Practice Paper – Set 2

A Level Chemistry A
H432/03 Unified Chemistry P2

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

Final

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.

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 50% 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, email or via the RM Assessor messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

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 isn't 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 email.

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, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content 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 science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

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 science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **2(b)(ii)** and **5(a)**.

11. **Annotations**

Annotation	Meaning
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

12. **Subject-specific Marking Instructions**

INTRODUCTION

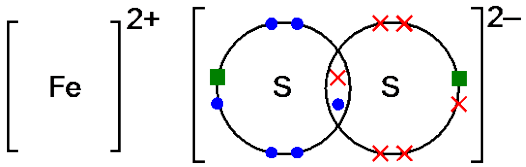
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- 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.

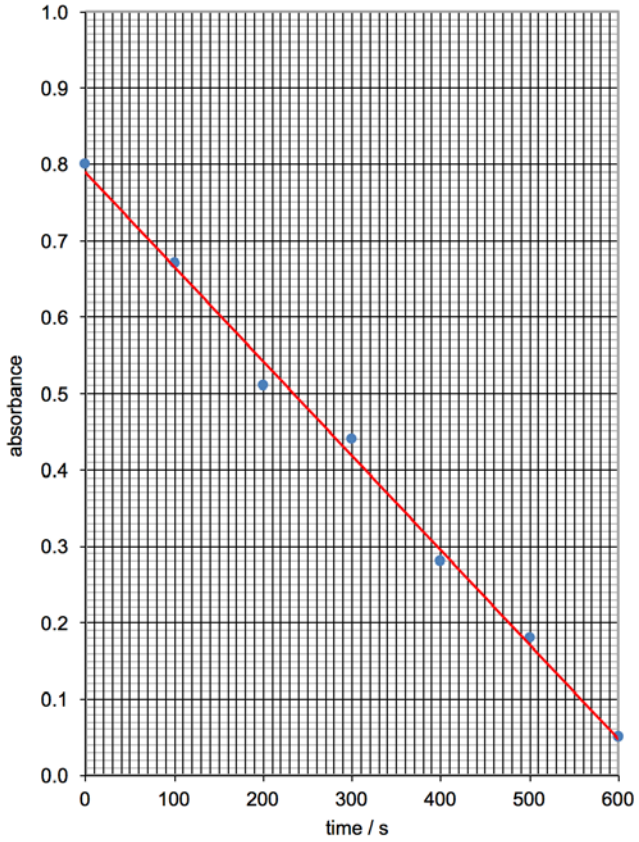
Question			Answer	Marks	Guidance
1	(a)	(i)	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ ✓	1	
		(ii)	 • Electrons for each S atom must be shown differently, e.g. • for left-hand S and × for right hand S • Two 'extra' electrons shown with different symbol (as a square in diagram above) with one square on each S atom. **MARKING** 1 covalent bond between two S atoms with • **AND** × ✓ Rest of structure correct including 2 extra electrons ✓	2	**IGNORE any outer electrons shown on Fe** Electrons donated by Fe **must** be different. **ALLOW** dative covalent bond for covalent bond using two dots **OR** 2 crosses for 1st mark 2nd mark will then have the 2 extra electrons on the S atom that has donated the electrons for the dative covalent bond.
1	(b)		**FIRST CHECK ANSWER ON THE ANSWER LINE** **IF answer = 13.4 (m^3) award 5 marks** --- **Amounts of FeS_2 and SO_2** $n(FeS_2) = \frac{0.0300 \times 10^6}{120}$ **OR** 250 (mol) ✓ $n(SO_2) = 2 \times 250 = 500$ (mol) ✓ **Pressure unit conversion** Use of $p = 100 \times 10^3$ (Pa) ✓ **Ideal gas equation**	1 1 1	**If there is an alternative answer, check to see if there is any ECF credit possible** **ALLOW ECF** from incorrect amount of FeS_2 e.g. incorrect *M* for FeS_2 could still score 4 marks --- **Common Errors** *No T conversion* ***4 marks*** $V = 2.08$ (m^3) *No p conversion* ***4 marks*** $V = 13\,400$ m^3)

