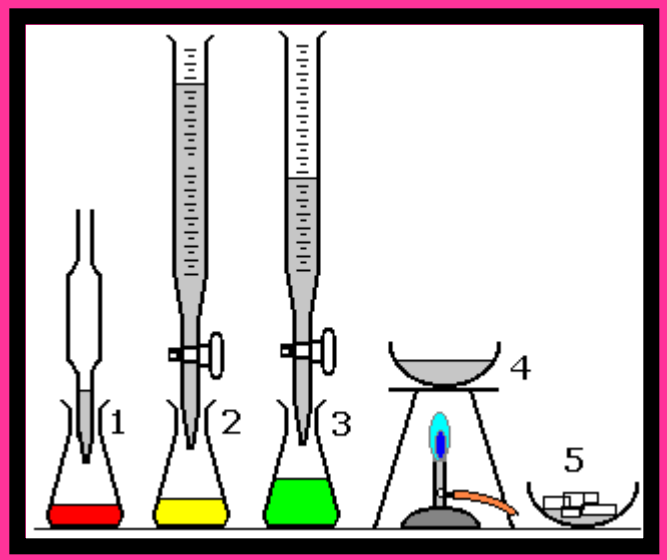
I. Introduction to Acids & Bases



A. Properties

ACIDS

- electrolytes
- sour taste
- turn litmus red
- react with metals to form H_2 gas
- vinegar, milk, soda, apples, citrus fruits

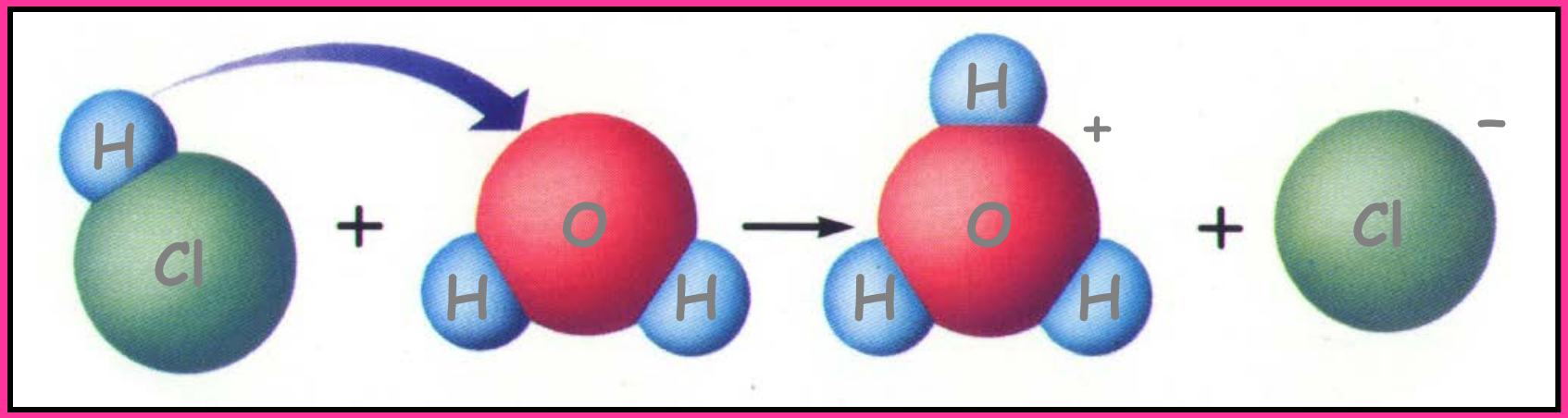
BASES

- electrolytes
- bitter taste
- turn litmus blue
- slippery feel (denature protein)
- ammonia, lye, antacid, baking soda

B. Definitions

- Arrhenius - **In aqueous solution…**
  - Acids form hydronium ions (H_3O^+)

