A Level OCR Chemistry

Chapter 16 – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)	A proton donor that fully dissociates in water		1 1	5.1.3 AO1
1(b)	Rinse beaker (and funnel) with distilled water Fill volumetric flask so bottom of meniscus is on line Using a pipette		1 1 1	2.1.4 AO1
1(c)	$-\log[H^+]$	Allow $\log_{10}$	1	5.1.3 AO1
1(d)	Moles at start = $0.3 \times 0.05 = 0.015$ Concentration = 0.015/0.25 = 0.06 mol dm^{-3} Diprotic so 0.06×2 $[H^+]$ pH = $-\log(2 \times 0.06) = 0.92$	 Must be 2 d.p.	1 1 1 1	5.1.3 2.1.3 AO2 MS0.4, MS2.5
2(a)(i)	$mol^2\ dm^{-6}$		1	5.1.3 AO1
2(a)(ii)	$M_r\ Ba(OH)_2 = 137.3 + (2 \times 17) = 171.3\ g\ mol^{-1}$ Moles $Ba(OH)_2 = 3.50/171.3 = 0.02$ Mole $OH^- = 0.04$ $[OH^-] = 0.04/0.5 = 0.08\ mol\ dm^{-3}$ $K_w = [H^+][OH^-] = 1 \times 10^{-14}$ $[H^+] = 1 \times 10^{-14}/0.08 = 1.22 \times 10^{-13}$ pH = $-\log(1.25 \times 10^{-13})$ = 12.91	 Accept 12.90 Must be 2 d.p.	 1 1 1 1 1 1	5.1.3 AO2

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2(c)	Moles of OH^- = 0.02/5 × 2 = 0.008 Moles HCl = 0.1 × 0.25 = 0.025 Excess H^+ = 0.025 − 0.008 = 0.017 Concentration H^+ = 0.017/0.350 = 0.04857… mol dm^{-3} pH = −log(0.04857…) = 1.31	Allow their mark **2** from 02.2 /5	1 1 1 1 1	5.1.3 AO2
3(a)	Place pH probe into **multiple** buffer solutions of known pH Rinse between solutions with distilled/deionised water Record pH on meter Plot graph of pH of buffer vs pH on meter / produce calibration curve		1 1 1 1	5.1.3 AO3
3(b)	$K_a = \frac{[H^+]^2}{[HA]}$ $[H^+] = \sqrt{1.76 \times 10^{-5} \times 0.10} = 0.00133$ pH = −log (0.00133) = 2.88	 Must be 2 d.p.	1 1 1 1	5.1.3 AO2

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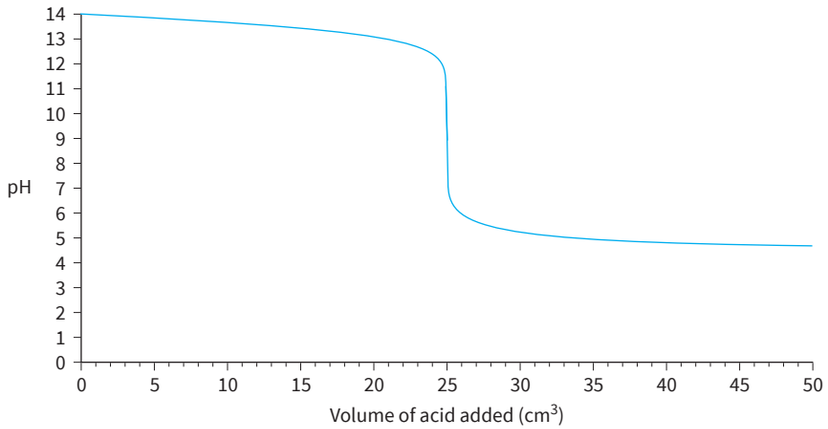
3(c)	 pH on Y axis, volume of acid on X start between 13.00 and 14.00 turn vertical before pH 7 Vertical line must be at 25 cm^3 final pH closer to pH 7 than pH 0		 1 1 1 1 1	5.1.3 AO3
3(d)	Thymolphthalein ticked		1	5.1.3 AO1
4(a)(i)	A buffer solution maintains an approximately constant pH, despite dilution or addition of small amounts of acid or base.		1 1	5.1.3 AO1

