

# Acids, Bases and Salts

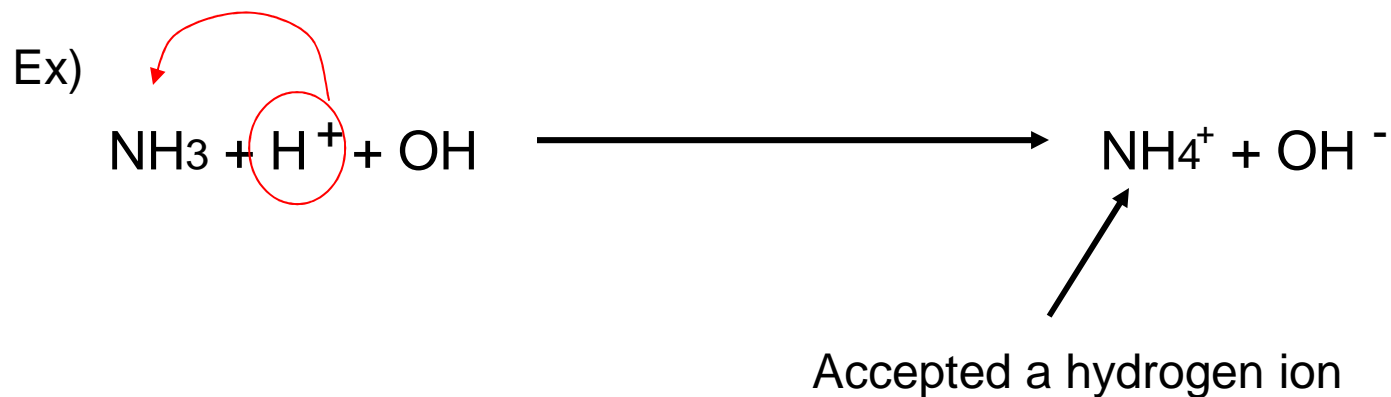
# Characteristics of Acids

- Has a pH below 7
- Sour taste.
- Aqueous solutions of acids conduct an electric current
- React with a base to form a **salt and water**
- React with certain metals to produce **hydrogen gas.**
- Cause acid-base indicators to change color
- Acids are Electrolytes.

# Types of Acids

Arrhenius Acid	Bronsted Lowry Acid	Lewis Acid
Generates H <sup>+</sup>	H <sup>+</sup> (proton) donor	Accepts e <sup>-</sup> pairs

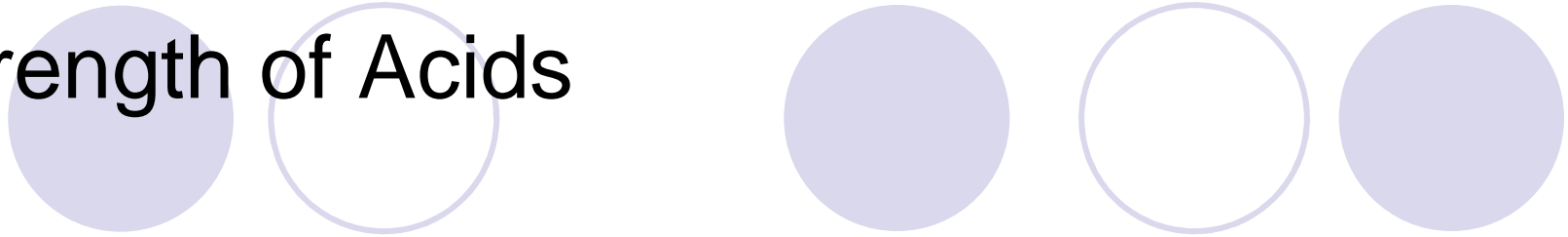
- A conjugate acid is formed when a base gains a hydrogen ion



# Naming Acids

- A binary acid has a hydrogen and any other element (like HCl)
  - To name this the binary acid begins with hydro- with the name of the other element ending in *-ic*. (HCl is hydrochloric acid)
- A ternary acid produces hydrogen ions in water and consists of oxygen-containing  $_{3}^{-}$  anion. (HNO<sub>3</sub> is a ternary acid)
  - To name use the anion suffixes *-ate* and *-ite* and replace them with *-ic* and *-ous*. (like HNO is nitric acid.)

