

Chemistry *Acids and Bases*

Practice Problems

ANSWERS

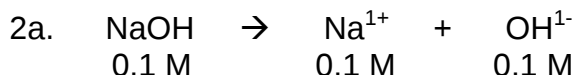
1a. $K_w = [H^{1+}] [OH^{1-}]$
 $K_w = 1.0 \times 10^{-14}$
 $1.0 \times 10^{-14} = x^2$
 $1.0 \times 10^{-7} = x$

Pure Water $[H^{1+}] = [OH^{1-}]$
 let $x = [H^{1+}]$

1a. $1.0 \times 10^{-7} \text{ M}$

1b. $pH = -\log [H^{1+}]$
 $pH = -\log [1.0 \times 10^{-7}]$
 $pH = 7$ (neutral)

1b. $pH = 7$



$K_w = [H^{1+}] [OH^{1-}]$
 $K_w = 1.0 \times 10^{-14}$
 $0.0 \times 10^{-14} = [H^{1+}] [0.1 \text{ M}]$
 $[H^{1+}] = 1.0 \times 10^{-13} \text{ M}$

2a. $1.0 \times 10^{-13} \text{ M}$

2b. $pH = -\log [H^{1+}]$
 $pH = -\log [1.0 \times 10^{-13}]$
 $pH = 13$ (base)

2b. $pH = 13$

3a. $pH = -\log [H^{1+}]$
 $5 = -\log [H^{1+}]$
 (on your calculator) $-5 \quad \boxed{10^x} = [H^{1+}]$
 $[H^{1+}] = 1.0 \times 10^{-5} \text{ M}$

3a. $1.0 \times 10^{-5} \text{ M}$

3b. $K_w = [H^{1+}] [OH^{1-}]$
 $K_w = 1.0 \times 10^{-14}$
 $1.0 \times 10^{-14} = [1.0 \times 10^{-5}] [OH^{1-}]$
 $[OH^{1-}] = 1.0 \times 10^{-9} \text{ M}$

3b. $1.0 \times 10^{-9} \text{ M}$

4a. $x \text{ mol HCl} = 1.90 \text{ g HCl} \frac{(1 \text{ mol HCl})}{(36.5 \text{ g HCl})} = 0.052 \text{ mol HCl}$

Molarity = mol / liters
 $M = (0.052 \text{ M}) / 0.642 \text{ L}$
 $[HCl] = 0.081 \text{ M}$

$pH = -\log [H^{1+}]$
 $pH = -\log [0.081 \text{ M}]$
 $pH = 1.1$ (acid)

4a. 0.081 M

$K_w = [H^{1+}] [OH^{1-}]$
 $K_w = 1.0 \times 10^{-14}$
 $1.0 \times 10^{-14} = [0.081 \text{ M}] [OH^{1-}]$
 $[OH^{1-}] = 1.2 \times 10^{-13} \text{ M}$

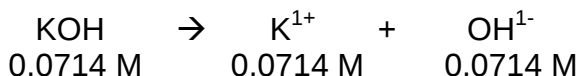
4b. $1.2 \times 10^{-13} \text{ M}$

$$5a. \quad x \text{ mol KOH} = 16.3 \text{ g KOH} \frac{(1 \text{ mol KOH})}{(56.1 \text{ g KOH})} = 0.2906 \text{ mol KOH}$$

Molarity = mol / liters

$$M = (0.2906 \text{ M}) / 4.07 \text{ L}$$

$$[\text{KOH}] = 0.0714 \text{ M}$$



$$5a. \quad 0.0714 \text{ M}$$

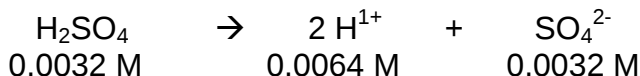
$$\begin{aligned} 5b. \quad K_w &= [\text{H}^{1+}] [\text{OH}^{1-}] \\ K_w &= 1.0 \times 10^{-14} \\ 1.0 \times 10^{-14} &= [\text{H}^{1+}] [0.0714 \text{ M}] \\ [\text{H}^{1+}] &= 1.4 \times 10^{-13} \text{ M} \end{aligned}$$

$$5b. \quad 1.4 \times 10^{-13} \text{ M}$$

$$\begin{aligned} 5c. \quad \text{pH} &= -\log [\text{H}^{1+}] \\ \text{pH} &= -\log [1.4 \times 10^{-13} \text{ M}] \\ \text{pH} &= 12.8 \quad (\text{base}) \end{aligned}$$

