Solutions

Each answer shows the steps, then the **result**.

2.1

- NO_3^-

2.2

- $\text{pH} = -\log(0.010) = 2.0$

3.1 B

- A weak acid and its salt make a buffer

3.2 C

- $[H^+] = 10^{-14}/0.10 = 10^{-13}$, so pH = 13

3.3

(a)

- $[H^+] = \sqrt{K_a[HA]} = \sqrt{1.8 \times 10^{-5} \times 0.10} = \sqrt{1.8 \times 10^{-6}} = 1.34 \times 10^{-3}$
- $\text{pH} = -\log(1.34 \times 10^{-3}) = 2.87$

(b)

- HA is only partly dissociated, so $[H^+]$ is lower than for fully-dissociated HCl, giving a higher pH

3.4

(a)

- $[H^+] = K_a \dfrac{[HA]}{[A^-]} = 1.8 \times 10^{-5} \times \dfrac{0.20}{0.20} = 1.8 \times 10^{-5}$; pH = 4.74

(b)

- added H^+ reacts with the ethanoate ion: $CH_3COO^- + H^+ \rightarrow CH_3COOH$, removing most of the added H^+ so the pH barely changes

3.5

(a)

- $K_{sp} = [Ag^+][Cl^-]$

(b)

- $s = \sqrt{1.8 \times 10^{-10}} = \mathbf{1.3 \times 10^{-5}}$ mol dm^{-3}

(c)

- $[Cl^-] = 0.10$ (the dissolved AgCl adds a negligible amount), so $s = [Ag^+] = \dfrac{1.8 \times 10^{-10}}{0.10}$
- $s = \mathbf{1.8 \times 10^{-9}}$ mol dm^{-3}

(d)

- the extra Cl^- (common ion) shifts the equilibrium $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$ to the left, so less AgCl dissolves

3.6

(a)

- added OH^- reacts with the ethanoic acid: $CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O$
- the large amounts of acid and ethanoate mean the ratio $[HA]/[A^-]$ barely changes, so the pH barely changes

(b)

- add sodium hydroxide to an excess of ethanoic acid, so only part of the acid is converted into ethanoate ions