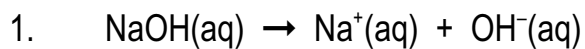


## PRACTICE: CALCULATING pH OF BASES



strong base

$$[\text{OH}^-(\text{aq})] = 0.050 \text{ mol/L}$$

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

$$\begin{aligned} [\text{H}^+(\text{aq})] &= \frac{K_w}{[\text{OH}^-(\text{aq})]} \\ &= \frac{1.0 \times 10^{-14}}{0.050} \\ &= 2.0 \times 10^{-13} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}^+] \\ &= -\log (2.0 \times 10^{-13}) \\ &= 12.698... \end{aligned}$$

Therefore the pH of the solution is 12.70.

2.

|   | $\text{C}_5\text{H}_5\text{N}(\text{aq})$ | + | $\text{H}_2\text{O}(\text{l})$ | $\rightleftharpoons$ | $\text{C}_5\text{H}_5\text{NH}^+(\text{aq})$ | + | $\text{OH}^-(\text{aq})$ |
|---|-------------------------------------------|---|--------------------------------|----------------------|----------------------------------------------|---|--------------------------|
| I | 0.050                                     |   | —                              |                      | 0                                            |   | ~0                       |
| C | -x                                        |   | —                              |                      | +x                                           |   | +x                       |
| E | 0.050-x                                   |   | —                              |                      | x                                            |   | x                        |

$$K_b = \frac{[\text{C}_5\text{H}_5\text{NH}^+(\text{aq})][\text{OH}^-(\text{aq})]}{[\text{C}_5\text{H}_5\text{N}(\text{aq})]}$$

$$1.5 \times 10^{-9} = \frac{(x)(x)}{0.050-x} \quad \{K_b = 1.5 \times 10^{-9} \text{ from data table on p19 in course manual}\}$$

$$1.5 \times 10^{-9} = \frac{x^2}{0.050-x}$$

$$1.5 \times 10^{-9} = \frac{x^2}{0.050} \quad \{\text{small } K_a ; \text{ assume } 0.050-x = 0.050\}$$

$$7.5 \times 10^{-11} = x^2 \quad \{\text{multiply by } 0.050\}$$

$$8.6602 \times 10^{-6} = x \quad \{\text{square root}\}$$

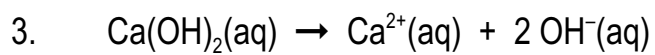
$$\begin{aligned} [\text{OH}^-]_{\text{eq}} &= x \text{ mol/L} \\ &= 8.6602 \times 10^{-6} \text{ mol/L} \end{aligned}$$

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

$$\begin{aligned} [\text{H}^+(\text{aq})] &= \frac{K_w}{[\text{OH}^-(\text{aq})]} \\ &= \frac{1.0 \times 10^{-14}}{8.6602 \times 10^{-6}} \\ &= 1.1547 \times 10^{-9} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}^+] \\ &= -\log (1.1547 \times 10^{-9}) \\ &= 8.9375 \dots \end{aligned}$$

Therefore the pH of the solution is 8.94.



strong base

$$\begin{aligned} [\text{OH}^{-}(\text{aq})] &= 2(0.050 \text{ mol/L}) && \{\text{two hydroxides per calcium hydroxide}\} \\ &= 0.10 \text{ mol/L} \end{aligned}$$

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

$$\begin{aligned} [\text{H}^{+}(\text{aq})] &= \frac{K_w}{[\text{OH}^{-}(\text{aq})]} \\ &= \frac{1.0 \times 10^{-14}}{0.10} \\ &= 1.0 \times 10^{-13} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}^{+}] \\ &= -\log (1.0 \times 10^{-13}) \\ &= 13.00 \end{aligned}$$

Therefore the pH of the solution is 13.00.