# Strength of Acids



- If an acid completely dissociates it is called a strong acid
- If an acid is only able to ionize slightly, it is said to be a weak acid.
- When an acid or base is completely ionized, ions are able to flow freely causing an electrical current. These strong acids and bases are called electrolytes.

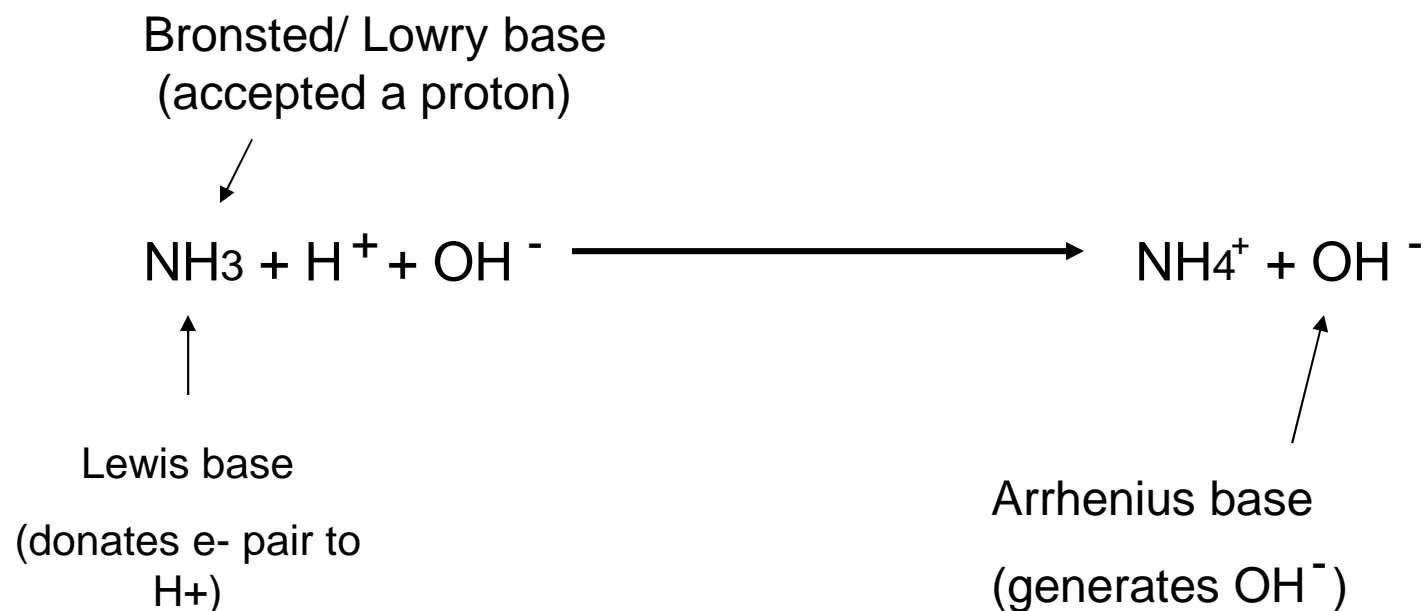
# Characteristics of Bases

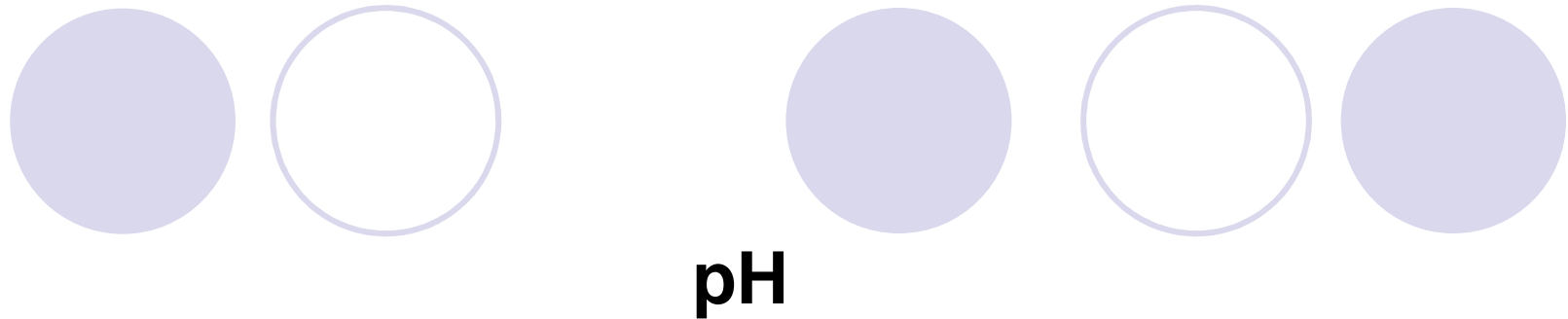


- Have bitter taste
