ACIDS AND BASES REFERENCE SHEET

ACIDS

- Juices/Fruits
- Tart, sour, sharp taste
- They are electrolytes
  - Conduct electricity
- React with Metals
- Common as aqueous and liquids

BASES

- Cleaning products
- Bitter tasting
- Slippery to the touch
- Common as Solids

7 Strong Acids (H^+) All other acids are weak			8 Strong Bases (OH^-) All other bases are weak	
Hydrochloric acid	HCl		Lithium hydroxide	LiOH
Hydrobromic acid	HBr		Sodium hydroxide	NaOH
Hydroiodic	HI		Potassium hydroxide	KOH
Perchloric acid	$HClO_4$		Rubidium hydroxide	RbOH
Chloric acid	$HClO_3$		Cesium hydroxide	CsOH
Nitric acid	HNO_3		Calcium hydroxide	$Ca(OH)_2$
Sulfuric acid	H_2SO_4		Strontium hydroxide	$Sr(OH)_2$
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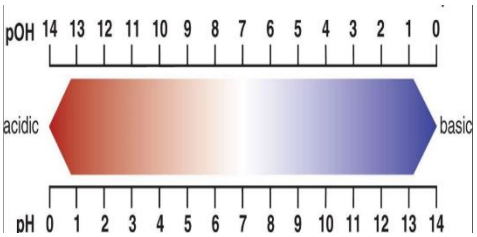
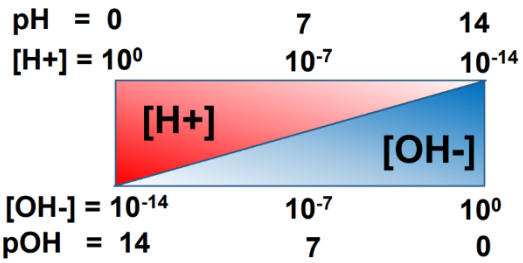
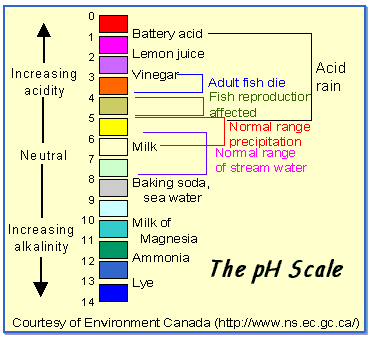
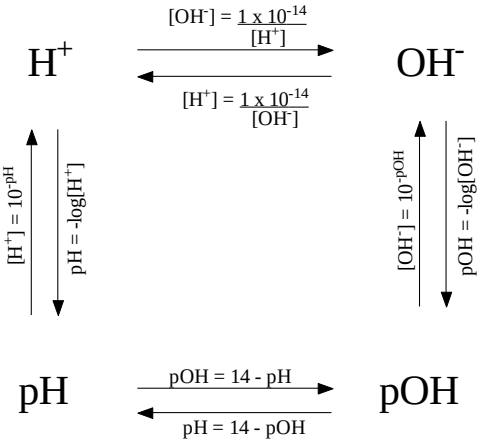
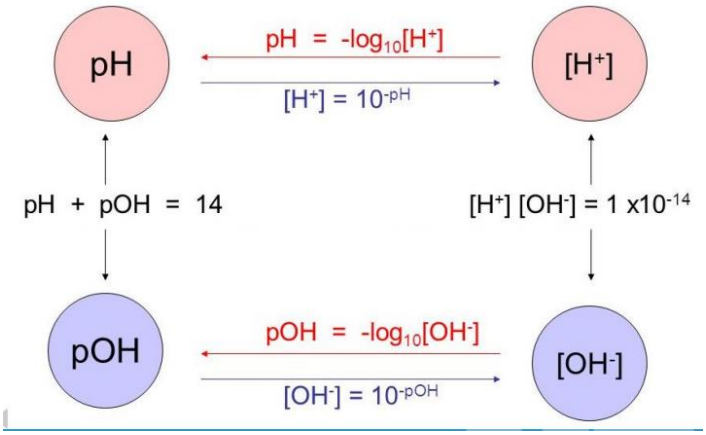
Memorize these 15, ALL ELSE ARE considered WEAK