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4(a)(ii)	$K_a = 10^{-4.19} = 6.46 \times 10^{-5}$ mol dm^{-3} Moles sodium benzoate = 4.65/144.1 = 0.0323 Concentration = 0.0323/0.25 = 0.129 mol dm^{-3} $K_a = \frac{[H^+][A^-]^2}{[HA]}$ $6.46 \times 10^{-5} \times \frac{0.20}{0.129} = [H^+] = 0.0001$ mol dm^{-3} pH = −log (0.0001) = 4.00	 Allow words of reagents 	1 1 1 1 1 1	5.1.3 AO2
4(b)	**Dissolve** impure crystals in **minimum** volume **Hot** water/solvent Filter using a hot funnel Allow (filtrate) to cool and crystals to form Filter under reduced pressure/Buchner funnel and side arm flask	 Ignore reference to pumps etc..	1 1 1 1 1	6.2.5 AO3
5(a)	A proton acceptor that fully dissociates in water		1 1	5.1.3 AO1
5(b)(i)	Volume of acid on x axis and pH on y- axis Suitable scales All points plotted correctly Smooth line with vertical line that crosses pH 7 at 25 cm^3	 Allow two errors outside 1 mm reject straight line from dot to dot	1 1 1 1	5.1.3 AO3

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5(c) (i)	% oxygen = 100−26−4.3 = 69.7 C = 26/12= 2.17 H = 4.3/1 = 4.3 O = 69.7/16 = 4.36 C = 2.17/2.17 = 1 H = 4.3/2.17 = 1.98 = 2 O = 4.36/2.17 = 2.00 CH_2O_2		1 1 1 1	2.1.3 AO2
5(c)(ii)	CH_2O_2		1	2.1.3 AO2
5(c)(iii)	Methanoic acid		1	4.1.1 AO1
6(a)	$K_w = [H^+][OH^-]$		1	5.1.3 AO1
6(b)(i)	$5.84\times10^{-14} = [H^+]^2$ as $[H^+] = [OH^-]$ $[H^+] = \sqrt{5.84\times10^{-14}} = 2.416\ldots \times10^{-7}$ pH = −log (2.42×10^{-7}) = 6.62	Must be 2 d.p.	1 1 1 1	5.1.3 AO2
6(b)(ii)	Same concentration of OH^- and H^+		1	5.1.3 AO1
6(c)	$(\Delta_r H = \Sigma\Delta_f H(\text{prod.}) - \Sigma\Delta_f H(\text{react.}))$ (−22.1) + (−300) − (2 × −293) = 263.9 kJ mol^{-1}		1 1	3.2.1 AO2 MS2.4

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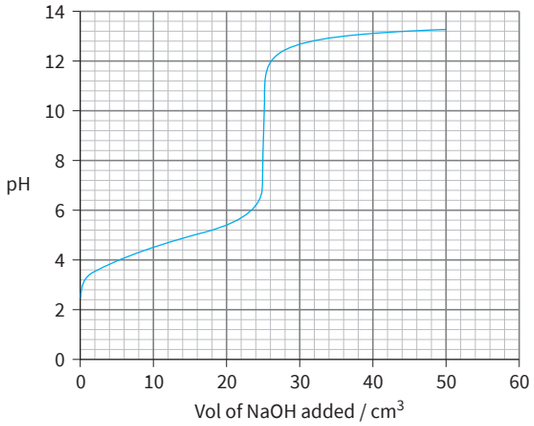
Skills box answers:

a) (i)



(ii) Read off the middle of the vertical portion of the graph. $8.8 \leq pH \leq 9.2$

(iii) Any sensible suggestion. Phenolphthalein or Cresolphthalein or Thymol blue (second step)

b) At the start the pH = 2.5. Using $[H^+] = 10^{-2.5}$ and $K_a = \frac{[H^+][A^-]}{[HA]} \approx \frac{[H^+]^2}{[HA]} = \frac{10^{-2.5 \times 2}}{0.5} = 2.00 \times 10^{-5}$ mol dm^{-3}