UNIT S API MS

2816/01

Mark Scheme

January 2010

Qu.	Expected answers	Mark:
2(a)	$H_2O_2 + 2I^- + 2H^+ \longrightarrow I_2 + 2H_2O$ equation includes H_2O_2 , I^- , H^+ as reactants and I_2 as product \checkmark equation balanced \checkmark	2
2(b)(i)	order = 1 with respect to I⁻ ✓ When [I⁻] doubles, rate doubles ✓	4
	order = 0 with respect to H ⁺ ✓ When [I ⁻] doubles, rate doubles OR when [I ⁻] quadruples, rate quadruples ✓	19 19 19 19 19
2(b)(ii)	rate = $k [H_2O_2][\Gamma] \checkmark$ [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 x 10 ⁻² \checkmark dm ³ mol ⁻¹ s ⁻¹ \checkmark [ECF from (ii)]. Accept 1.2 × 10 ⁻²	3
2(c)(i)	$2H_1O_2 \longrightarrow 2H_2O + O_2 \checkmark$	1
2(c)(ii)	1 dm ³ H ₂ O ₂ \longrightarrow 40 dm ³ O ₂ amount of O ₂ = $\frac{40}{24}$ OR 1.67 m concentration of H ₂ O ₂ = $\frac{2 \times 40}{24}$ = 3.3 mol dm ⁻³ OR 2 × 1.67 = 3.34 Accept 3.3'	3
	Αυση σ.σ	10

Qu.	Expected Answers	Marks
1 (a)	$K_{c} = \frac{[CH_{3}COOC_{2}H_{5}][H_{2}O]}{[CH_{3}COOH][C_{2}H_{5}OH]} \checkmark$	1
(b)(i)	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
(ii)	$K_c = \frac{6.5 \times 6.5}{1.5 \times 8.0} \checkmark = 3.5 \checkmark$ (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 \checkmark forward and reverse reactions affected by same amount OR equilibrium is reached in less time OR catalyst not in K_c expression \checkmark	2
(e)	Equilibrium —→ left OR more reactants OR less products ✓ (forward) reaction is exothermic ✓	2
	Total:	11

Expected answers	Mark
$I_2(aq) + H_2S(g) \longrightarrow 2HI(aq) + S(s)$	2
state symbols: accept (s) for l₂; (aq) for H₂S ✓	
moles HI = $\frac{47.2}{1.5}$ = 0.36875 mol \checkmark	2
1=0	
$[HI] = \frac{0.00076 \text{ Å} 1000}{225} = 1.64 \text{ mol dm}^3$	
pH = -log 1.64 = -0.21 ✓	
CH₃COOH ⇒ H ⁺ + CH₃COO⁻ ✓	1
,	
$K_{a} = \frac{[H^{+}(aq)] [CH_{3}COO^{-}(aq)]}{[CH_{3}COOH(aq)]} OR [H^{+}] = \sqrt{([CH_{3}COOH] [K_{a}])} \checkmark$	3
1111	
FCF: pH Must be from both ICH-COOHI AND K-	
If no square root, ECF answer = 7.33	
HI + CH₃COOH = I + CH₃COOH₂+ ✓	2
acid 1 base 2 base 1 acid 2 ✓	
Mark acid base pairs ECF from equation showing ethanoic acid as	
proton donor	
NaHCO₂ is an alkali or base / neutralises acid ✓	2
vinegar is acidic ✓	2
neutralises alkali in wasp sting ✓	
$K_a \times [HCOOH(aq)] = 1.60 \times 10^{-4} \times 0.75$	2
[1,000 (44)]	
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	'
	½(aq) + H₂S(g) → 2HI(aq) + S(s) species and balance ✓ state symbols: accept (s) for I₂; (aq) for H₂S ✓ moles HI = 47.2 / 128 = 0.36875 mol ✓ accept rounding back to 0.369 mol [HI] = 0.36875 × 1000 / 225

Qu.	Expected answers	Mark
4(a)	moles of NaOH = <u>0.152 × 19.80</u> / 3.01 × 10 ⁻³ mol ✓	8
	1000	
	moles of acid = $3.01 \times 10^{-3} \text{ mol } \checkmark (3.0096 \times 10^{-3})$	
	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 = C ₆ H ₁₀ O ₂ ✓	
	A six carbon carboxylic acid	
	(e.g. hexanoic acid) shown (bod) ✓	
	Any 2 possible structural isomers ✓✓ eg:	
	CH ₃ CH ₂ CH ₂ =CH(CH ₃)COOH	
	CH ₃ CH ₂ =CH(CH ₃)CH ₂ COOH	
	Accept structural formulae or displayed formulae as long as they are unambiguous.	
4(9)	Rate-concentration graphs	8
	Zero order: horizontal line ✓	
	First order: straight rising line going through origin ✓	
***	Second order: curve rising upwards going through origin	
	Of straight line in a rate vs conc² graph ✓	
	correct abeled axes shown once ✓	
	Marks can be obtained by three clear sketch graphs	
	pH curves	
	Sketch graph with a sharp ise for strong acid and strong base with line	
	Vertical part of curve centred Mahout pH 7	
	Must be some indication of pH numbers fitting the vertical part of curve ✓	
	Sketch graph with a sharp rise for strong and and strong base with line	
	vertical part of curve centred at a pH greater than 7	
	Must be some indication of pl numbers fitting the vertical part of curve ✓	
	Vertical section in strong/strong graph is larger than vertical section for	
	weak/strong grant AND pH curve for weak starts at higher protein for	
·	strong ✓	
	correct labeled axes shown once ✓	
- FOLING	(For x axis, accept 'volume OR amount of what is added')	
QWC	For pH titration pH curve, a statement that the colour change of suitable indicator range matches the vertical section ✓	1
		10