- Have a slippery or soapy feeling
- Conduct electric current
- React with acids to produce water and a salt
  
- Cause acid-base indicators to change color

# Types of Bases

Arrhenius Base	Bronsted Lowry Base	Lewis Base
Generates $\text{OH}^-$	Accepts $\text{H}^+$	Donates $\text{e}^-$ pairs





**7, corresponds to the neutral point.**

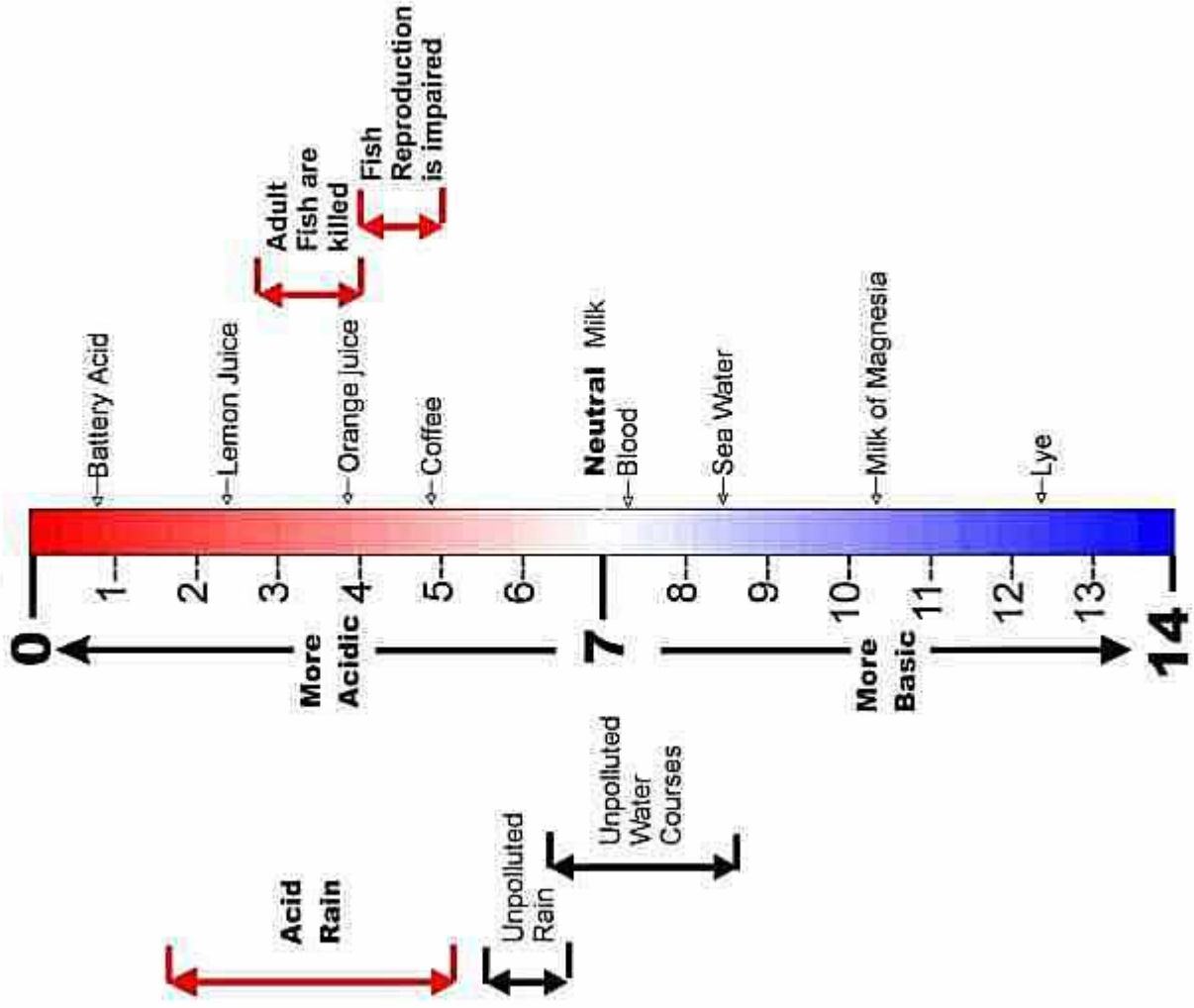
**Values below 7 indicate that the sample is acidic.**

