**WS 20.1** $pH = -\log[H^+]$ Name: _____ $[H^+] = 10^{-pH}$

**1.** Classify each compound as acidic, basic, or neutral.

KOH B  $HNO_3$ A  $Ca(OH)_2$ B  KCl N  $H_2O$ N

$Na_2CO_3$ B  NaOH B  NaBr N  $H_2SO_3$  $NH_3$ B

**2.** a. Draw the dot structure of each molecule b. Identify the type of compound/functional group
c. classify each compound as acidic, basic, or neutral.

$C_2H_5OH$ — neutral — alcohol

$CH_3COOH$ — acid — acidic! — acid

$C_4H_{10}$ — neutral — alkane

$C_2H_5NH_2$ — BASIC — amine

**3. a.** What is the pH of a 0.01 Molar solution of $HNO_3$? 2.0

**b.** What is the pH of a 0.0001 M solution of HCl? 4.0

**c.** What is the pH of a 10 Molar solution of HBr? -1.0

**4.a.** If an HCl solution has a pH of 5.0, what is the concentration of hydrogen ion in this solution? $10^{-5} = .00001\ M$

**b.** If an $HNO_3$ solution has a pH of 1.0, what is the concentration of hydrogen ion in this solution? $10^{-1} = 0.1\ M$

**c.** If a solution has a pH of -1.0, what is the concentration of hydrogen ion in this solution? $10^{+1} = 10\ M$

**d.** If a solution has a pH of 0.0, what is the concentration of hydrogen ion in this solution? $10^{-0} = 1\ M$

**5. a.** What is the pH of pure water? 7.00

**b.** Based on the pH, what is the concentration of hydrogen ion in pure water? $10^{-7.00} = 1.0 \times 10^{-7}\ M$ ($[H^+]$)

**6.** *Notes on the "Autoionization of Water" and the Equilibrium Constant, $K_w$*

$$H_2O_{(l)} \rightleftharpoons H^{+1}_{(aq)} + OH^{-1}_{(aq)}$$

$$K_w = [H^{+1}][OH^{-1}] = 1.0 \times 10^{-14}\ M^2 \text{ acc to expt at } 25^\circ C$$

In pure $H_2O$, $[H^{+1}] = [OH^-] = x$

$x^2 = (x)(x) = 1.0 \times 10^{-14}\ M^2$

$x = \sqrt{1.0 \times 10^{-14}\ M^2}$

$x = 1.0 \times 10^{-7}\ M$

$[H^+] = [OH^-] = 1.0 \times 10^{-7}\ M$

$pH = -\log(1.0 \times 10^{-7}) = \boxed{7.00}$ (neutral)

acidic

$pH < 7$

$[H^{+1}] > 10^{-7}\ M$

$[OH^-] < 10^{-7}\ M$

basic $pH > 7$

$[OH^-] > 10^{-7}\ M$

$[H^+] < 10^{-7}\ M$

**11.** Fill in the blanks and SHOW WORK!!!

| Substance | pH | Concentration of Hydrogen ion | Concentration of Hydroxide ion | A/B/N? |
|---|---|---|---|---|
| Cocacola (contains $H_3PO_4$ and $H_2CO_3$) | $-\log(.0032) = 2.49$ | 0.0032 M | $\frac{1.00\times10^{-14}}{.0032} = 3.1\times10^{-12}$ M | acid |
| Unpolluted Rain | 5.92 | $10^{-5.92} = 1.2\times10^{-6}$ M | $\frac{1.00\times10^{-14}}{1.202\times10^{-6}} = 8.3\times10^{-9}$ M | acidic (slightly) |
| Milk of Magnesia (Contains $Mg(OH)_2$) | $-\log(1.587\times10^{-10}) = 9.80$ | $\frac{1.00\times10^{-14}}{.000063} = 1.6\times10^{-10}$ M | 0.000063 M | Basic |
| Lime/Lemon Juice (contains $H_3C_6H_5O_7$) | $-\log(.0040) = 2.40$ | $\frac{1.00\times10^{-14}}{2.5\times10^{-12}} = .0040$ M | $2.5 \times 10^{-12}$ M | acidic |
| Blood | $-\log(3.8\times10^{-8}) = 7.42$ | $3.8 \times 10^{-8}$ M | $\frac{1.00\times10^{-14}}{3.8\times10^{-8}} = 2.6\times10^{-7}$ M | very slightly basic |
| Drano (contains NaOH) | 13.14 | $10^{-13.14} = 7.2\times10^{-14}$ M | $\frac{1.00\times10^{-14}}{7.2\times10^{-14}} = 1.4\times10^{-1} \rightarrow 0.14$ M | Basic |
| Apple Juice | $-\log(.00078\text{ M}) = 3.11$ | 0.00078 M | $\frac{1.00\times10^{-14}}{.00078} = 1.3\times10^{-11}$ M | acidic |
| Washing Soda Solution (Contains $Na_2CO_3$) | 11.63 | $10^{-11.63} = 2.3\times10^{-12}$ M | $\frac{1.00\times10^{-14}}{2.34\times10^{-12}} = .0043$ M | Basic |
| Gastric Juice (from your stomach) | $-\log(.030303) = 1.52$ | $\frac{1.00\times10^{-14}}{3.3\times10^{-13}} = 0.030$ M | $3.3 \times 10^{-13}$ M | acidic |
| Coffee | $-\log(2.083\times10^{-6}) = 5.68$ | $\frac{1.00\times10^{-14}}{4.8\times10^{-9}} = 2.1\times10^{-6}$ M | $4.8 \times 10^{-9}$ M | slightly acidic |
| Bleach (contains NaClO) | 12.60 | $2.5\times10^{-13}$ M | $4.0\times10^{-2} \rightarrow .040$M | basic |
| Vinegar ($HC_2H_3O_2$(aq)) | 3.11 | 0.00077 M | $1.3\times10^{-11}$ M | acid |
| 2.0 Molar HCl | −0.30 | 2.0 M | $5.0\times10^{-15}$ M | acid |
| Limewater (contains $Ca(OH)_2$) | 10.43 | $3.7\times10^{-11}$ M | $2.7\times10^{-4}$ M | base |
| 2.0 Molar NaOH | 14.30 | $5.0\times10^{-15}$ M | 2.0 M | base |