6.7 & 21.3/16 = 1.33 \\ 4.5 & : & 5 & : & 1 \\ 9 & : & 10 & : & 2 \end{matrix}$ • molecular formula is $\text{C}_9\text{H}_{10}\text{O}_2$ Use of IR to identify ester • peak at 1700cm^{-1} showing C=O bond • <i>peak at 1300cm^{-1} showing C-O bond</i> • NO broad peak at $2500\text{--}3300\text{cm}^{-1}$ no O-H bond • <i>not carboxylic acid/ COOH</i> • <i>suggests ester/ COO</i> Analysis of proton NMR • 4 peaks so 4 different proton environments • ratio 3:2:3:2 so 10H supports molecular formula • peaks between $\delta = 7 - 8$ show aromatic protons /H • <i>5 aromatic protons so only one substituent</i> • peak at $\delta = 1.3$ is HC-R so $\text{CH}_3\text{(-R)}$ • <i>which is a triplet (using $n+1$) CH_3 is next to CH_2</i> • peak at $\delta = 4.4$ is CH_2 • <i>which is a quartet (using $n+1$) next to CH_3</i> • <i>(peak at peak at $\delta = 4.4$) HC-O so next to O of ester functional group</i> <i>Aspects of the communication statement might typically have been met when:</i> • <i>Logical links made with range of data to justify the structure</i> • <i>Suggested ester is correctly linked to the relevant data</i> • <i>Links between the data and structural features are made</i>
			20	

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
33	(a)		weigh bottle after tipping out the solid (AW) ✓ subtract this from bottle + solid (AW) ✓	2	
	(b)	(i)	$(100 \times 0.5 \times 2 / 6.5) = 15.4 (\%)$ ✓	1	ALLOW 2 or more sf.
	(b)	(ii)	Increase the mass/moles of ammonium nitrate temperature change/decrease will be greater OR Decrease the volume of water ✓ temperature change/decrease will be greater ✓	2	DO NOT ALLOW temperature increase IGNORE use of lid reduce heat exchange
	(c)		CHECK ANSWER ON ANSWER LINE If $\Delta_{sol}H = +24$ OR $+23.7$ (kJmol⁻¹) award 4 marks $10.10/80 = 0.12625$ moles ✓ $Q = 110.10 \times 4.18 \times (20.5 - 14.0) = 2991.417$ J ✓ $\Delta H = 2991/(0.12625 \times 1000) = (+)23.69439208$ kJmol ⁻¹ ✓ 2 sf +24 OR 3sf +23.7 (kJ mol ⁻¹) ✓	4	Either 2sf or 3sf is appropriate. $\Delta T = 6.5$ (2sf) calculated from 20.5-14.0 (3sf). MP1 calculate moles MP2 correct use of $q=mc\Delta T$ MP3 evaluate q/n and convert to kJmol ⁻¹ MP4 correct sig. fig and + sign ALLOW ECF for MP1, 2 & 3 only

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
	(d)	(i)		2	ALLOW $\text{NH}_4\text{NO}_3(\text{aq})$
	(d)	(ii)	25 (kJ mol ⁻¹) ✓	1	
	(e)		Ammonium ion/ NH_4^+ has a smaller charge density than sodium ion/ Na^+ (ORA) ✓ Ammonium ion/ NH_4^+ has weaker (electrostatic) attractions to the nitrate ion/ NO_3^- (ORA) ✓	2	ALLOW NH_4^+ has larger radius/ is bigger ion (ORA) IGNORE atomic radius
				14	

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
34	(a)	(i)	The reaction is in equilibrium/ reversible ✓	1	
	(a)	(ii)	H ₃ PO ₄ ✓	1	
	(a)	(iii)	A buffer resists changes in/ maintains pH ✓ When an acid is added the equilibrium shifts left/ HPO₄²⁻ removes the added H⁺ ✓ When a base is added the equilibrium shifts right/ H₂PO₄⁻ dissociates to give H⁺ which removes the OH⁻ ✓ [weak acid] and [salt/ conjugate base] are both large (AW) ✓	4	ALLOW maintains [H⁺] ‘Large quantities of’ and ‘in excess’ are both acceptable AW