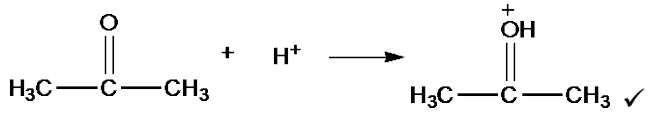
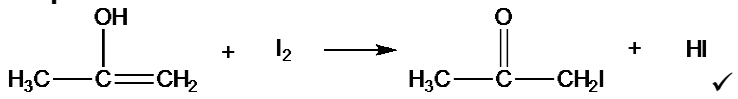
Question			Answer	Marks	Guidance
			$V = \frac{nRT}{p}$ **OR** $V = \frac{500 \times 8.314 \times 323}{100 \times 10^3}$ **AND** Use of T = 323 K ✓ **Final answer** V = 13.4 (m^3) ✓ *Must be to **3 SF***	**1** **1**	*No p **AND** T conversion* ***3 marks*** V = 2080 m^3 *No 3 SF* ***4 marks*** V = 13.42711 (m^3) **OR** 4 SF and more *No × 2 for n(SO_2) **AND** 3SF* ***4 marks*** V = 6.71 (m^3)
1	**(c)**	**(i)**	Bond angle: 104º–105º ✓ Two **bonded** pairs **AND** two **lone pairs** repel ✓ Lone pairs repel more than bonded pairs ✓	**3**	**ALLOW** 99° (actual bond angle) **IGNORE** surrounded by four atoms **IGNORE** four areas of electron charge repel **IGNORE** four electron pairs repel (*one could be lp*) **DO NOT ALLOW** atoms repel
		(ii)	**Low boiling point:** intermolecular forces involved ✓ **Energy and boiling** Weak intermolecular forces are broken by a small quantity of energy ✓ **Solubility:** DMS does **not** form hydrogen bonds to water ✓	**3**	**ALLOW** dipole interaction/ induced **OR** permanent dipole interaction/London forces/van der Waals' forces **DO NOT ALLOW** hydrogen bonds **OR** covalent bonds
			Total	**14**	

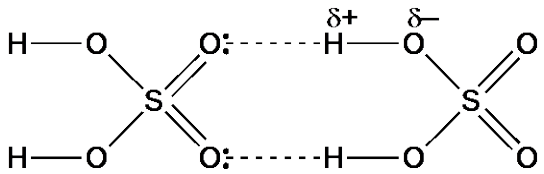
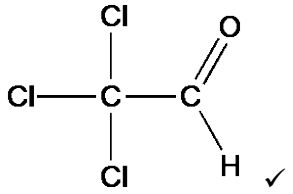
Question			Answer	Marks	Guidance
2	(a)		$n(H_2O)$ = 27.55/18.0 = 1.5306 (mol) ✓ $n((NH_4)_2Fe(SO_4)_2)$ = 72.45/284.0 = 0.2551 (mol) ✓ whole number ratio of $(NH_4)_2Fe(SO_4)_2 : H_2O$ = 0.2551 : 1.5306 = 1 : 6 **OR** x = 6 ✓	3	**If there is an alternative answer, check to see if there is any ECF credit possible** **ALLOW** calculator value or rounding to two significant figures or more but **IGNORE** 'trailing zeroes' if wrong *M* produces such numbers throughout. **ALLOW ECF** If no working, **ALLOW** 1 mark for *x* = 6.
2	(b)	(i)	To neutralise acidic soil ✓	1	
		(ii)	*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Describes practical details of tests and observations that allows all four ions to be identified **AND** Attempts associated equations, with most correct. *There is a well-developed line of reasoning and the method is clear and logically structured. The information presented is relevant and substantiated by observations from the tests described and practical details.* **Level 2 (3–4 marks)** Describes most practical details of tests including the observations that allows most ions to be identified **AND** Attempts associated equations, with some correct. *There is a line of reasoning presented and the method has*	6	**Indicative scientific points may include** **<u>Practical details:</u>** • Sample stirred with water and mixture filtered. • SO_4^{2-}, Fe^{2+}, NH_4^+ tests on filtrate. • CO_3^{2-} test on residue or garden product **<u>Tests and associated equations:</u>** CO_3^{2-} test: *Test*: Add nitric acid. *Observation*: effervescence. *Equation*: $CaCO_3 + 2H^+ \rightarrow Ca^{2+} + CO_2 + H_2O$ ***ALLOW*** $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$ ***OR*** *overall equation of* $CaCO_3$ *and an acid.* SO_4^{2-} test: Add $BaCl_2(aq)/Ba(NO_3)_2(aq)/Ba^{2+}(aq)$. Observation: white precipitate. Equation: $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ Fe^{2+} test:

