

Acid-Base Equilibria - Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(a)(i)	<ul style="list-style-type: none"> pH = (0.85387) = 0.85 		1

Question number	Answer	Additional guidance	Mark
(a)(ii)	<ul style="list-style-type: none"> re-arrangement of K_a expression (1) calculation of $[H^+]$ (1) calculation of pH (1) 	<p>Example of calculation:</p> $[H^+]^2 = K_a [HA]$ $[H^+]^2 = 1.76 \times 10^{-5} \times 0.14$ $= 2.464 \times 10^{-6}$ $[H^+] = \sqrt{(1.76 \times 10^{-5} \times 0.14)}$ $= 1.5697 \times 10^{-3}$ <p>pH = (2.8042) = 2.8(0)</p> <p>Penalise not to 2DP once only in (a)(i) and (ii) Correct answer with no working scores 3</p>	3

Question number	Answer	Additional guidance	Mark
(b)(i)	<ul style="list-style-type: none"> at half equivalence point, pH = pK_a (1) reads off pH from graph (1) calculates K_a (1) 	<p>Example of calculation:</p> <p>= 4.8 Allow 4.5 to 5.2</p> $K_a = 10^{-pH} = 10^{-4.8} = 1.6 \times 10^{-5} \text{ (mol dm}^{-3}\text{)}$ <p>Allow answers in the range 6.3×10^{-6} to 3.2×10^{-5}</p>	3

Question number	Answer	Additional guidance	Mark
(b)(ii)	<ul style="list-style-type: none"> $[HA] \gg [A^-]$ (1) ratio $[A^-]:[HA]$ changes (significantly) in this region (1) 	<p>Allow for 1 mark 'not buffered'</p>	2

Question number	Answer	Additional guidance	Mark
(c)(i)	<ul style="list-style-type: none"> calculation of $[HA]/[A^-] = 2/1$ (1) correct calculation of $[H^+] = 2.6 \times 10^{-5}$ (mol dm⁻³) (1) correct calculation of pH (1) 	Example of calculation: $[HA] = 1.0 \times 20 \div 40 = 0.50$ $[A^-] = 1.0 \times 10 \div 40 = 0.25$ or any recognition that $[HA]/[A^-] = 2/1$ $[H^+] = 2.6 \times 10^{-5}$ (mol dm ⁻³) pH = 4.6/4.59/4.58 Correct answer with no working scores 3 marks	3

Question number	Answer	Additional guidance	Mark
(c)(ii)	<ul style="list-style-type: none"> no H⁺ ions come from (ionisation of) water or $[acid]_{initial} = [acid]_{eqm}$ 		1

Q2.

Question number	Answer	Mark
	B methyl orange	1

Q3.

Question number	Answer	Mark
	A approximately 6.5	1