**Values above 7 indicate that the sample is basic.**

- The pH scale is logarithmic, which means that a difference of one pH unit corresponds to a change of 10 times the strength.  
pH 5 is 10 times more acidic than pH of 6.  
pH 4 is 100 times more acidic than pH of 6.**



# The pH Scale



# The pH Scale - Acids and Alkali

pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Colour	red	red	orange	orange	yellow	yellow	green	green	teal	blue	blue	purple	purple	violet
strength	Strong	ACIDS			Weak		Neu- tral	Weak		ALKALIS			Strong	

10 Times  
More Acid



Acid

Alkaline

100 Times  
More Acid!

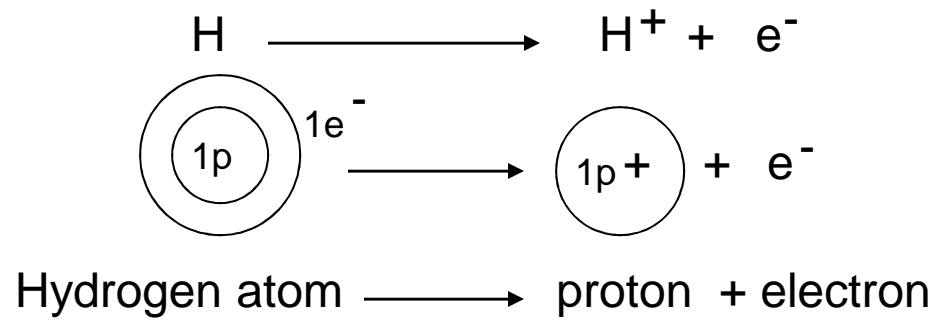


Acid

Alkaline

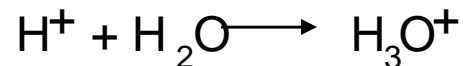
# Hydrogen ion Properties

- Contains one proton and electron
- When hydrogen atom becomes a positive ion an electron is lost
- The remaining ion is positive, called a proton
- Hydrogen ion is not able to exist in a water solution and is attracted to an unshared pair of electrons in a water molecule, creating a hydronium ion

