U8LM1B-WS Acids and Bases Basics **Name: _____KEY_____**

1. Acids turn blue litmus **red** while bases turn red litmus **blue.**

2. According to the Arrhenius definition, an acid is a substance that produces **H^+ (hydrogen ions)** in dilute aqueous solution.
   For example: HCl (aq) → **H^+** (aq) + **Cl^-** (aq)

3. According to the Arrhenius definition, a base is a substance that produces **OH^- (hydroxide ions)** in dilute aqueous solution.
   For example: NaOH(aq) → **Na^+** (aq) + **OH^-** (aq)

4. There are **seven** common strong acids. These acids are labeled strong because they completely ionize. The names and formulas of these acids are:

HCl	**hydrochloric acid**
HBr	**hydrobromic acid**
HI	**hydroiodic acid**
HNO_3	**nitric acid**
$HClO_3$	**chloric acid**
$HClO_4$	**perchloric acid**
H_2SO_4	**sulfuric acid**

5. There are **eight** common strong bases. They are all hydroxides and their names and formulas are:

LiOH	**lithium hydroxide**
NaOH	**sodium hydroxide**
KOH	**potassium hydroxide**
RbOH	**rubidium hydroxide**
CsOH	**cesium hydroxide**
$Ca(OH)_2$	**calcium hydroxide**
$Sr(OH)_2$	**strontium hydroxide**
$Ba(OH)_2$	**barium hydroxide**

6. An acid that ionizes very slightly in dilute aqueous solution is classified as a **weak acid**.

7. The name and formula of the most common weak base are **NH_3, ammonia**. Just like a weak acid, a weak base also partially **ionizes**.

8. All hydroxides that are not strong bases are NOT weak bases, instead they are classified as **insoluble** bases.

9. Acids that are composed of two elements, a hydrogen and a non-metal, are termed **binary** acids.

10. Acids that are composed of three elements, hydrogen, oxygen and a non-metal are termed **ternary or oxy-** acids.

11. Acids that contain the **COOH (carboxyl)** group are called organic or **carboxylic** acids.

12. Among the following acids, HNO_3, HCOOH, $HClO_4$, H_3PO_4, CH_3COOH, H_2CO_3, the organic acids are **HCOOH and CH_3COOH.**

13. There are **three** strong binary acids.

14. There are **four** strong ternary acids.

15. Classify each of the following compounds as a strong acid (SA), a weak acid (WA), a strong base (SB), a weak base (WB), or an insoluble base (IB):

$Ca(OH)_2$	SB	$HClO_4$	SA
CH_3CH_2COOH	WA	LiOH	SB
NaOH	SB	$Cu(OH)_2$	IB
H_3PO_4	WA	H_2SO_4	SA
$Sr(OH)_2$	SB	H_2S	WA
CsOH	SB	HCN	WA
HCOOH	WA	HF	WA
NH_3	WB	LiOH	SB
$Fe(OH)_3$	IB	H_2SO_3	WA
CH_3NH_2	WB	HNO_3	SA
HI	SA	$Cu(OH)_2$	IB
HClO	WA	$Mg(OH)_2$	IB
$HBrO_2$	WA	H_2CO_3	WA

16. According to the Bronsted-Lowry definition, an acid is defined as a **proton** donor, and a base is defined as a proton **acceptor**.

17. List the Bronsted-Lowry conjugate acid base partners in the following reactions:

Acids are in red, bases are in blue. One conjugate "pair" is underlined, the other not.

a. $\underline{HNO_3}$ (aq) + $\underline{H_2O}$ (l) ←→ $\underline{NO_3^-}$ (aq) + H_3O^+ (aq)
Nitric acid is a B-L acid, and its conjugate base is the nitrate ion. Likewise, water is the conjugate base of hydronium.

b. $\underline{H_2O}$ (l) + H_2O (l) ←→ $\underline{H_3O^+}$ (aq) + OH^- (aq)
Water is amphoteric, meaning it can be an acid or a base. Its conjugate acid is hydronium, and its conjugate base is hydroxide.

c. $\underline{NH_3}$ (aq) + H_2O (l) ←→ $\underline{NH_4^+}$ (aq) + OH^- (aq)
Ammonia is a B-L base, and its conjugate acid is ammonium. Water serves an acid in this instance.

d. $\underline{H_3PO_4}$ (aq) + H_2O (l) ←→ $\underline{H_2PO_4^-}$ (aq) + H_3O^+ (aq)
Phosphoric acid is a B-L acid, and its conjugate base is the dihydrogen phosphate anion. Water serves a base.

e. $\underline{HPO_4^{2-}}$ (aq) + H_3O^+ ←→ $\underline{H_2PO_4^-}$ (aq) + H_2O (l)
The hydrogen phosphate anion is a B-L base, and its conjugate acid is the dihydrogen phosphate anion. The hydronium ion donates a proton in this reaction to form its conjugate base, water.