

Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

**Need to know Sheet Acids and Bases Part 1**

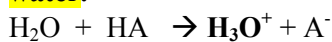
**Both Acids and Bases** are considered opposites; they **neutralize each other** in chemical reactions (neutralization). They **both** can be **electrolytes** in aqueous solution (conduct electricity), and both cause **indicators** (certain chemical dyes) to change color.

<b>Acids release H<sup>+</sup> ions (“proton donors”)</b>	<b>Bases catch H<sup>+</sup> ions (“proton acceptors”) or release OH<sup>-</sup> ions (hydroxide ions)</b>
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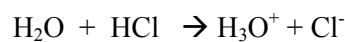
**Acids**

Acids have several distinctive properties and they are in many common items. They give foods a tart or sour taste. For example, vinegar contains acetic acid, citrus fruits citric acid, tea tannic acid, vitamin C is ascorbic acid etc.

**Acids (HA) have at least one acidic hydrogen and produce hydronium ions (H<sub>3</sub>O<sup>+</sup>) when dissolved in water.**



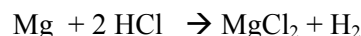
example



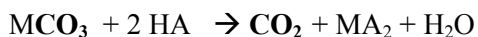
Many **metals**, such as zinc and magnesium, react with aqueous solutions of acids to produce hydrogen gas.



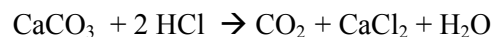
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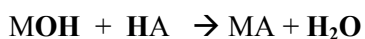
Acids (HA), when reacting with compounds containing **carbonate ions** (CO<sub>3</sub><sup>2-</sup>), form carbon dioxide (CO<sub>2</sub>), water and a salt (*problems of buildings being damaged by acid rain*).



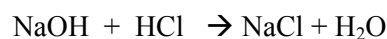
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Acids (HA) react with compounds containing **hydroxide ions** OH<sup>-</sup> (a base) to form water and a salt.

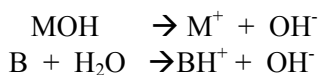


example

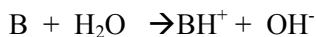
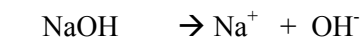
**Bases**

Aqueous solutions of bases taste bitter and feel slippery. Simple bases are metal hydroxides such as NaOH. NaOH (lye) is used as a drain cleaner. Milk of magnesia (Mg(OH)<sub>2</sub> suspension in water) is a base used to treat the problem of excess stomach acid. Ammonia (NH<sub>3</sub>), a cleaning reagent, and Lime (CaO), used to neutralize acidic soil, are also bases.

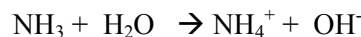
**Bases (B) are compounds that produce hydroxide ions (OH<sup>-</sup>) when dissolved in water.** Ionic hydroxides are bases because their ions dissociate in water. Covalent bases (like NH<sub>3</sub>) ionize when water transfers a hydrogen ion (H<sup>+</sup>) to the base, leaving hydroxide ion (OH<sup>-</sup>) behind..



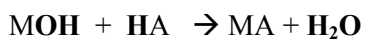
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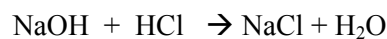
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Bases also react with acids to form water and a salt (neutralization reaction, combining H<sup>+</sup> with OH<sup>-</sup> to H<sub>2</sub>O).



example



**More definitions:**

**Acidic hydrogen** atom is one that can be transferred to water as  $H^+$  (written at first in the formula of the acid). It is often covalently bonded to a very electronegative element, upon ionization the electron is completely transferred onto the neighboring atom.

**Monoprotic** acids contain only one acidic hydrogen, example  $HCl \rightarrow H^+ + Cl^-$

**Diprotic** acids contain two acidic hydrogens, example  $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$

**Triprotic** acids contain three acidic hydrogens, example  $H_3PO_4 \rightarrow 3H^+ + PO_4^{3-}$  (polyprotic)

**Special Type of Acids and Bases: Anhydrides**

**Anhydrides are oxides, which contain besides oxygen only one other element.**

(*Anhydride = contains no water*). Anhydrides differ depending if the second element is a metal or nonmetal.

Second element	Acid or base	Properties
<b>Nonmetal</b> <i>Ex: NO<sub>2</sub></i>	<b>Acidic</b> Anhydrides	<p>Nonmetal oxides form acids when they react with water <math>\rightarrow</math> Acidic anhydrides</p> <p>Carbon dioxide reacts with water (during rain or in beverages) to carbonic acid</p> $CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq) \text{ carbonic acid}$ <p><math>H_2CO_3</math> is a weak acid, which makes even unpolluted rain slightly acidic. Air pollutions, especially oxides of sulfur and nitrogen react with water to much stronger acids, causing <b>acid rain</b>. Example:</p> $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq) \text{ (sulfuric acid)}$
<b>Metal</b> <i>Ex: CaO</i>	<b>Basic</b> Anhydrides	<p>Metal oxides form acids when they react with water <math>\rightarrow</math> Basic anhydrides</p> <p>Most important metal oxides are those of sodium, potassium, and calcium. They are ionic compounds, therefore solids even at the high temperature of a roaring fire and the major component of the <b>ash</b> that is left when the fire burns out.</p> <p><b>Lime</b> is CaO, used to neutralize acidic soil. It reacts with the surface water to calcium hydroxide <math>Ca(OH)_2</math>, a base, which is only slightly soluble in water, thus a safe and longlasting protection for the soil.</p> $CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$ <p>Early <b>soap</b> makers used metal oxides (even from wood ash) as bases to make soap.</p>

**Strong and Weak Acids and Bases**

Type	Properties	Examples acids	Examples Bases
<b>Strong</b>	A <b>strong acid or base</b> is completely (or almost completely) ionized in water.	HCl, HBr, HI, HNO <sub>3</sub> nitric acid, H <sub>2</sub> SO <sub>4</sub> sulfuric acid, HClO <sub>4</sub> perchloric acid	All group 1 and 2 hydroxides LiOH, NaOH, KOH, Mg(OH) <sub>2</sub> , Ca(OH) <sub>2</sub> , Sr(OH) <sub>2</sub>
<b>Weak</b>	A <b>weak acid or base</b> is only slightly ionized in water, forming only few ions. <b>Most</b> acids and bases are weak.	Acetic acid (in vinegar), H <sub>3</sub> PO <sub>4</sub> phosphoric acid, H <sub>2</sub> CO <sub>3</sub> carbonic acid (both in soft drinks)	NH <sub>3</sub> ammonia, Al(OH) <sub>3</sub> Fe(OH) <sub>3</sub>

**pH scale measures the  $H^+$  ion concentration in a given solution**

pH smaller than 7 (acidic); equal 7 (neutral); bigger than 7 (basic)

$$pH < 7.0$$

$$pH = 7.0$$

$$pH > 7.0$$