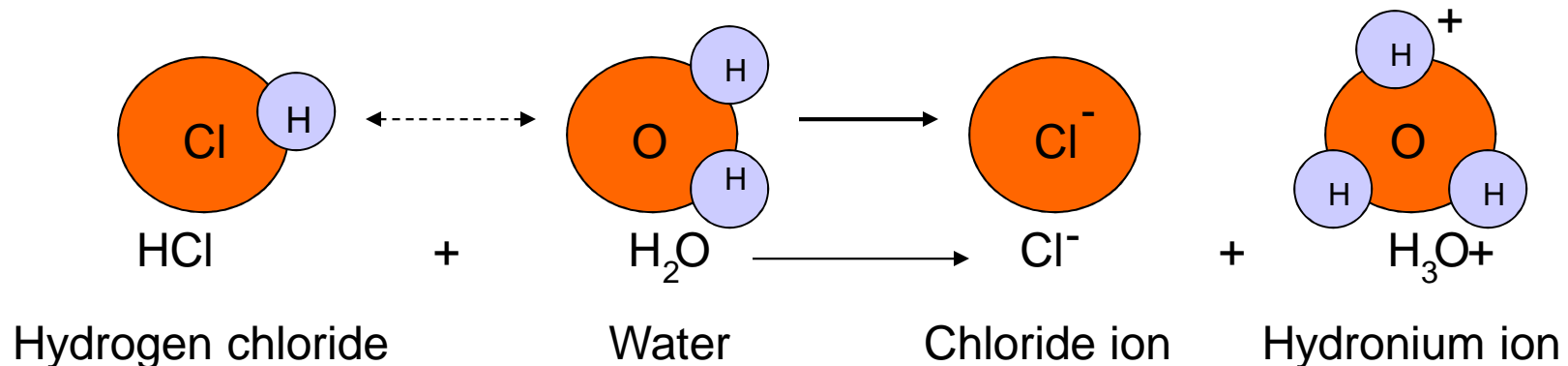


# Hydronium ion Properties

- Is formed when a proton is covalently bonded with water forming  $H_3O^+$



- Are the properties of an acid
- Any acid that produces a single hydrogen ion is called a monoprotic acid.
- Acids that produce two hydrogen ions are called diprotic acids





# Hydroxide ion Properties

- $\text{OH}^-$
- Presence of hydroxide ion makes the base an electrolyte
- Organic compounds react with water to form hydroxide ions along with amines
- Alcohols and hydroxyl groups are not bases.

# Naming Acids and Bases Cont.

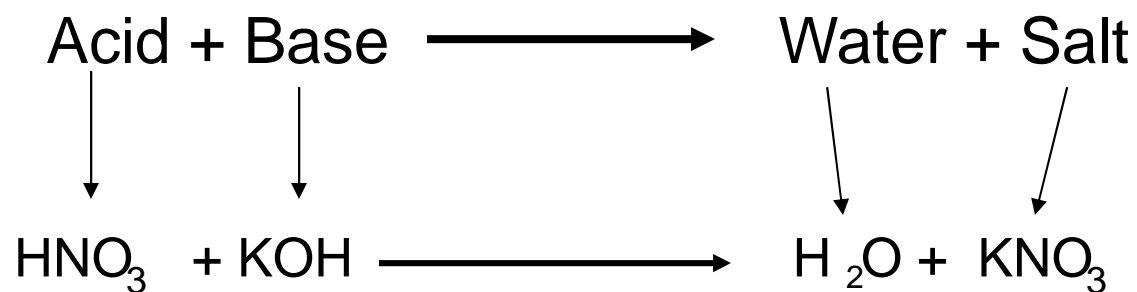
Names of Several Acids and Their Ions		
Acid name	Formula of Acid	Anion name
hydrochloric	HCl	chloride
sulfuric	H <sub>2</sub> SO <sub>4</sub>	sulfate
sulfurous	H <sub>2</sub> SO <sub>3</sub>	sulfite
nitric	HNO <sub>3</sub>	nitrate
nitrous	HNO <sub>2</sub>	nitrite

- To name a base, the positive ion stays the same and the name of the base ends with hydroxide. ( Ca(OH)<sub>2</sub> is named calcium hydroxide.)



