# Introduction to Physical Science

Acids & Bases, pH

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## Acids and Bases

- Defined in terms of the transfer of hydrogen ions
  - A compound that donates a proton to another is an acid
  - A compound that accepts a proton from another is a base
- Neutral solution - equal concentration of hydronium and hydroxide ions
- Acidic solution - greater concentration of hydronium than hydroxide
- Basic solution - lesser concentration of hydronium than hydroxide

## pH and pOH

- The pH of a solution is the molar concentration of the hydronium (  ) in the solution
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  -
- The pOH of a solution is similarly defined
  -
  -

## Example

- What are the pH and pOH of pure water? The hydronium ion molarity in pure water is $1.0x10^{-7}$ at 25ºC.

$$[H_3O^+] = [OH^-] = 1.0x10^{-7}M$$

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

$$pH = -log(1.0x10^{-7}) = +7.0$$

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

$$pOH = -log(1.0x10^{-7}) = +7.0$$

# Acids, Bases and Neutral Solutions

**Summary of Relations for Acidic, Basic and Neutral Solutions**

| Classification | Relative Ion Concentrations | pH at 25 °C |
|---|---|---|
| acidic | $[H_3O^+] > [OH^-]$ | pH < 7 |
| neutral | $[H_3O^+] = [OH^-]$ | pH = 7 |
| basic | $[H_3O^+] < [OH^-]$ | pH > 7 |

**Table 14.1**

Image Credit: OpenStax Chemistry Table 14.1 CC BY 4.0

# Acids, Bases and Neutral Solutions

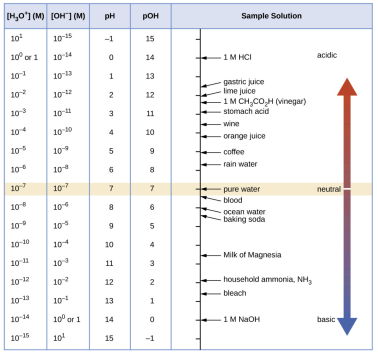


Image Credit: OpenStax Chemistry Figure 14.2 CC BY 4.0

# Example

- What is the pH of stomach acid, a solution of HCl with a hydronium concentration of $1.2x10^{-3}M$?

$$[H_3O^+] = 1.2x10^{-3}M$$

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

$$pH = -log(1.2x10^{-3}) = +2.92$$

# Example

- Calculate the hydronium ion concentration of blood with a pH of 7.3.

$$pH = 7.3$$

$$pH = -log[H_3O^+] = 7.3$$

$$log[H_3O^+] = -7.3$$

$$[H_3O^+] = 10^{-7.3}$$

$$[H_3O^+] = 5.0x10^{-8}M$$

## Example

- What are the pOH and the pH of a 0.0125 M solution of potassium hydroxide (KOH)?

$$[OH^-] = 0.0125$$

$$pOH = -log[OH^-] = -log 0.0125$$

$$pOH = -(-1.903) = 1.903$$

$$pH + pOH = 14.00$$

$$pH = 14.00 - pOH$$

$$pH = 14.00 - 1.903 = 12.1$$

## Measuring pH

- pH can often be measured with devices like a pH meter
- pH test strips can also be used to give a rough idea of the acid/base level of a solution


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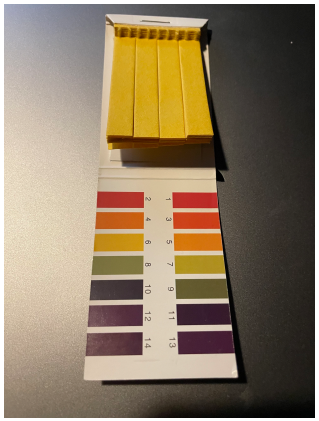

Image Credit: Robert Wagner (own work) CC-BY-4.0

## Summary

- An acid is a compound that donates a proton to another compound
- The pH of a substance is a measure of the concentration of the hydronium ion
- The pH and pOH of substances can be calculated and/or measured by various methods