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 x 10-7 M

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

1b. pH = 7

2a. $NaOH \rightarrow Na^{1+} + OH^{1-}$
0.1 M 0.1 M 0.1 M

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

2a. 1.0×10^{-13} 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 $\boxed{10^x}$ $= [H^{1+}]$
$[H^{1+}] = 1.0 \times 10^{-5}$ M

3a. 1.0×10^{-5} M

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

3b. 1.0×10^{-9} M

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

Molarity = mol / liters
M = (0.052 M) / 0.642 L
[HCl] = 0.081 M

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

4a. 0.081 M

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

4b. 1.2×10^{-13} M

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

Molarity = mol / liters
M = (0.2906 M) / 4.07 L
[KOH] = 0.0714 M

$KOH \rightarrow K^{1+} + OH^{1-}$
0.0714 M 0.0714 M 0.0714 M

5a. 0.0714 M

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

5b. 1.4×10^{-13} M

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

5c. 12.8

6a. x mol H_2SO_4 = 0.314 g H_2SO_4 $\frac{(1 \text{ mol } H_2SO_4)}{(98.1 \text{ g } H_2SO_4)}$ = 3.2×10^{-3} mol H_2SO_4

$H_2SO_4 \rightarrow 2\ H^{1+} + SO_4^{2-}$
0.0032 M 0.0064 M 0.0032 M

6a. 0.0064 M

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

6b. 1.56×10^{-12} M

6c. pH = - log $[H^{1+}]$
pH = - log [0.0064 M]
pH = 2.2 (acid)

6c. 2.2

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

Molarity = mol / liters
M = $(5.25 \times 10^{-5} \text{ M}) / 3.55$ L
$[Ba(OH)_2] = 1.48 \times 10^{-5}$ M

$Ba(OH)_2 \rightarrow Ba^{2+} + 2\ OH^{1-}$
1.48×10^{-5} M 2.96×10^{-5} M

7a. 2.96×10^{-5} M

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

7b. 3.38×10^{-10} M

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

7c. 9.47

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

8a. 2.0×10^{-6} M

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

8b. 5.0×10^{-9} M

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

9a. 6.0×10^{-10} M

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

9b. 1.7×10^{-5} M