General Chemistry
Mr. MacGillivray
Worksheet: Acids & Bases, Part I

1. Answer these questions about acids. All solutions are aqueous solutions at 25°C.
   a. What is the name for the H_3O^+ ion? hydronium
   b. What is always true about $[H_3O^+]$ of acidic solutions? (Is it bigger or smaller than $[OH^-]$?) $[H_3O^+] > [OH^-]$
   c. What is the numerical value of $[H_3O^+]$ for an acid? (Give a range.) $[H_3O^+] > 10^{-7} M$
   d. What is the pH range of acids? $pH < 7$
   e. What is the pOH range of acids? → $pOH > 7$
   f. Explain what is meant by the logarithm of a number. the power to which you must raise 10 to return that number.
   g. What is the formula for calculating pH from $[H_3O^+]$? $pH = -\log[H_3O^+]$

2. Answer these questions about bases. All solutions are aqueous solutions at 25°C.
   a. What is the name for the OH^- ion? hydroxide
   b. What is always true about $[H_3O^+]$ of basic solutions? (Is it bigger or smaller than $[OH^-]$?) $[H_3O^+] < [OH^-]$ → $[OH^-] > 10^{-7} M$
   c. What is the numerical value of $[OH^-]$ for a base? (Give a range.)
   d. What is the pH range of bases? → $pH > 7$
   e. What is the pOH range of bases? $pOH < 7$
   f. What is the formula for calculating pOH from $[OH^-]$? → $pOH = -\log[OH^-]$

3. State whether the following statements (about aqueous solutions) are TRUE or FALSE:
   a. The product of **$[OH^-] \times [H_3O^+]$** is equal to 1.00×10^{-14} for a neutral solution. (T)
   b. The product of **$[OH^-] \times [H_3O^+]$** is equal to 1.00×10^{-14} for all solutions. (T)
   c. **$[OH^-] = [H_3O^+]$** for all solutions. No, False
   d. **$[OH^-] = 1.00 \times 10^{-7}$** for all solutions. No, False

4. Acids are proton (a) donors and electron pair (b) acceptors. Acids produce (c) hydronium ions in solution.

5. Bases are proton (a) acceptors and electron pair (b) donors. Bases produce (c) hydroxide ions in solution.

6. For the preceding problems you used the (a) Brønsted-Lowry (b) Lewis, and (c) Arrhenius definitions to define acids and bases.

7. Write the chemical reaction between HF acid and water below. Then, label the conjugate acid-base pairs.

$$HF + H_2O \rightleftharpoons F^- + H_3O^+$$

HF acid
H_2O base
F^- base
H_3O^+ acid

8. Write the chemical reaction between the acetate ion ($CH_3CO_2^-$), a base, and water below. Then, label the conjugate acid-base pairs.

$$C_2H_3O_2^- + H_2O \rightleftharpoons HC_2H_3O_2 + OH^-$$

OH^- base
$HC_2H_3O_2$ acid
H_2O acid
$C_2H_3O_2^-$ base

General Chemistry
Mr. MacGillivray
Worksheet: Acids & Bases, Part I

9. Fill in the missing values in each box.

Problem	Answer	Problem	Answer
$10^{3} = ?$	1000	$10^{-7} = ?$	0.0000001
$10^{?} = 1000$	10^{3}	$10^{?} = 0.0001$	10^{-4}
$10^{-4} = ?$	0.0001	$10^{-3} = ?$	0.001
$10^{?} = 0.1$	10^{-1}	$10^{?} = 0.0368$	$10^{-1.434}$

take the log of this # ($\log_{10}$)

Answer is −1.434

10. Solve for the missing values.

[OH]	$[H_3O^+]$	Acidic, Basic, or Neutral Solution	pH	pOH
1.0×10^{-7} M	1.0×10^{-7} M	N	7	7
1.0×10^{-5} M	1.0×10^{-9} M	B	9	5
1.0×10^{-5} M	1.0×10^{-9} M	B	9	5
0.0161 M	6.2×10^{-13} M	B	12.21	1.79
9.3×10^{-9} M	1.08×10^{-6} M	A	5.97	8.03

$[OH^-][6.2\times10^{-13}] = 1\times10^{-14}$

$[OH^-] = \frac{1\times10^{-14}}{6.2\times10^{-13}} = 0.0161$

$pOH = -\log[0.0161] = 1.79$

$pH = -\log[6.2\times10^{-13}] = 12.21$

$(9.3\times10^{-9})([H_3O^+]) = 1\times10^{-14}$

$[H_3O^+] = \frac{1\times10^{-14}}{9.3\times10^{-9}}$

$= 1.08\times10^{-6}\ M$

$-\log[1.08\times10^{-6}] = pH$

$5.97 =$

$pOH = 14 - 5.97 = 8.03$