

EQUILIBRIUM LESSON-10 QUIZ: CALCULATING pH OF BASES

1. Calculate the pH of a 0.015 mol/L solution of ammonia, $\text{NH}_3(\text{aq})$.
Clearly show your process.

ANSWER

	$\text{NH}_3(\text{aq})$	+	$\text{H}_2\text{O}(\text{l})$	\rightleftharpoons	$\text{NH}_4^+(\text{aq})$	+	$\text{OH}^-(\text{aq})$
I	0.015		—		0		~0
C	-x		—		+x		+x
E	0.015-x		—		x		x

$$K_b = \frac{[\text{NH}_4^+(\text{aq})][\text{OH}^-(\text{aq})]}{[\text{NH}_3(\text{aq})]}$$

$$1.8 \times 10^{-5} = \frac{(x)(x)}{0.015-x} \quad \{K_b = 1.8 \times 10^{-5} \text{ from data table in information package}\}$$

$$1.8 \times 10^{-5} = \frac{x^2}{0.015-x}$$

$$1.8 \times 10^{-5} = \frac{x^2}{0.015} \quad \{\text{small } K_b ; \text{ assume } 0.015-x = 0.015\}$$

$$2.7 \times 10^{-7} = x^2 \quad \{\text{multiply by } 0.015\}$$

$$5.1961 \times 10^{-4} = x \quad \{\text{square root}\}$$

$$\begin{aligned} [\text{OH}^-]_{\text{eq}} &= x \text{ mol/L} \\ &= 5.1961 \times 10^{-4} \text{ mol/L} \end{aligned}$$

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

$$\begin{aligned} [\text{H}^+(\text{aq})] &= \frac{K_w}{[\text{OH}^-(\text{aq})]} \\ &= \frac{1.0 \times 10^{-14}}{5.1961 \times 10^{-4}} \\ &= 1.9245 \times 10^{-11} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}^+] \\ &= -\log (1.9245 \times 10^{-11}) \\ &= 10.7156 \dots \end{aligned}$$

Therefore the pH of the solution is 10.72.