## PRACTICE: **CALCULATING pH OF BASES**

1. $NaOH(aq) \rightarrow Na^+(aq) + OH^-(aq)$

strong base

$[OH^-(aq)] = 0.050$ mol/L

$K_w = [H^+(aq)]\,[OH^-(aq)]$

$$[H^+(aq)] = \frac{K_w}{[OH^-(aq)]}$$

$$= \frac{1.0\times10^{-14}}{0.050}$$

$$= 2.0\times10^{-13} \text{ mol/L}$$

$$pH = -\log [H^+]$$

$$= -\log (2.0\times10^{-13})$$

$$= 12.698...$$

Therefore the pH of the solution is 12.70.

2.

| | $C_5H_5N(aq)$ | + | $H_2O(l)$ | $\rightleftharpoons$ | $C_5H_5NH^+(aq)$ | + | $OH^-(aq)$ |
|---|---|---|---|---|---|---|---|
| I | 0.050 | | — | | 0 | | ~0 |
| C | –x | | — | | +x | | +x |
| E | 0.050–x | | — | | x | | x |

$$K_b = \frac{[C_5H_5NH^+(aq)]\,[OH^-(aq)]}{[C_5H_5N(aq)]}$$

$$1.5\times10^{-9} = \frac{(x)(x)}{0.050-x} \quad \{K_b = 1.5\times10^{-9} \text{ from data table on p19 in course manual}\}$$

$$1.5\times10^{-9} = \frac{x^2}{0.050-x}$$

$$1.5\times10^{-9} = \frac{x^2}{0.050} \quad \{\text{small } K_a \text{ ; assume } 0.050-x = 0.050\}$$

$$7.5\times10^{-11} = x^2 \quad \{\text{multiply by } 0.050\}$$

$$8.6602...\times10^{-6} = x \quad \{\text{square root}\}$$

$$[OH^-]_{eq} = x \text{ mol/L}$$
$$= 8.6602...\times10^{-6} \text{ mol/L}$$

$$K_w = [H^+(aq)]\,[OH^-(aq)]$$

$$[H^+(aq)] = \frac{K_w}{[OH^-(aq)]}$$
$$= \frac{1.0\times10^{-14}}{8.6602...\times10^{-6}}$$
$$= 1.1547...\times10^{-9} \text{ mol/L}$$

$$pH = -\log [H^+]$$
$$= -\log (1.1547...\times10^{-9})$$
$$= 8.9375...$$

Therefore the pH of the solution is 8.94.

3. $Ca(OH)_2(aq) \rightarrow Ca^{2+}(aq) + 2\ OH^-(aq)$

strong base

$[OH^-(aq)] = 2(0.050\ mol/L)$ {two hydroxides per calcium hydroxide}

$= 0.10\ mol/L$

$K_w = [H^+(aq)]\,[OH^-(aq)]$

$$[H^+(aq)] = \frac{K_w}{[OH^-(aq)]}$$

$$= \frac{1.0\times10^{-14}}{0.10}$$

$$= 1.0\times10^{-13}\ mol/L$$

$pH = -\log [H^+]$

$= -\log (1.0\times10^{-13})$

$= 13.00$

Therefore the pH of the solution is 13.00.