15.41 Why do we not usually quote $K_a$ values for strong acids such as HCl and HNO$_3$? Why is it necessary to specify temperature when giving $K_a$ values?

15.42 Which has the highest pH value: (a) 0.40 M HCOOH, (b) 0.40 M HClO$_4$ or (c) 0.40 M CH$_3$COOH?

15.44 What are the concentrations of H$^+$, CH$_3$COO$^-$, and CH$_3$COOH at equilibrium in a 50.0 mL solution containing 0.0560 g CH$_3$COOH ($K_a = 1.8 \times 10^{-5}$)? Check that the 5% approximation is valid.

\[ \text{CH}_3\text{COOH}(aq) + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COO}^-(aq) + \text{H}_3\text{O}^+ (aq) \]

I (M): \\
C (M): \\
E (M):

15.45 What is the $K_a$ of an acid if a solution with initial concentration 0.010 M has pH = 6.20?

**Important:** Since the pH of this solution is so close to being neutral, the ionization of water is significant. Thus, we need to assume that the [H$^+$] is $1.0 \times 10^{-7}$M before the acid is added. Thus, I have written $1.0 \times 10^{-7}$M as the initial [H$^+$] into the ICE chart below. Now, since the pH of the equilibrium solution is 6.20, determine the equilibrium [H$^+$] and complete the rest of the ICE chart. Lastly, solve for $K_a$.

\[ \text{HA}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{A}^-(aq) \]

\[
\begin{array}{c|c|c|c}
I & C & E \\
0.010 & 1.0 \times 10^{-7} & 0 \\
\end{array}
\]

15.49 A 0.040 M solution of a monoprotic acid is 14% ionized. Calculate $K_a$ of the acid.

\[ \text{HA}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{A}^-(aq) \]

\[
\begin{array}{c|c|c|c}
I & C & E \\
0.040 & & \\
\end{array}
\]
15.46 What is the original molarity of a solution of formic acid (HCOOH) whose pH is 3.26 at equilibrium?\[ \text{\(K_a = 1.7 \times 10^{-4}\). [Hint: set the \([HCOOH]_o = I\) in the ICE table. What must \([H^+]_e\) and \([HCOO^-]_e\) be?]} \]

\[
\text{HCOOH(aq) + H}_2\text{O(l) \rightleftharpoons HCOO}^-\text{(aq)} + \text{H}_3\text{O}^+ (aq) \]

I (M):
C(M):
E(M):

15.52 Which of the following has a higher pH? (a) 0.20 M NH\(_3\) or (b) 0.20 M NaOH

15.54 The pH of a 0.30 \(M\) solution of a weak base is 10.66. What is \(K_b\) of the base?

\[
\text{B(aq) + H}_2\text{O(l) \rightleftharpoons B(OH)_2}} \]

I(M):
C (M):
E (M):

15.56 In a 0.080 \(M\) NH\(_3\) solution, what are the pH and the percent ionization of the NH\(_3\) (as NH\(_4^+\))? The \(K_a\) of NH\(_4^+\) = 5.6 \(\times\) 10\(^{-10}\).

\[
\text{NH}_3(aq) + \text{H}_2\text{O(l) \rightleftharpoons NH}_4^+(aq) + \text{OH}^- (aq) \]

I(M):
C (M):
E (M):

15.57 Using the NH\(_3/\text{NH}_4^+\) system, write the equation relating \(K_a\) for a weak acid and \(K_b\) for its conjugate base and derive the relationship between \(K_a\) and \(K_b\).