Question			Answer	Marks	Guidance
			some structure. The information presented is in the most-part relevant and supported by some evidence of observations from the tests described but practical details may be absent. **Level 1 (1–2 marks)** Describes some of the practical details of tests and observations would only allow some ions to be identified. **OR** Attempts associated equations, with some correct. *The information is basic and the method lacks structure. The information is supported by limited evidence of the observations, the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.		Test: Add NaOH(aq) Observation: green precipitate Equation: $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ NH_4^+ test: *Test*: Add NaOH(aq) and warm *Observation*: gas turns red litmus indicator blue *Equation*: $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$
2	**(c)**	**(i)**	Equation: $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ ✓ *State symbols required* Observation: Blue precipitate ✓	**2**	**ALLOW** $[Cu(H_2O)_6]^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(H_2O)_4(OH)_2(s) + 2H_2O(l)$ **ALLOW** blue solid
		(ii)	Coordinate/dative covalent bonds between protein and Cu^{2+}/Cu ✓ N atoms **OR** O atoms in protein donate electron pairs ✓	**2**	
			Total	**14**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>Iodine (solution) has a yellow/orange/brown colour
AND
Concentration of I_2 decreases/I_2 is used up ✓</td><td>1</td><td>ALLOW products are colourless</td></tr>
<tr><td>3</td><td>(b)</td><td></td><td><table><tr><th>Time/s</th><th>$[I_2(aq)]$/mol dm^{-3}</th></tr><tr><td>0</td><td>0.0100 ✓</td></tr><tr><td>500</td><td>0.00225 ✓</td></tr></table></td><td>2</td><td>ALLOW 0.01 and 0.010
ALLOW 0.0023</td></tr>
</table>

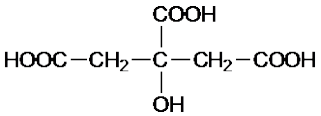
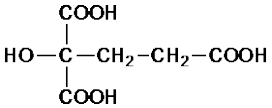
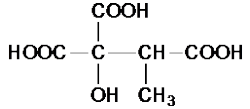
Question			Answer	Marks	Guidance
3	(c)	(i)	 Axes labelled with units **AND** linear scales **AND** at least half of the graph paper used ✓ Points correctly plotted ✓ Best fit straight line ✓	3	Each point **must** be within one small square on graph paper of value in table

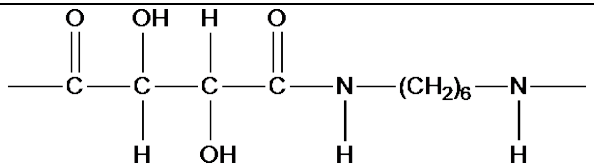
Question			Answer	Marks	Guidance
		(ii)	Order = 0 ✓ Straight line graph shows rate is constant throughout **OR** rate does not depend on $[I_2]$ ✓	2	
3	(d)		**Step 1**:  ✓ **Step 3**:  ✓	2	**ALLOW** correct molecular, structural **OR** skeletal **OR** displayed formula **OR** mixture of the above as long as non-ambiguous
			Total	10	

Question			Answer	Marks	Guidance
4	(a)		 One correct H–O dipole **AND** lone pair on O ✓ Hydrogen bond between O**:** and H on 2nd molecule ✓	**2**	
4	(b)		$H_2SO_4 + 8HI \rightarrow 4I_2 + H_2S + 4H_2O$ All species correct **OR** H_2SO_4 : HI ratio = 1 : 8 ✓ Equation complete and balanced ✓	**2**	
4	(c)	(i)	 ✓	**1**	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous
		(ii)	Any **organic** reaction in which sulfuric acid is a catalyst e.g: Elimination of (H_2O from) alcohols Nitration of benzene Esterification Hydrolysis of esters/amides	**1**	The answer needs to refer to the reaction: i.e. 'Elimination', 'hydrolysis' are insufficient but 'Esterification' describes the reaction **DO NOT ALLOW** oxidation for alcohols/ aldehydes
4	(d)	(i)	**FIRST, CHECK THE ANSWER ON ANSWER LINE**	**4**	***FULL ANNOTATIONS MUST BE USED***

Question			Answer	Marks	Guidance
			IF $\Delta_{sol}H$ = –43.3 (kJ mol^{-1}) award 4 marks **----------** ***Energy released in J OR kJ*** = 113.42 × 4.18 × 10.5 = 4978 (J) **OR** 4.978 (kJ) ✓ ***Correctly calculates n(H_2SO_4)*** = $\frac{11.28}{98.1}$ = 0.115 (mol) ✓ **ΔH value in J OR kJ** *Answer **MUST** divide energy by n(H_2SO_4)* (–) $\frac{4978}{0.115}$ **OR** (–)43286 (J) **OR** (–)$\frac{4.978}{0.115}$ **OR** (–)43.3 (kJ) ✓ *(Sign ignored and/or more than 3 SF)* Correct $\Delta_{sol}H$ in kJ **AND** – sign **AND** 3 SF = –43.3 (kJ mol^{-1}) ✓		**----------** **Calculator:** 4978.0038 **DO NOT ALLOW** less than 3 SF **IGNORE** units **ALLOW** *correctly calculated number in J **OR** kJ* **Calculator** 0.1149847095 **ALLOW ECF** from *n*(H_2SO_4) **AND/OR** Energy **Calculator from 4978 and 0.115 = 43286.95652** **From unrounded values, = 43292.74581** **IGNORE** absence of – sign and **3 SF** requirement Final mark requires – sign, kJ **AND** 3 SF **NOTE:** Use of 100 for *m* → 4389 J **ECF** available for → –38.2 kJ mol^{-1} (3 marks)
		(ii)	$\frac{0.5}{10.5}$ × 100 × 2 = 9.5% ✓ *One decimal place required*	**1**	