# Neutralization Reactions

- Occurs when an Arrhenius acid and an Arrhenius base react to form water and a salt.



# Salts



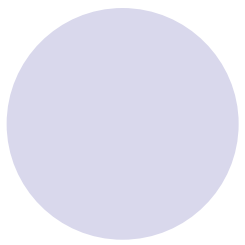
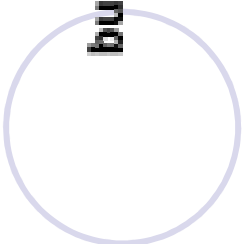
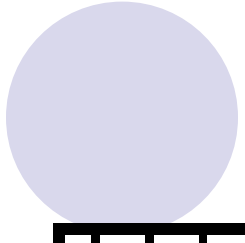
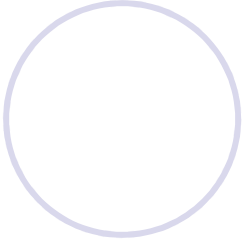
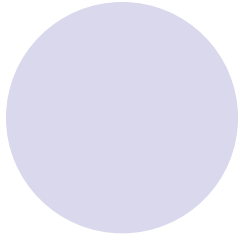
- The salts resulting from a neutralization reaction are ionic substances made of positively charged metallic or polyatomic ions, and negative ions other than hydroxide ions.

ex)  $(\text{NH}_4)_3\text{PO}_4$  and  $\text{NaCl}$

- To name a salt use the positive ion of the base and then negative ion of the acid.

# Acid-Base Titration

- Process of adding measured volumes of an acid or base of known concentration to an acid or base of unknown concentration until neutralization occurs.
- The known concentration is called the standard solution
- There must be a ratio of 1:1 between hydrogen ions and the hydroxide ions
- To find the Molarity of a substance in a titration experiment, use the formula:  $M_A \times V_A = M_B \times V_B$