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

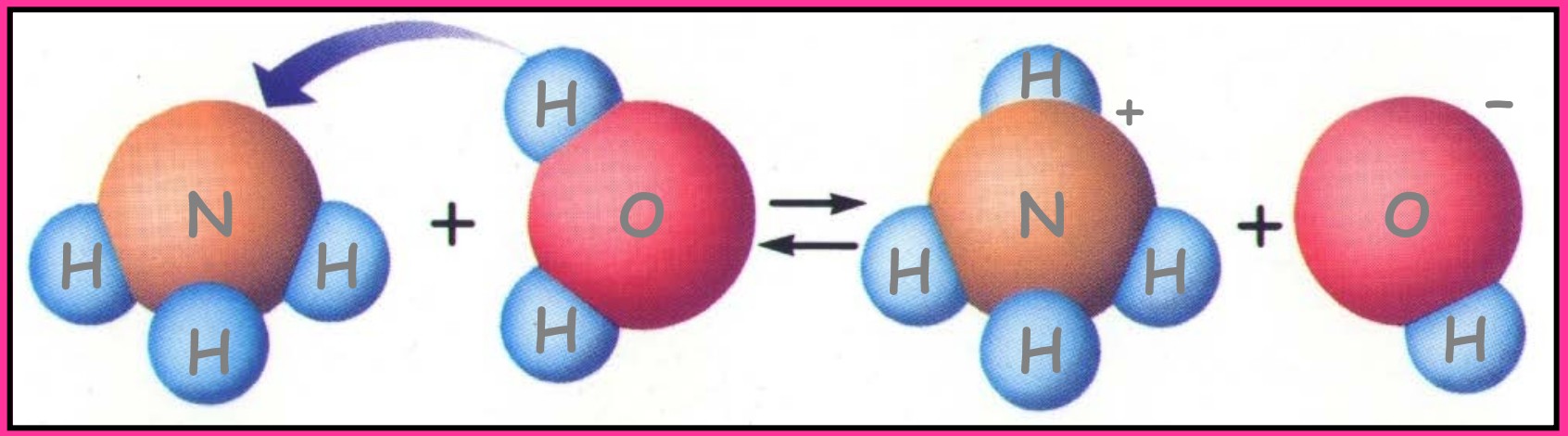


acid

B. Definitions

- Arrhenius - **In aqueous solution…**
  - Bases form hydroxide ions (OH^-)

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$



base

B. Definitions

- Brønsted-Lowry
  - Acids are proton (H^+) donors.
  - Bases are proton (H^+) acceptors.

