Chemistry Lecture #96: pH and pOH

In addition to pH, there's also pOH. Mathematically,

\[ pOH = -\log[\text{OH}^-] \]

What is the pOH of a solution that contains \(8.7 \times 10^{-3}\) M OH⁻?

**Answer**

\[ pOH = -\log[\text{OH}^-] \]
\[ pOH = -\log[8.7 \times 10^{-3}] \]
\[ pOH = -(2.06) \]
\[ pOH = 2.06. \]

The pOH is given with two places past the decimal since \(8.7 \times 10^{-3}\) has two significant figures.

If a solution is described as a strong base or a strong acid we can assume 100% ionization. The concentration of the acid is also the concentration of \(\text{H}^+\), and the concentration of the base is the concentration of \(\text{OH}^-\).

Find the pH of 0.050 M HCl, a strong acid.

**Answer**

Since this is a strong acid, we assume 0.050 HCl means 0.050 M \(\text{H}^+\).

\[ \text{pH} = -\log[\text{H}^+] \]
\[ \text{pH} = -\log[0.050] \]
\[ \text{pH} = 1.30 \]
Find the pH of 0.030 M NaOH, a strong base.

**Answer**
Since this is a strong base, we assume that 0.030 M NaOH means 0.030 M OH⁻.

\[ \text{pOH} = -\log[\text{OH}^-] \]
\[ \text{pOH} = -\log[0.030] \]
\[ \text{pOH} = 1.52 \]

Find the pH of a 7.5 \times 10^{-4} M solution of Ca(OH)\_2, a strong base.

**Answer**
Notice that Ca(OH)\_2 contains two hydroxide groups. One formula unit of Ca(OH)\_2 will ionize to produce two OH⁻:

\[
\text{Ca(OH)}_2 \rightarrow \text{Ca}^{2+} + 2\text{OH}^- 
\]

Thus, to find the concentration of OH⁻, multiply the concentration of Ca(OH)\_2 by 2.

\[
[\text{OH}^-] = 2 \times (7.5 \times 10^{-4}) 
\]
\[
[\text{OH}^-] = 0.0015 \text{ M} 
\]

\[ \text{pOH} = -\log[\text{OH}^-] \]
\[ \text{pOH} = -\log[0.0015] \]
\[ \text{pOH} = 2.82 \]
If the pH and the pOH of a solution is added together, the sum will equal 14.00.

\[
\text{pH} + \text{pOH} = 14.00
\]

The hydroxide ion concentration of an ammonia solution is \(4.0 \times 10^{-3}\) M. Find the pH.

\[
\text{pOH} = -\log[\text{OH}^-]
\]
\[
\text{pOH} = -\log[4.0 \times 10^{-3}]
\]
\[
\text{pOH} = 2.40
\]

\[
\text{pH} + \text{pOH} = 14.00
\]
\[
\text{pH} + 2.40 = 14.00
\]
\[
\text{pH} = 11.60
\]

The pOH of a solution is 5.42. Find the concentration of \(\text{H}^+\).

\[
\text{pH} + \text{pOH} = 14.00
\]
\[
\text{pH} + 5.42 = 14.00
\]
\[
\text{pH} = 8.58
\]

\[
\text{pH} = -\log[\text{H}^+]
\]
\[
8.58 = -\log[\text{H}^+]
\]
\[
-8.58 = \log[\text{H}^+]
\]
\[
[\text{H}^+] = 10^{-8.58}
\]
\[
[\text{H}^+] = 2.6 \times 10^{-9}\ \text{M}
\]