$$5c. \quad 12.8$$

$$6a. \quad x \text{ mol H}_2\text{SO}_4 = 0.314 \text{ g H}_2\text{SO}_4 \frac{(1 \text{ mol H}_2\text{SO}_4)}{(98.1 \text{ g H}_2\text{SO}_4)} = 3.2 \times 10^{-3} \text{ mol H}_2\text{SO}_4$$



$$6a. \quad 0.0064 \text{ M}$$

$$\begin{aligned} 6b. \quad K_w &= [\text{H}^{1+}] [\text{OH}^{1-}] \\ K_w &= 1.0 \times 10^{-14} \\ 1.0 \times 10^{-14} &= [0.0064 \text{ M}] [\text{OH}^{1-}] \\ [\text{OH}^{1-}] &= 1.56 \times 10^{-12} \text{ M} \end{aligned}$$

$$6b. \quad 1.56 \times 10^{-12} \text{ M}$$

$$\begin{aligned} 6c. \quad \text{pH} &= -\log [\text{H}^{1+}] \\ \text{pH} &= -\log [0.0064 \text{ M}] \\ \text{pH} &= 2.2 \quad (\text{acid}) \end{aligned}$$

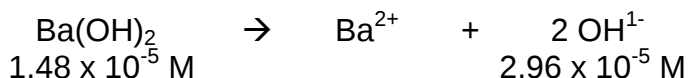
$$6c. \quad 2.2$$

$$7a. \quad x \text{ mol Ba(OH)}_2 = 0.009 \text{ g Ba(OH)}_2 \frac{(1 \text{ mol Ba(OH)}_2)}{(171.3 \text{ g Ba(OH)}_2)} = 5.25 \times 10^{-5} \text{ mol Ba(OH)}_2$$

Molarity = mol / liters

$$M = (5.25 \times 10^{-5} \text{ M}) / 3.55 \text{ L}$$

$$[\text{Ba(OH)}_2] = 1.48 \times 10^{-5} \text{ M}$$



$$7a. \quad 2.96 \times 10^{-5} \text{ M}$$

$$\begin{aligned} 7b. \quad K_w &= [\text{H}^{1+}] [\text{OH}^{1-}] \\ K_w &= 1.0 \times 10^{-14} \\ 1.0 \times 10^{-14} &= [\text{H}^{1+}] [2.96 \times 10^{-5} \text{ M}] \\ [\text{OH}^{1-}] &= 3.38 \times 10^{-10} \text{ M} \end{aligned}$$

$$7b. \quad 3.38 \times 10^{-10} \text{ M}$$

7c. $\text{pH} = -\log [\text{H}^{1+}]$
 $\text{pH} = -\log [3.38 \times 10^{-10} \text{ M}]$
 $\text{pH} = 9.47 \quad (\text{base})$

7c. 9.47

8a. $\text{pH} = 5.17 \quad [\text{H}^{1+}] = ?$
 $\text{pH} = -\log [\text{H}^{1+}]$
 $5.7 = -\log [\text{H}^{1+}]$
(on your calculator) $- 5.7 \quad \boxed{2^{\text{nd}}} \quad \boxed{\log} = [\text{H}^{1+}]$
 $\boxed{10^x}$
 $[\text{H}^{1+}] = 2.0 \times 10^{-6} \text{ M}$

8a. $2.0 \times 10^{-6} \text{ M}$

8b. $K_w = [\text{H}^{1+}] [\text{OH}^{1-}]$
 $K_w = 1.0 \times 10^{-14}$
 $1.0 \times 10^{-14} = [2.0 \times 10^{-6} \text{ M}] [\text{OH}^{1-}]$
 $[\text{OH}^{1-}] = 5.0 \times 10^{-9} \text{ M}$

8b. $5.0 \times 10^{-9} \text{ M}$

9a. $\text{pH} = 9.22 \quad [\text{H}^{1+}] = ?$
 $\text{pH} = -\log [\text{H}^{1+}]$
 $9.22 = -\log [\text{H}^{1+}]$
(on your calculator) $- 9.2 \quad \boxed{2^{\text{nd}}} \quad \boxed{\log} = [\text{H}^{1+}]$
 $\boxed{10^x}$
 $[\text{H}^{1+}] = 6.0 \times 10^{-10} \text{ M}$

9a. $6.0 \times 10^{-10} \text{ M}$

9b. $K_w = [\text{H}^{1+}] [\text{OH}^{1-}]$
 $K_w = 1.0 \times 10^{-14}$
 $1.0 \times 10^{-14} = [6.0 \times 10^{-10} \text{ M}] [\text{OH}^{1-}]$
 $[\text{OH}^{1-}] = 1.7 \times 10^{-5} \text{ M}$

9b. $1.7 \times 10^{-5} \text{ M}$