$$HCl + H_2O \rightarrow Cl^- + H_3O^+$$

acid base

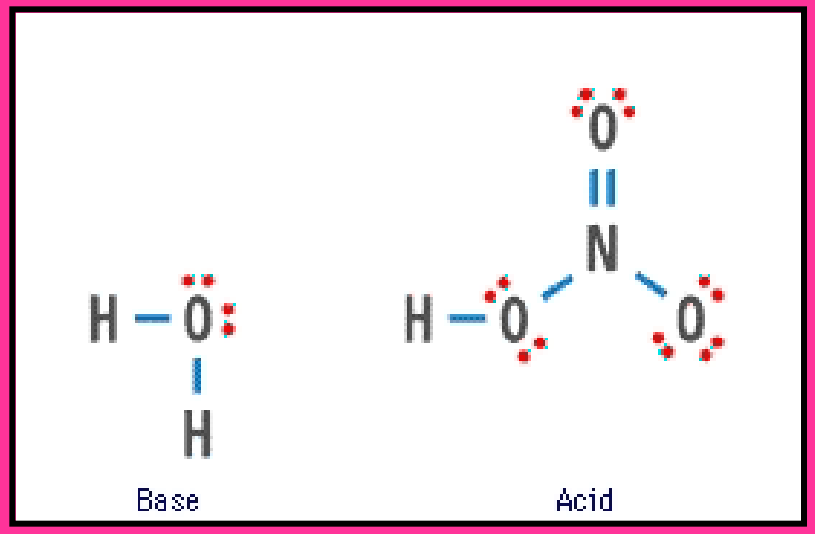
conjugate base

conjugate acid

B. Definitions

$$H_2O + HNO_3 \rightarrow H_3O^+ + NO_3^-$$

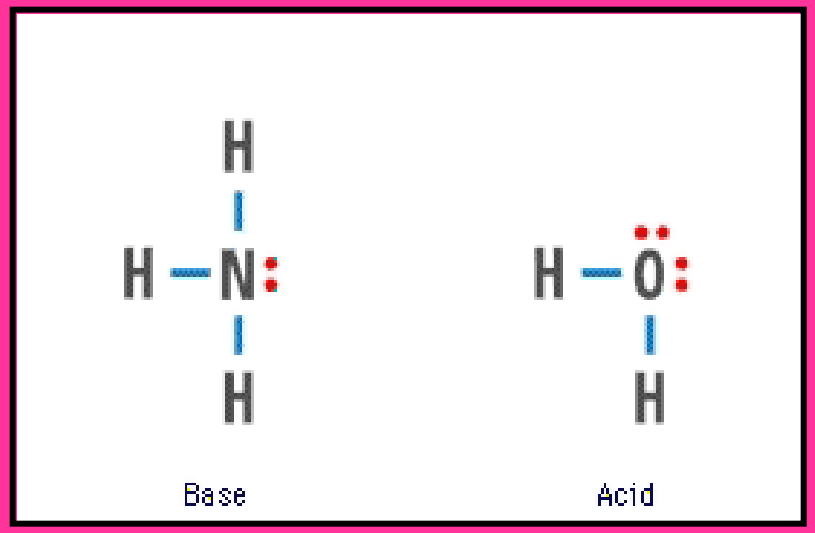
B A CA CB



B. Definitions

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$

B A CA CB



- Amphoteric - can be an acid or a base.

B. Definitions

- Give the conjugate base for each of the following:

$HF \rightarrow F^-$

$H_3PO_4 \rightarrow H_2PO_4^-$

$H_3O^+ \rightarrow H_2O$

- Polyprotic - an acid with more than one H^+

B. Definitions

- Give the conjugate acid for each of the following:

