

## COMPONENT 3: CHEMISTRY IN PRACTICE

### MARK SCHEME

#### GENERAL INSTRUCTIONS

##### Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark, apart from extended response questions where a level of response mark scheme is applied.

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

##### Extended response questions

A level of response mark scheme is applied. The complete response should be read in order to establish the most appropriate band. Award the higher mark if there is a good match with content and communication criteria. Award the lower mark if either content or communication barely meets the criteria.

##### Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

##### Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1.	(a)		diagram with labels calorimeter / polystyrene cup (1) thermometer (1) allow (1) if both drawn but neither labelled copper(II) sulfate (1) <b>must</b> be labelled	3			3		3
	(b)	(i)	straight line of best fit through 'after reaction' points (1) higher line extrapolated to point of mixing (1) $\Delta T$ determined from graph (1) error carried forward (ecf) possible		1	1	3	1	3
		(ii)	moles of Zn = $0.60/65$ (1)  $50 \times 4.2 \times \Delta T$ [from (i)] (1)  calculation of enthalpy change of reaction  $= \frac{50 \times 4.2 \times \Delta T \times 65}{1000 \times 0.60}$ (1)  $= -227.5$ <b>must</b> be negative value (1)  award (3) for correct answer only (cao) – AO1 mark withheld ecf possible	1	1		4	1	4
	(c)	(i)	reaction slower because surface area is less (1) fewer collisions per unit time / less chance of collisions (1)	2			2		
		(ii)	it would take more time for the graph to reach its maximum after mixing / graph will not rise as steeply accept sensible alternatives			1	1		
			<b>Question 1 total</b>	<b>6</b>	<b>5</b>	<b>2</b>	<b>13</b>	<b>3</b>	<b>10</b>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2.	(a)		final volume/ burette reading, initial volume/ burette reading and titre/ volume added headings in first column <b>with units</b> (1)  titre/ volume added in bottom row of table (1)	2			2		2
	(b)		to avoid dilution of the acid (1)  leading to a larger than expected titre (1)			2	2		2
	(c)	(i)	$2.52/106 = 0.0238$  moles of $\text{Na}_2\text{CO}_3$ in $25.0 \text{ cm}^3 = 0.00238$ (1)  $1 \text{ mol H}_2\text{SO}_4 : 1 \text{ mol Na}_2\text{CO}_3$ therefore $0.00238 \text{ mol H}_2\text{SO}_4$ in $20.10 \text{ cm}^3$ (1)  $\text{conc.} = \frac{0.00238 \times 1000}{20.1} = 0.118$ (1)  award (3) for cao allow ecf  <b>or</b>  $c_1V_1 = c_2V_2$ $c_1 = 0.0951$ (1) $0.0951 \times 0.025 = c_2 \times 0.0201$ (1) $c_2 = 0.118$ (1)		1		3	1	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2.	(c)	(ii)	burette measures $\pm 0.05 \text{ cm}^3$ but initial and final readings compound error giving $\pm 0.10 \text{ cm}^3$ (1)  max % error = $\frac{0.1}{20.1} \times 100 = 0.50 \text{ (\%)} (1)$ (accept calculation based on only one reading and on burettes with $\pm 0.10 \text{ cm}^3$ precision)  this is less than 1% error (but more than 0.1%) so record to 3 significant figures (1)			3	3	2	3
			<b>Question 2 total</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>10</b>	<b>4</b>	<b>7</b>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3.	(a)	(i)	measure the volume of gas given off (1) in a certain time period (1)  <b>or</b> measure the decrease in mass (of the reaction mixture) (1) in a certain time period (1)		2		2		2
		(ii)	temperature	1			1		1
	(b)		labelled axes with units (1) points correctly plotted – within half a small square (1) line drawn through points – should miss point at conc = 0.400 (1)	2		1	3	2	
	(c)		rate reaction (directly) proportional to concentration $\text{H}_2\text{O}_2$ therefore first order with respect to $\text{H}_2\text{O}_2 / x = 1$ (1)  $k = \frac{0.0511}{[0.100][0.103]}$ (1)  $k = 4.96$ (1) (answer must be given to 3 sig figs)  $\text{dm}^3 \text{mol}^{-1} \text{s}^{-1}$ (1) (accept $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$ )  credit similar calculation based on other set of results ecf possible		1	1			
			<b>Question 3 total</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>10</b>	<b>6</b>	<b>7</b>

