

pH Practice Problems

Name Key

Use the pH equations covered in your notes to complete the following problems.

1) A 250.0 mL solution of hydrochloric acid is prepared from 8.37 g of solute.

a. What is the  $[H_3O^+]$  of the solution?

$$250.0 \text{ mL} \left( \frac{1 \text{ L}}{1000 \text{ mL}} \right) = 0.2500 \text{ L}$$

$$8.37 \text{ g} \left( \frac{1 \text{ mol}}{36.46 \text{ g}} \right) = 0.230 \text{ mol HCl}$$

$$\frac{0.230 \text{ mol HCl}}{0.2500 \text{ L}} = 0.918 \text{ M HCl} \left( \frac{1 \text{ mol } H^+}{1 \text{ mol HCl}} \right) = \boxed{0.918 \text{ M } H^+}$$

b. What is the pH of the solution?

$$\begin{aligned} \text{pH} &= -\log(0.918) \\ &= \boxed{0.037} \end{aligned}$$

c. What is the pOH of the solution?

$$\begin{aligned} \text{pOH} &= 14 - 0.037 \\ &= \boxed{13.96} \end{aligned}$$

d. What is the  $[OH^-]$  of the solution?

$$\begin{aligned} [OH^-] &= 10^{-13.96} \\ &= \boxed{1.09 \times 10^{-14} \text{ M}} \end{aligned}$$

or

$$\begin{aligned} [OH^-] &= \frac{1.0 \times 10^{-14}}{0.918} \\ &= \boxed{1.09 \times 10^{-14} \text{ M}} \end{aligned}$$

2) A 550.0 mL solution of sulfuric acid has a pH of 1.10.

a. What is the pOH of the solution?

$$\begin{aligned} \text{pOH} &= 14 - 1.10 \\ &= \boxed{12.9} \end{aligned}$$

b. What is the  $[\text{OH}^-]$  of the solution?

$$[\text{OH}^-] = 10^{-12.9}$$

$$[\text{OH}^-] = \boxed{1.26 \times 10^{-13} \text{ M}}$$

c. What is the  $[\text{H}_3\text{O}^+]$  of the solution?

$$[\text{H}_3\text{O}^+] = 10^{-1.10} = \boxed{0.0794 \text{ M}}$$

or

$$[\text{H}_3\text{O}^+] = \frac{1.0 \times 10^{-14} \text{ M}}{1.26 \times 10^{-13} \text{ M}} = \boxed{0.0794 \text{ M}}$$

d. How many grams of sulfuric acid were used to make the solution?

$$0.0794 \text{ M H}^+ \left( \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol H}^+} \right) = 0.0397 \text{ M H}_2\text{SO}_4$$

$$(0.0397 \text{ M}) (0.5500 \text{ L}) = 0.0218 \text{ mol H}_2\text{SO}_4$$

$$0.0218 \text{ mol H}_2\text{SO}_4 \left( \frac{98.08 \text{ g}}{1 \text{ mol}} \right) = \boxed{2.14 \text{ g H}_2\text{SO}_4}$$

3) A 55mL solution of potassium hydroxide is made from 5.7g of solute.

a. What is the  $[\text{OH}^-]$ ?

$$0.055 \text{ L}$$

$$5.7 \text{ g} \left( \frac{1 \text{ mol}}{56.11 \text{ g}} \right) = 0.10 \text{ mol KOH}$$

$$\frac{0.10 \text{ mol KOH}}{0.055 \text{ L}} = 1.8 \text{ M KOH} \left( \frac{1 \text{ mol OH}^-}{1 \text{ mol KOH}} \right) = \boxed{1.8 \text{ M OH}^-}$$

b. What is the pOH of the solution?

$$\begin{aligned} \text{pOH} &= -\log(1.8) \\ &= \boxed{-0.27} \end{aligned}$$

c. What is the pH of the solution?

$$\begin{aligned} \text{pH} &= 14 - (-0.27) \\ &= \boxed{14.27} \end{aligned}$$

d. What is the  $[\text{H}_3\text{O}^+]$ ?

$$\begin{aligned} [\text{H}_3\text{O}^+] &= 10^{-14.27} \\ &= \boxed{5.6 \times 10^{-15} \text{ M}} \end{aligned}$$

or

$$\begin{aligned} [\text{H}_3\text{O}^+] &= \frac{1 \times 10^{-14}}{1.8} \\ &= \boxed{5.6 \times 10^{-15} \text{ M}} \end{aligned}$$

4) A 2500.0 mL solution of calcium hydroxide has a pH of 13.2

a. What is the pOH of the solution?

2.500 L

$$\text{pOH} = 14 - 13.2 \\ = \boxed{0.8}$$

b. What is the  $[\text{OH}^-]$  of the solution?

$$[\text{OH}^-] = 10^{-0.8} \\ = \boxed{0.158 \text{ M}}$$

c. What is the  $[\text{H}_3\text{O}^+]$  of the solution?

$$[\text{H}_3\text{O}^+] = 10^{-13.2} = \boxed{6.33 \times 10^{-14} \text{ M}}$$

or

$$[\text{H}_3\text{O}^+] = \frac{1 \times 10^{-14}}{0.158} = \boxed{6.33 \times 10^{-14} \text{ M}}$$

d. How many grams of calcium hydroxide were used to make the solution?

$$0.158 \text{ M OH}^- \left( \frac{1 \text{ mol Ca(OH)}_2}{2 \text{ mol OH}^-} \right) = 0.079 \text{ M Ca(OH)}_2$$

$$(0.079 \text{ M})(2.500 \text{ L}) = 0.1975 \text{ mol Ca(OH)}_2$$

$$0.1975 \text{ mol Ca(OH)}_2 \left( \frac{74.09 \text{ g}}{1 \text{ mol}} \right) = \boxed{14.6 \text{ g Ca(OH)}_2}$$