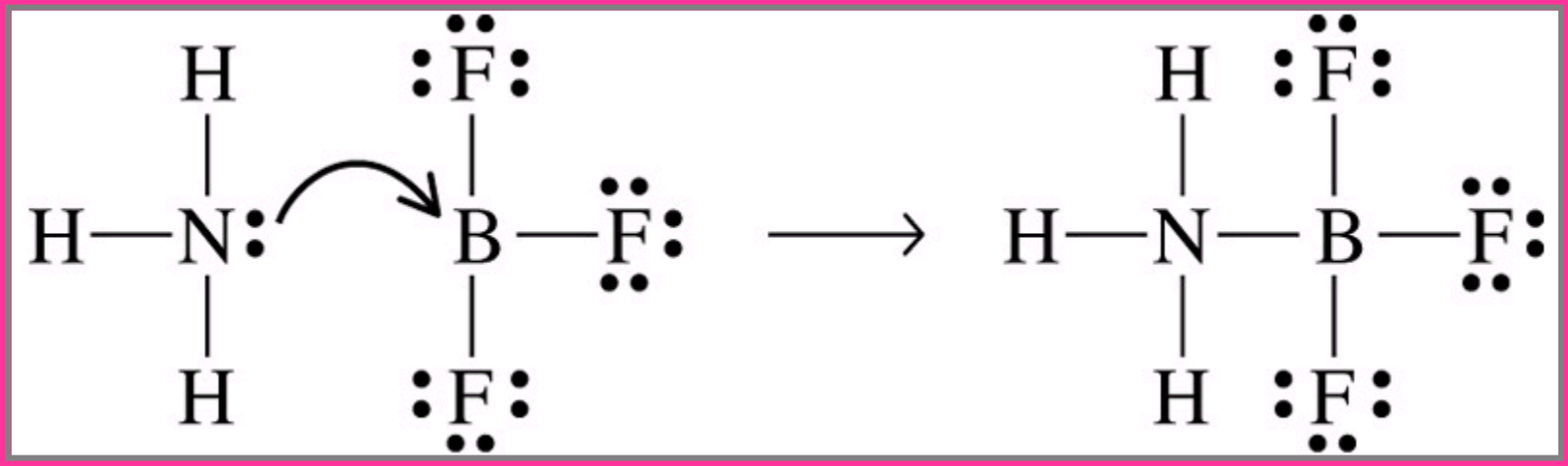
$Br^- \rightarrow HBr$

$HSO_4^- \rightarrow H_2SO_4$

$CO_3^{2-} \rightarrow HCO_3^-$

B. Definitions

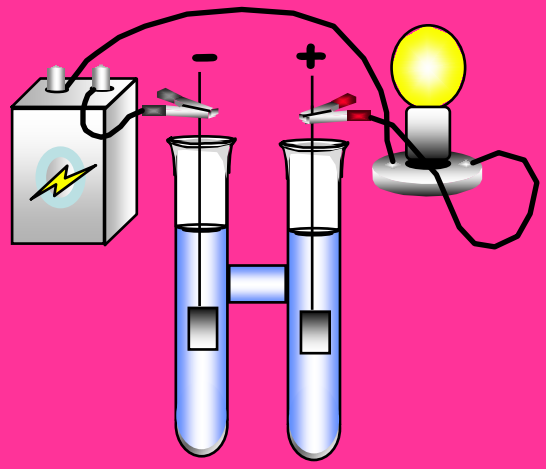
- Lewis
  - Acids are electron pair acceptors.
  - Bases are electron pair donors.



