

UNIT 5 API MS

2816/01

Mark Scheme

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Qu.	Expected answers	Mark:
2(a)	$\text{H}_2\text{O}_2 + 2\text{I}^- + 2\text{H}^+ \longrightarrow \text{I}_2 + 2\text{H}_2\text{O}$ equation includes H_2O_2 , I^- , H^+ as reactants and I_2 as product ✓ equation balanced ✓	2
2(b)(i)	order = 1 with respect to I^- ✓ When $[\text{I}^-]$ doubles, rate doubles ✓ order = 0 with respect to H^+ ✓ When $[\text{I}^-]$ doubles, rate doubles OR when $[\text{I}^-]$ quadruples, rate quadruples ✓	4
2(b)(ii)	rate = $k [\text{H}_2\text{O}_2] [\text{I}^-]$ ✓ [ECF from (i)]	1
2(b)(iii)	From one of experiments, e.g. Experiment 1: $k = \frac{5.75 \times 10^{-6}}{0.05 \times 0.01} \checkmark$ $= 1.15 \times 10^{-2} \checkmark \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1} \checkmark$ [ECF from (ii)]. Accept 1.2×10^{-2}	3
2(c)(i)	 $2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2 \checkmark$ 	1
2(c)(ii)	 $1 \text{ dm}^3 \text{ H}_2\text{O}_2 \longrightarrow 40 \text{ dm}^3 \text{ O}_2$ amount of $\text{O}_2 = \frac{40}{24}$ OR 1.67 mol concentration of $\text{H}_2\text{O}_2 = \frac{2 \times 40}{24} = 3.3 \text{ mol dm}^{-3}$ OR $2 \times 1.67 = 3.34$ Accept 3.3 	3
		10

Qu.	Expected Answers	Marks												
1 (a)	$K_c = \frac{[\text{CH}_3\text{COOC}_2\text{H}_5][\text{H}_2\text{O}]}{[\text{CH}_3\text{COOH}][\text{C}_2\text{H}_5\text{OH}]}$ ✓	1												
(b)(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>CH₃COOH</th> <th>C₂H₅OH</th> <th>CH₃COOC₂H₅</th> <th>H₂O</th> </tr> </thead> <tbody> <tr> <td>8.0</td> <td>14.5</td> <td>0</td> <td>0</td> </tr> <tr> <td>1.5</td> <td>8.0</td> <td>6.5</td> <td>6.5</td> </tr> </tbody> </table> <div style="text-align: center;"> </div>	CH ₃ COOH	C ₂ H ₅ OH	CH ₃ COOC ₂ H ₅	H ₂ O	8.0	14.5	0	0	1.5	8.0	6.5	6.5	2
CH ₃ COOH	C ₂ H ₅ OH	CH ₃ COOC ₂ H ₅	H ₂ O											
8.0	14.5	0	0											
1.5	8.0	6.5	6.5											
(ii)	$K_c = \frac{6.5 \times 6.5}{1.5 \times 8.0}$ ✓ = 3.5 ✓ (calc. value 3.520833333) ALLOW 2 significant figures upwards DO NOT ALLOW numerical answer if units given [or ECF based on answers to (i) and/or (a)]	2												
(c)(i)	More CH ₃ COOC ₂ H ₅ & H ₂ O OR less CH ₃ COOH & C ₂ H ₅ OH OR /equilibrium → right AND	1												
(ii)	to oppose increase in ethanol OR to decrease the ethanol OR to oppose the change ✓ AW K_c stays same ✓	1												
(d)	Stays that same OR catalyst does not shift equilibrium position ✓ forward and reverse reactions affected by same amount OR equilibrium is reached in less time OR catalyst not in K_c expression ✓	2												
(e)	Equilibrium → left OR more reactants OR less products ✓ (forward) reaction is exothermic ✓	2												
	Total:	11												

Qu.	Expected answers	Mark
4(a)	moles of NaOH = $\frac{0.152 \times 19.80}{1000} / 3.01 \times 10^{-3} \text{ mol } \checkmark$ moles of acid = $3.01 \times 10^{-3} \text{ mol } \checkmark$ (3.0096×10^{-3}) moles of acid in flask = $4 \times 3.00 \times 10^{-3} = 1.20 \times 10^{-2} \text{ mol } \checkmark$ (0.0120384) molar mass of compound = $\frac{\text{mass}}{n} = \frac{1.368}{1.20 \times 10^{-2}} = 114 \checkmark$ Molecular formula = $\text{C}_6\text{H}_{10}\text{O}_2 \checkmark$ A six carbon carboxylic acid (e.g. hexanoic acid) shown (bod) \checkmark Any 2 possible structural isomers $\checkmark \checkmark$ eg: $\text{CH}_3\text{CH}_2\text{CH}_2=\text{CH}(\text{CH}_3)\text{COOH}$ $\text{CH}_3\text{CH}_2=\text{CH}(\text{CH}_3)\text{CH}_2\text{COOH}$ Accept structural formulae or displayed formulae as long as they are unambiguous.	8
4(b)	 Rate-concentration graphs Zero order: horizontal line \checkmark First order: straight rising line going through origin \checkmark Second order: curve rising upwards going through origin OR straight line in a rate vs conc² graph \checkmark correct labeled axes shown once \checkmark Marks can be obtained by three clear sketch graphs pH curves Sketch graph with a sharp rise for strong acid and strong base with line vertical part of curve centred at about pH 7 Must be some indication of pH numbers fitting the vertical part of curve \checkmark Sketch graph with a sharp rise for strong acid and strong base with line vertical part of curve centred at a pH greater than 7 Must be some indication of pH numbers fitting the vertical part of curve \checkmark Vertical section in strong/strong graph is larger than vertical section for weak/strong graph AND pH curve for weak starts at higher pH than for strong \checkmark correct labeled axes shown once \checkmark (For x axis, accept 'volume OR amount of what is added') 	8
QWC	For pH titration pH curve, a statement that the colour change of suitable indicator range matches the vertical section \checkmark	1