

Properties of Acids and Bases

(Science Perspectives 10, pp. 268-271)

	Acids	Bases
How to recognize from formula	Chemical formulas begin with hydrogen (H)	Usually contain hydroxide ion (OH ⁻) in formula in ionic compound Can contain bicarbonate (HCO ₃ ⁻) - reacts with water to form hydroxide
Example Substances	HCl (hydrochloric acid) Acetic acid (vinegar) Ascorbic acid (vitamin C) Citric acid (oranges, lemons)	Sodium hydroxide (drain cleaner) - NaOH Potassium hydroxide (soap) - KOH Sodium bicarbonate (baking soda) - NaHCO ₃
Physical Properties	Sour tasting Water soluble Good electrical conductors when dissolved in water	Bitter tasting Feel slippery when dissolved in water Good electrical conductors when dissolved in water
Chemical Properties	Very reactive, corrosive Release H ⁺ ions when dissolved in water	Release hydroxide (OH ⁻) ions when dissolved in water Break down proteins (e.g. hair)

Reactions involving acids and bases:

(a) Acids can react with some metals to produce hydrogen gas:

Word Equation: (Zinc forms ions with a +2 charge)

zinc (s) + hydrochloric acid (aq) → hydrogen (g) + zinc chloride (aq)

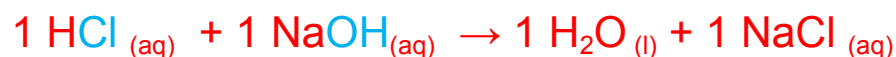
(b) Acids and bases are **good conductors of electricity** when dissolved in water because acids release hydrogen (H⁺) ions and bases release hydroxide (OH⁻) ions.**Word Equations:**

hydrochloric acid (aq) → hydrogen ions (aq) + chloride ions (aq)

sodium hydroxide (aq) → sodium ions (aq) + hydroxide ions (aq)

(c) **Neutralization** reactions occur when acids and bases react with each other. The products of a neutralization reaction are a **salt** and **water**.**Word Equation:**

hydrochloric acid (aq) + sodium hydroxide (aq) → water (l) + sodium chloride (aq)



Properties of Acids and Bases Questions

1. Identify each of the following substances as acidic or basic (alkaline) when dissolved in water, and write the corresponding name or formula for each substance:

Substance	Acidic or Basic?	Name or Formula
HClO_3	Acidic	Hydrogen chlorate
potassium hydroxide	Basic	KOH
$\text{Mg}(\text{OH})_2$	basic	Magnesium hydroxide
HNO_3	Acidic	Hydrogen nitrate
sodium bicarbonate (baking soda)	Basic (carbonate)	NaHCO_3

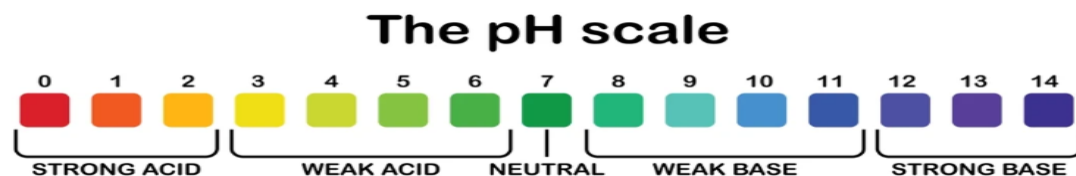
2. Oxyacids (Table 2, p. 269) are compounds formed when hydrogen combines with polyatomic ions that contain oxygen. What patterns can you find that relate the ion name to the formula and acid name?

Ion name	Ion formula	Oxyacid formula	Oxyacid name
Nitrate	NO_3^-	HNO_3	Nitric acid
Carbonate	CO_3^{2-}	H_2CO_3	Carbonic acid
sulfate	SO_4^{2-}	H_2SO_4	Sulfuric acid
Phosphate	PO_4^{3-}	H_3PO_4	Phosphoric acid

The pH Scale and Neutralization Reactions

(Science Perspectives 10, pp. 272 – 275, 278-280)

The pH scale:



Represents how acidic or basic a solution is;

Stands for the “power of Hydrogen” (the concentration of hydrogen ions in a solution)

pH = 0 (very acidic), pH = 7 (neutral, e.g. pure water), pH = 14 (very basic, or alkaline)

Acidic solutions: low pH, Basic/alkaline solutions: high pH

How much more acidic or basic is a solution?

pH scale: every change of 1 unit = 10x

e.g. solution with pH= 3 is 10x more acidic than solution with pH = 4

e.g. solution with pH = 9 is 10×10 (=100x) more basic than pH = 7

Applications of Neutralization Reactions:

Neutralization reactions occur in many contexts. Here are some examples:

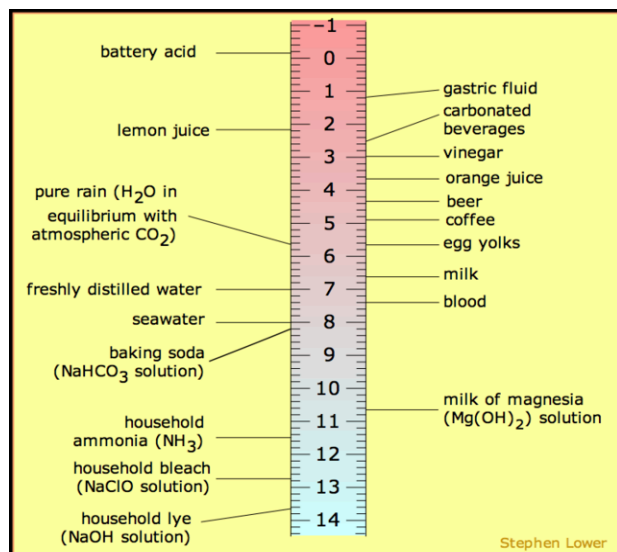
Treatment of acid indigestion: ingest a mild base/antacid tablet (Tums, Rolaids)

Cleaning up acid spills or neutralizing acidic soil or lakes;

Hair-curling: base breaks links to soften hair; acid stops the curling process;

Citrus (e.g. lemons) neutralize bases in fish oils that give off distinct odour;

Baking: baking powder is a mixture of baking soda (NaHCO_3) and a dry acid – when added to water, neutralization reaction produces gas bubbles in batter, and causes it to rise



Questions:

1. What is acid indigestion? How is it treated, and explain how the treatment works.

High concentration of stomach acid, causes irritation; treated with a slightly basic substance (e.g. tums) to neutralize the acid.

2. What would you expect as an approximate pH value for each of the following? (Use the pH scale in Figure 1 on page 296)
 - a) A very concentrated base 12-14
 - b) A dilute basic (or alkaline) solution 8-11
 - c) A very concentrated acid 0-2
 - d) A dilute acid 3-6
 - e) Tap water 7
3. Consider a solution with a pH of 6.5 and a solution of 3.5. Which is more acidic? How much more acidic is it?

Solution with pH of 3.5 is more acidic, 1000 times more acidic

4. Roughly how much more acidic is lemon juice than apples (see Figure 1 on the previous page)? Roughly how much more basic is bleach than blood?
(apples have pH = 3, lemons have pH = 2)

Lemon juice 10x more acidic than apples; bleach 100,000x more basic than blood

5. What happens to the pH of an acid when water is added to it?

The acid becomes much more dilute, so the pH increases