Lewis base

Lewis acid

C. Strength



- **Strong Acid/Base**
  - 100% ionized in water
  - strong electrolyte

<u>Strong Acids</u>

HCl

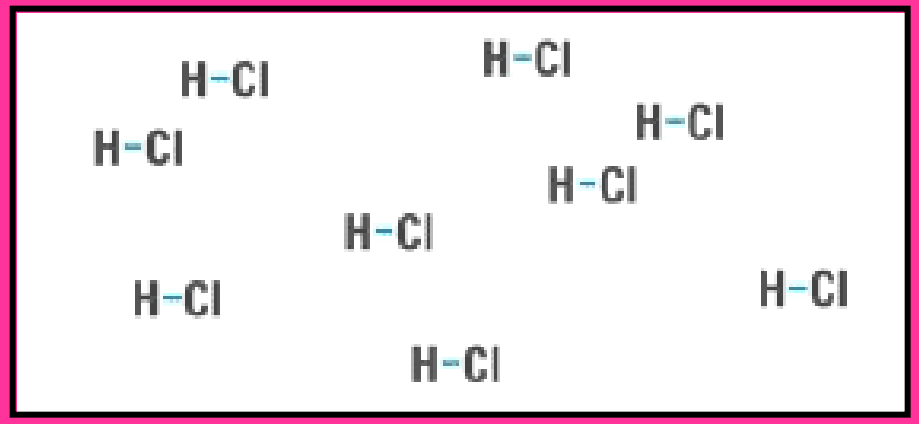
HNO_3

H_2SO_4

HBr

HI

$HClO_4$



<u>Strong Bases</u>

NaOH

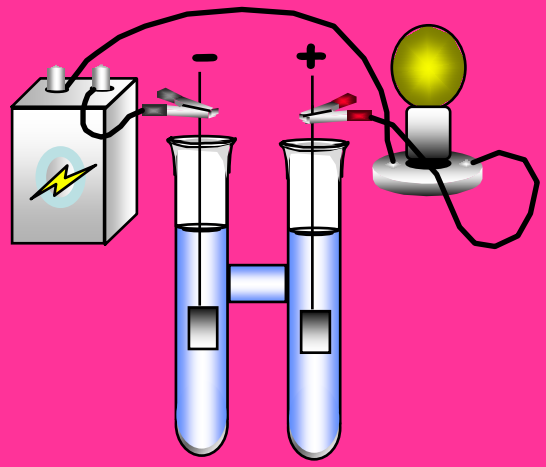
KOH

$Ca(OH)_2$

$Ba(OH)_2$

C. Strength

- **Weak Acid/Base**
  - does not ionize completely
  - weak electrolyte



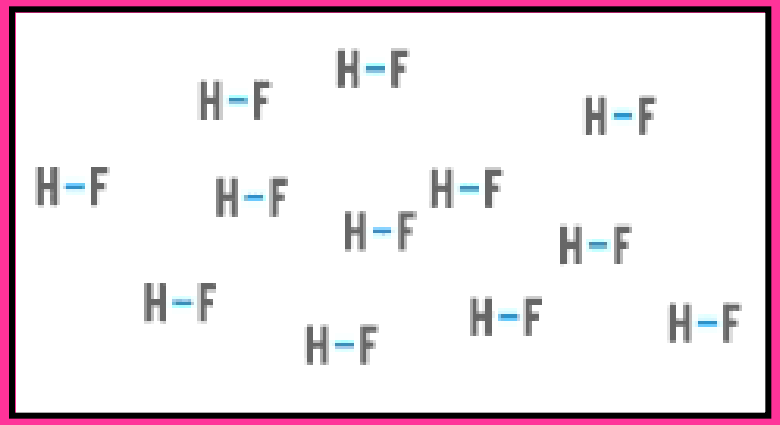
HF

CH_3COOH

H_3PO_4

H_2CO_3

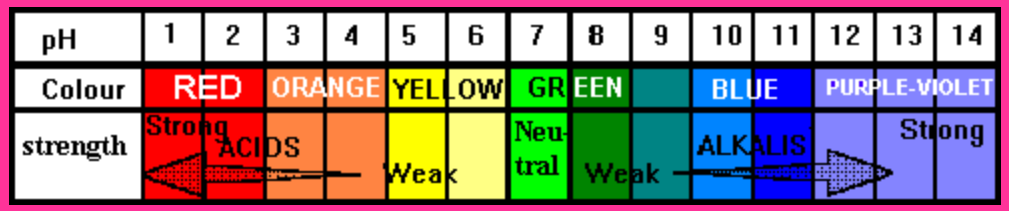
HCN



NH_3

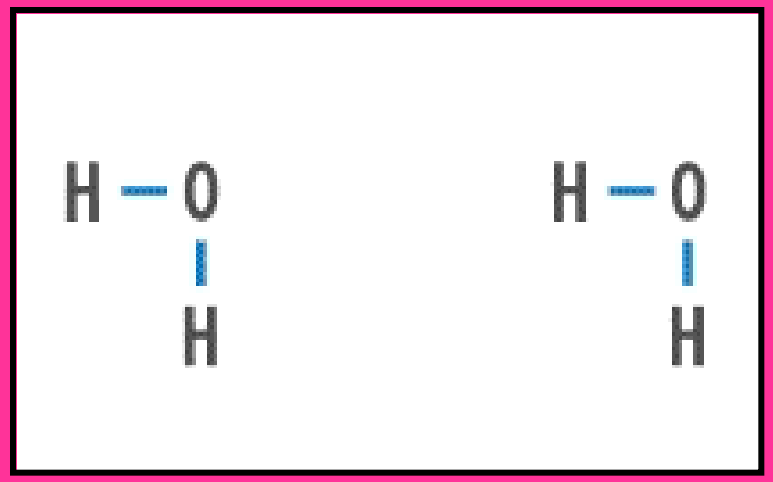
II. pH

Acids & Bases



The colors of solutions with universal indicator

A. Ionization of Water



$$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$$

$$\mathbf{K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}}$$

A. Ionization of Water

- Find the hydroxide ion concentration of 3.0×10^{-2} M HCl.