Question			Answer	Marks	Guidance
		(iii)	**Predictions** ΔT is less **AND** $\Delta_{sol}H$ is the same ✓ **Reason for ΔT less** (same) energy/heat spread over larger volume (of water) ✓ ΔT = 7 ºC ✓ **Reason for $\Delta_{sol}H$ same** Same energy released per mole of H_2SO_4 ✓	**4**	**ALLOW** heat spread over more water **ALLOW** 6–8 ºC **Note**: m is ~ 1/3 larger. $q = mc\Delta T$ and so ΔT will be ~ 1/3 smaller **ALLOW** $\Delta_{sol}H$ is for dissolving 1 mol
4	**(e)**	**(i)**	Complete dissociation would give $[H^+] = 0.2$ (mol dm^{-3}) ✓ pH from complete dissociation = –log 0.2 = 0.7 **OR** actual $[H^+] = 10^{-0.96} = 0.11$ (mol dm^{-3}) ✓ **Stage 1** is complete dissociation **AND** **Stage 2** is partial dissociation ✓	**3**	**IGNORE** **Stage** 1 is a strong acid **AND Stage 2** is a weak acid.
		(ii)	Observation: fizzing ✓ H^+ reacts with carbonate **AND** (Stage 2) equilibrium shifts to the right ✓	**2**	**ALLOW** effervescence/'bubbling'
			Total	**20**	

Question			Answer	Marks	Guidance
5	(a)*		*Please refer to marking instructions on page 4 of mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** A comprehensive analysis of the information available with through explanations linked to the evidence. Acid **C** identified as a tricarboxylic acid with a tertiary –OH group and the correct molecular formula of $C_6H_8O_7$. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated* **Level 2 (3–4 marks)** Analysis of the information available but explanations may be incomplete or there may be mistakes in calculations, although the method may be sound. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A simple analysis of the information available and limited explanations which may or may not be explicitly linked to the evidence. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks –** No response worthy of credit.	**6**	**Indicative scientific points may include** **Identification of functional groups** • Tribasic acid → three –COOH groups *From 1 mol **C** requires 3 mol NaOH* • Tertiary alcohol *From no colour change with hot acidified dichromate(VI)* **Determination of molecular formula of C** • $M(\mathbf{C}) = \frac{2.323}{1.21 \times 10^{-2}} = 192$ (g mol^{-1}) *From 1.21×10^{-2} mol **C** has a mass of 2.323 g.* • 192 – 3 × 45 (3 × COOH) – 16 (O) = 41 41 → C_3H_5 *(or evidence of working)* • Molecular formula = $C_6H_8O_7$ **Structure of citric acid** • 4 peaks in ^{13}C NMR → 4 types of carbon • Correct structure of **C** matching evidence.  **NOTE**: Structure below match all evidence except for ^{13}C NMR. See Level 3 criteria.  
	(b)	(i)	$C_2H_3O_3$ ✓	**1**	

Question			Answer	Marks	Guidance
		(ii)	2,3-dihydroxybutanedioic acid ✓	1	**ALLOW** 2,3-dihydroxybutane-1,4-dioic acid **ALLOW** absence of hyphens or extra hyphen or space, e.g. 2,3-dihydroxy butanedioic acid **ALLOW** full stops or spaces between numbers e.g. 2.3 dihydroxybutanedioic acid
		(iii)	 Correct amide link ✓ Rest of structure ✓	2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous 'End bonds' **MUST** be shown **IGNORE** brackets **IGNORE** *n*
		(iv)	$[H_3N^+(CH_2)_6NH_3^+]$ $[\ ^-OOC(CHOH)_2COO^-\ ]$ **OR** $[H_3N(CH_2)_6NH_3]^{2+}$ $[OOC(CHOH)_2COO]^{2-}$ Positive ion correct ✓ Negative ion correct ✓	2	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous **ALLOW** charge either on N atom or NH_3^+ Negative charge must be on COO^- **ALLOW** $[H_2N(CH_2)_6NH_3^+]$ $[\ ^-OOC(CHOH)_2COOH\ ]$
			Total	12	