

## Chemistry Lecture #96: pH and pOH

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

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

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

*Answer*

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

$$\text{pOH} = -\log[8.7 \times 10^{-3}]$$

$$\text{pOH} = -(-2.06)$$

$$\text{pOH} = 2.06$$

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 pOH 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<sup>-</sup>.

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

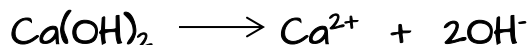
$$\text{pOH} = -\log[0.030]$$

$$\text{pOH} = 1.52$$

Find the pOH of a  $7.5 \times 10^{-4}$  M solution of Ca(OH)<sub>2</sub>, a strong base.

*Answer*

Notice that Ca(OH)<sub>2</sub> contains two hydroxide groups. One formula unit of Ca(OH)<sub>2</sub> will ionize to produce two OH<sup>-</sup>.



Thus, to find the concentration of OH<sup>-</sup>, multiply the concentration of Ca(OH)<sub>2</sub> 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  $\text{H}^+$ .

$$\text{pH} + \text{pOH} = 14.00$$

$$\text{pH} + 5.42 = 14.00$$

$$\text{pH} = 8.58$$

$$\text{pH} = -\log[\text{H}^+]$$

$$8.58 = -\log[\text{H}^+]$$

$$-8.58 = \log[\text{H}^+]$$

$$[\text{H}^+] = 10^{-8.58}$$

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