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
	(a)	(iv)	CHECK ANSWER ON ANSWER LINE If mass = 3.0 (g) award 5 marks $[H^+] (= 10^{-7.40}) = 3.98 \times 10^{-8} \checkmark$ $K_a (= 10^{-7.20}) = 6.31 \times 10^{-8} \checkmark$ $(K_a = [H^+][\text{salt}]/[\text{acid}])$ $6.31 \times 10^{-8} = 3.98 \times 10^{-8} \times 0.02/[\text{acid}] \checkmark$ $([\text{NaH}_2\text{PO}_4]) = 0.0126(1489) \checkmark$ $0.01262 \times 2 \times 120 = 3.0(3) \checkmark$	5	ALLOW 1 or more sf ALLOW ECF from incorrect MP1 & MP2 MP4 is dependent on MP3 MP5 can be awarded from incorrect MP4 MP1 $[H^+]$ MP2 K_a MP3 substitution MP4 rearrangement and evaluation of correctly substituted equation MP5 conversion to mass in dm^3
	(b)	(i)	$\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^- \checkmark$	1	If state symbols are included they must be correct
	(c)	(ii)	$(-\log 0.05) = 1.30 \checkmark$	1	Accept value with correct rounding from 1.3 up to 1.301029996
				13	

H433/01

Mark Scheme

June 2025

Question			Answer	Mark	Guidance
35	(a)	(i)	bromate(V) ✓	1	ALLOW gap between 'e' and '(V)'
	(a)	(ii)	$6\text{I}^- + \text{BrO}_3^- + 6\text{H}^+ \rightarrow 3\text{I}_2 + \text{Br}^- + 3\text{H}_2\text{O}$ Correct species ✓ Correctly balanced ✓	2	IGNORE state symbols
	(a)	(iii)	CHECK ANSWER ON ANSWER LINE If $E_a = (+)51.3$ OR $(+)51.4$ (kJ mol⁻¹), award 3 marks $\ln k_1 - \ln k_2 = 1.132$ AND $(1/T_2 - 1/T_1) = 1.83 \times 10^{-4}$ ✓ $E_a = (1.132 \times 8.314)/1.83 \times 10^{-4}$ (J mol ⁻¹) ✓ $= (+)51.3$ OR 51.4 (kJ mol ⁻¹) ✓	3	ALLOW 2 or more sf MP1 substitution and evaluation of given terms MP2 rearrangement MP3 evaluation & unit conversion DO NOT ALLOW negative sign

H433/01

Mark Scheme

June 2025

Question		Answer	Mark	Guidance
	(b)	<i>Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.</i> Level 3 (5–6 marks) Includes most practical detail AND uses observations to identify all ions linked to correct equations in each case, including some fine detail. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3-4 marks) Includes most practical detail AND uses observations to identify all ions with at least one correct equation. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1-2 marks) Includes some practical detail AND either observations OR equations for at least two ions. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.	6	Indicative scientific points include (<i>fine detail in italic</i>) Test for cations • <i>Make a solution of salt</i> • Adding sodium hydroxide (aq)/ solution • Cu(II) gives blue ppt (or flame test; blue-green) • Fe(II) gives green ppt • NH₄⁺ gives ammonia gas/fumes <i>on warming</i> • <i>Detect with damp pH paper / red litmus paper goes blue</i> Test for anions • <i>Make a solution salt</i> • <i>Add dilute acid (DO NOT ALLOW HCl)</i> • Adding silver nitrate (aq)/ solution to test for halide ion • Cl⁻ white ppt, Br⁻ cream ppt, I⁻ yellow ppt • <i>Add ammonia</i> • <i>AgCl dissolves in dilute ammonia, AgBr dissolves in conc ammonia/partially soluble in dilute ammonia, AgI does not dissolve</i> Expected equations (full or ionic): $\text{Ag}^+(\text{aq}) + \text{X}^-(\text{aq}) \rightarrow \text{AgX}(\text{s}) \text{ OR } \text{X as Cl, Br \& I}$ $\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Cu}(\text{OH})_2(\text{s})$ $\text{Fe}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$ $\text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{NH}_3(\text{g}) + \text{H}_2\text{O}(\text{l})$ IGNORE use of ethanol as solvent <i>Aspects of the communication statement might typically have been met when:</i> • <i>Clear links between points are made</i> • <i>Only relevant information is included</i>
			12	

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