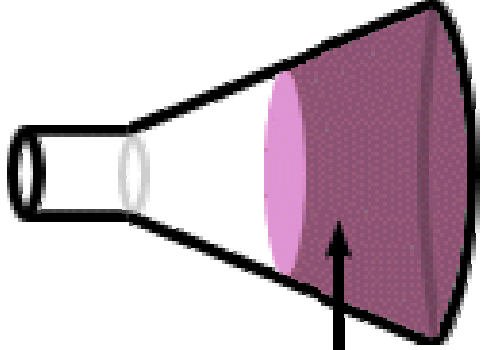
buret



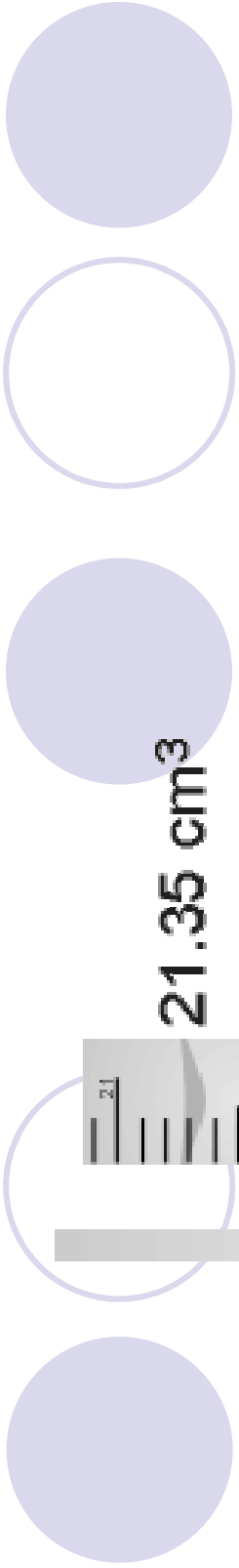
base of known concentration



stopcock



acid of unknown concentration



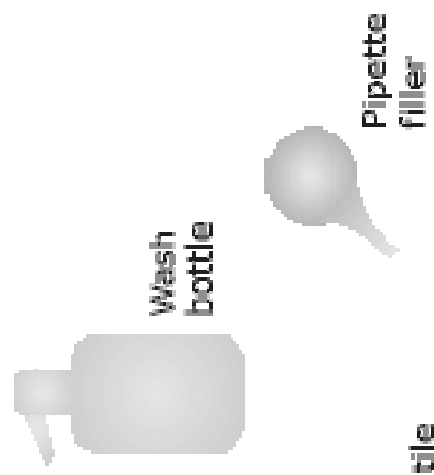
21.35 cm<sup>3</sup>

Retort stand

Boss and clamp

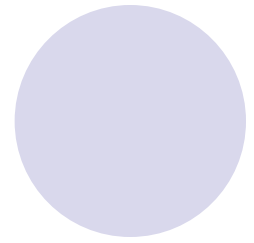
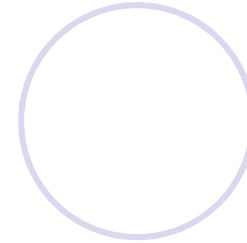
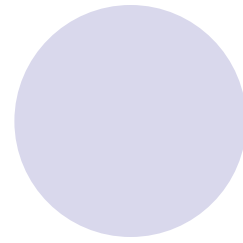
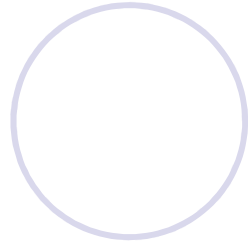
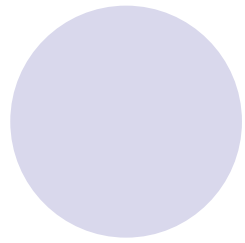
White tile

	Rough	Accurate		
		1st	2nd	3rd etc.
Final Reading (cm <sup>3</sup> )				
Initial Reading (cm <sup>3</sup> )				
Titre (cm <sup>3</sup> )				



Wash bottle

Pipette filler



<https://www.youtube.com/watch?v=sFpFCPTDv2w>

# pH Scale



- Expresses  $[H^+]$  as a number from 0 to 14
- 0 is strongly acidic
- 14 is a strong base
- The scale is logarithmic, meaning each change is tenfold in the change in concentration.
  
- As the hydrogen ion increases, hydroxide ion concentration decreases.

# Acid-Base Indicators

- An indicator changes color when it gains or loses a proton.
- Determines whether a solution is acidic or basic depending on the color change

Indicator	pH range	Color Change
Methyl orange	3.2-4.4	Red to yellow
Bromthymol blue	6.0-7.6	Yellow to blue
Phenolphthalein	8.2-10	Colorless to pink
Litmus	5.5-8.2	Red to blue
Bromcresol green	3.8-5.4	Yellow to blue
Thymol blue	8.0-9.6	Yellow to blue



# Common Acids

Formula	Name
HCl (aq)	Hydrochloric acid
HNO <sub>3</sub> (aq)	Nitric acid
H <sub>2</sub> SO <sub>4</sub> (aq)	Sulfuric acid
H <sub>3</sub> PO <sub>4</sub> (aq)	Phosphoric acid
H <sub>2</sub> CO <sub>3</sub> (aq) or CO <sub>2</sub> (aq)	Carbonic acid
CH <sub>3</sub> COOH (aq) or HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> (aq)	Ethanoic acid (acetic acid)

# Common Bases

Formula	Name
NaOH (aq)	Sodium hydroxide
KOH (aq)	Potassium hydroxide
Ca(OH) <sub>2</sub> (aq)	Calcium hydroxide
NH <sub>3</sub> (aq)	Aqueous ammonia