$$[H_3O^+][OH^-] = 1.0 \times 10^{-14}$$

$$[3.0 \times 10^{-2}][OH^-] = 1.0 \times 10^{-14}$$

$$\mathbf{[OH^-] = 3.3 \times 10^{-13}\ M}$$

Acidic or basic? Acidic HCL

B. pH Scale

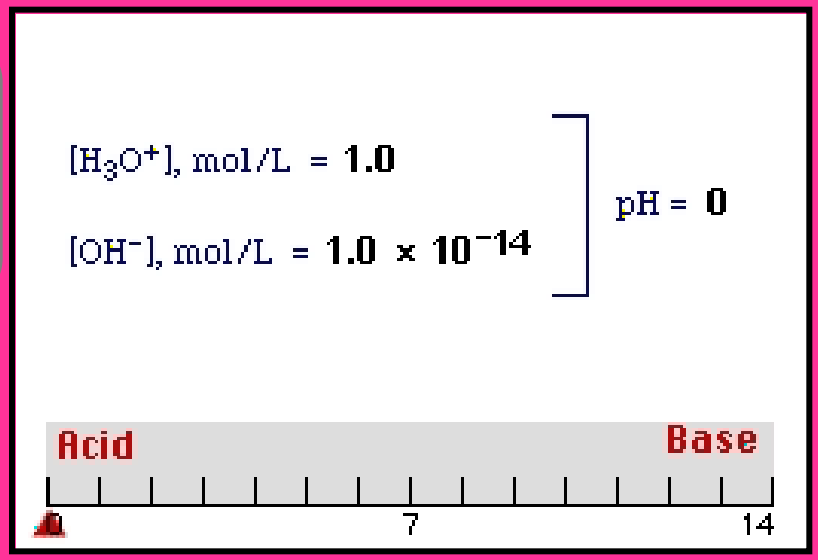
0 — 14

7

INCREASING ACIDITY ← NEUTRAL → INCREASING BASICITY

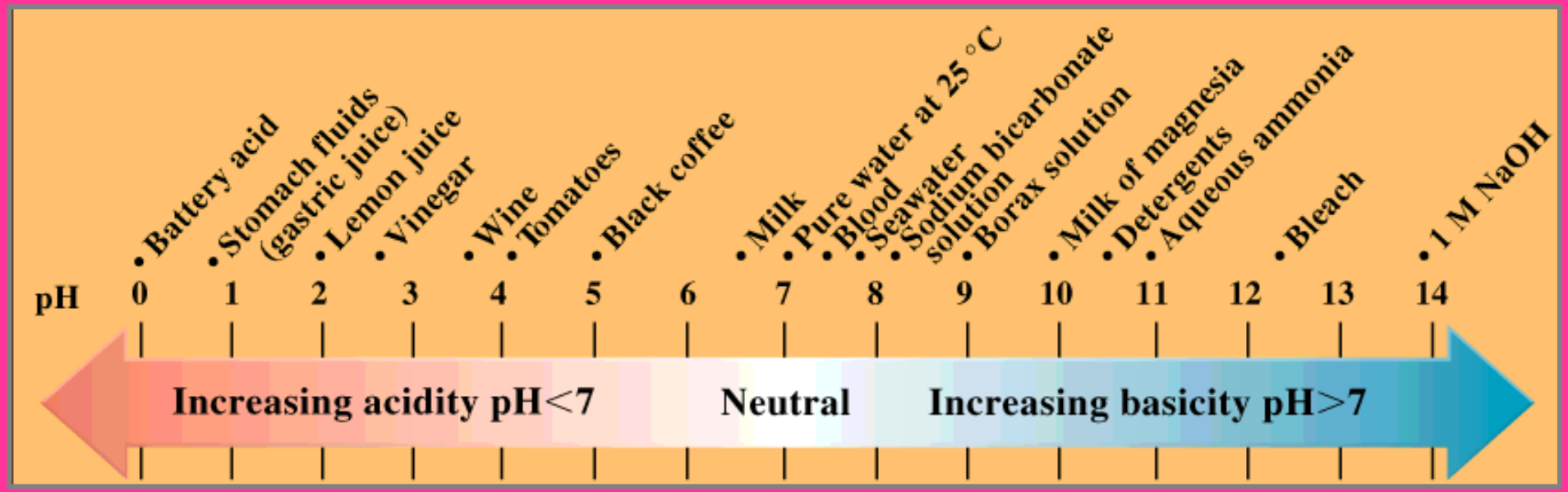
$$pH = -\log[H_3O^+]$$

pouvoir hydrogène (Fr.)
"hydrogen power"



B. pH Scale

pH of Common Substances



B. pH Scale

$$pH = -\log[H_3O^+]$$

$$pOH = -\log[OH^-]$$

$$pH + pOH = 14$$

B. pH Scale

- What is the pH of 0.050 M HNO_3?

$$pH = -\log[H_3O^+]$$

$$pH = -\log[0.050]$$

pH = 1.3

Acidic or basic? Acidic

B. pH Scale

- What is the molarity of HBr in a solution that has a pOH of 9.6?

$pH + pOH = 14$

$pH + 9.6 = 14$

$pH = 4.4$

Acidic

$pH = -\log[H_3O^+]$

$4.4 = -\log[H_3O^+]$

$-4.4 = \log[H_3O^+]$

$[H_3O^+] = 4.0 \times 10^{-5}$ M HBr

Teacher resources for acid/base unit

- http://educ.queensu.ca/~science/main/concept/chem/c10/c10main.htm
- www.docbrown.info/page03/AcidsBasesSalts.htm