Question	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
4.	<p>award (1) for each relevant test linked to functional group / named compound(s) up to maximum of 3 marks – general description of test rather than exact reagents is sufficient</p> <p>for example            2,4 DNPH identifies carbonyl compounds (1)            Tollens' identifies aldehyde (1)            iodoform identifies methyl ketone (1)            hydrolysis/Ag<sup>+</sup> identifies halogenoalkane (1)</p> <p>all 3 could be awarded by implication is a well-constructed plan maximum of 2 marks if any irrelevant/unnecessary test included [AO3 mark withheld]</p> <p>all 5 compounds identified with clear rationale including all observations and conclusions (4)            all 5 compounds identified with some missing detail in rationale (3)            at least three compounds identified with some missing detail in rationale (2)            at least two compounds identified (1)</p> <p>strategy clearly indicating that tests are only carried out on compounds that remain unidentified (1)</p> <p>for example            2,4 DNPH test on all compounds – orange/yellow/red ppt with 3 compounds and no reaction with 2 compounds; Tollens' test on 3 compounds giving positive 2,4 DNPH – silver mirror with propanal and no reaction with 2 compounds; iodoform test on 2 compounds giving negative Tollens' – pale yellow ppt with butanone and no reaction with pentan-3-one            hydrolysis/Ag<sup>+</sup> test on 2 compounds giving negative 2,4 DNPH – white ppt with 1-chlorobutane and cream ppt with 1-bromobutane</p>	2		1			
	<b>Question 4 total</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>8</b>	<b>0</b>	<b>8</b>

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5.	(a)		reflux	1			1		1
	(b)		$\text{C}_6\text{H}_5\text{CH}_3 + \text{OH}^- + 3[\text{O}] \rightarrow \text{C}_6\text{H}_5\text{COO}^- + 2\text{H}_2\text{O} \quad (1)$ $\text{C}_6\text{H}_5\text{COO}^- + \text{H}^+ \rightarrow \text{C}_6\text{H}_5\text{COOH} \quad (1)$		2		2		
	(c)	(i)	<p>Indicative content</p> <ul style="list-style-type: none"> <li>solvent <b>B</b> selected</li> <li>dissolve solid in <b>minimum</b> amount of <b>hot</b> solvent <b>B</b></li> <li>filter mixture whilst <b>hot</b> and cool until solid recrystallises</li> <li>filter again, wash with cold solvent <b>B</b> and dry crystals</li> </ul> <p>Missing steps or an incorrect order of steps should be considered as 'significant omissions' and credit must be limited to the 1-2 marks band</p> <p><b>5-6 marks:</b> Each point included in the correct order; details in <b>bold</b> essential</p> <p><i>The candidate constructs a relevant, coherent and logically structured account including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.</i></p> <p><b>3-4 marks:</b> Correct solvent; correct order; reference to 'hot' at dissolving and filtering stages</p> <p><i>The candidate constructs a coherent account including most of the key elements of the indicative content and little irrelevant material. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.</i></p>	4		2	6		6

			<p><b>1-2 marks:</b> Minimum of two from correct solvent, dissolve in hot solvent, filter hot, cool, filter</p> <p><i>The candidate attempts to link at least two relevant points from the indicative content. Coherence is limited by omission and/or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.</i></p> <p><b>0 marks:</b> <i>The candidate does not make any attempt or give an answer worthy of credit.</i></p>						
		(ii)	measure the melting temperature and check against literature value	1			1		1
			<b>Question 5 total</b>	<b>6</b>	<b>2</b>	<b>2</b>	<b>10</b>	<b>0</b>	<b>8</b>



Question		Marking details		Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6.	(a)		sodium hydroxide added to ethanoic acid (1) ethanoic acid in (conical) flask / beaker and sodium hydroxide in burette (1) 25 cm <sup>3</sup> of acid (1)  measure pH with pH probe/ meter after each (small volume) addition / continuous measurement with data logger or computer (1)		1	1	4		4
	(b)		cresol red because indicator needs to change colour in pH range of vertical section on graph			1	1		1
	(c)		$K_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]} \quad (1)$ (from graph) pH = 2.9 (1) $[H^+] = 1.26 \times 10^{-3} \quad (1)$ $K_a = \frac{(1.26 \times 10^{-3})^2}{0.1} = 1.6 \times 10^{-5} \quad (1)$ award (4) for cao ecf possible  accept answer based on $pK_a = \text{pH}$ at half neutralisation		1	1	4	1	1
<b>Question 6 total</b>				<b>0</b>	<b>5</b>	<b>4</b>	<b>9</b>	<b>2</b>	<b>5</b>

**COMPONENT 3: CHEMISTRY IN PRACTICE****SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

<b>Question</b>	<b>AO1</b>	<b>AO2</b>	<b>AO3</b>	<b>Total</b>	<b>Maths</b>	<b>Prac</b>
<b>1.</b>	6	5	2	13	3	10
<b>2.</b>	2	3	5	10	4	7
<b>3.</b>	4	3	3	10	6	7
<b>4.</b>	2	2	4	8	0	8
<b>5.</b>	6	2	2	10	0	8
<b>6.</b>	0	5	4	9	2	5
<b>Totals</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>60</b>	<b>15</b>	<b>45</b>