Arrhenius

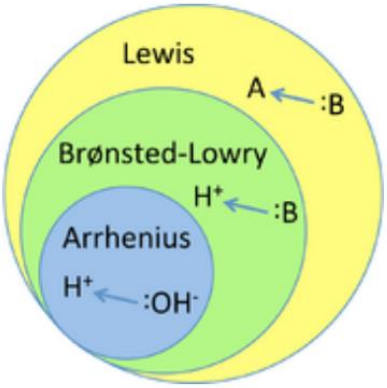
- Acids make H^+ ions in aqueous solutions
- Bases make OH^- ions in solution

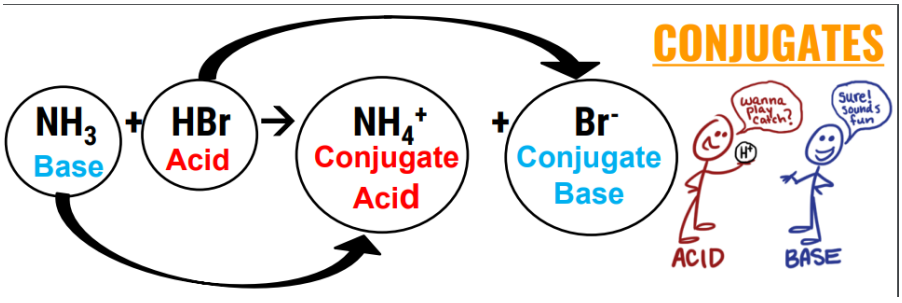
Bronsted-Lowry

- Acids donate protons
- Bases accept protons

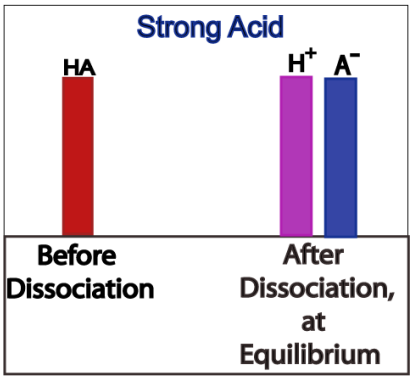
Lewis

- Acids accept electron pairs
- Bases donate electron pairs

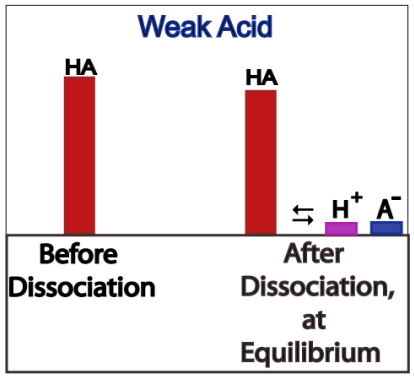




STRONG ACIDS			
Acid	**Formula**	**Conj. Base**	**K_a**
Perchloric	$HClO_4$	ClO_4^-	Very large
Hydriodic	HI	I^-	Very large
Hydrobromic	HBr	Br^-	Very large
Hydrochloric	HCl	Cl^-	Very large
Nitric	HNO_3	NO_3^-	Very large
Sulfuric	H_2SO_4	HSO_4^-	Very large
Hydronium ion	H_3O^+	H_2O	1.0



COMMON WEAK ACIDS			
Acid	**Formula**	**Conj.Base**	**K_a**
Iodic	HIO_3	IO_3^-	1.7×10^{-1}
Oxalic	$H_2C_2O_4$	$HC_2O_4^-$	5.9×10^{-2}
Sulfurous	H_2SO_3	HSO_3^-	1.5×10^{-2}
Phosphoric	H_3PO_4	$H_2PO_4^-$	7.5×10^{-3}
Citric	$H_3C_6H_5O_7$	$H_2C_6H_5O_7^-$	7.1×10^{-4}
Nitrous	HNO_2	NO_2^-	4.6×10^{-4}
Hydrofluoric	HF	F^-	3.5×10^{-4}
Formic	HCOOH	$HCOO^-$	1.8×10^{-4}
Benzoic	C_6H_5COOH	$C_6H_5COO^-$	6.5×10^{-5}
Acetic	CH_3COOH	CH_3COO^-	1.8×10^{-5}
Carbonic	H_2CO_3	HCO_3^-	4.3×10^{-7}
Hypochlorous	HClO	ClO^-	3.0×10^{-8}
Hydrocyanic	HCN	CN^-	4.9×10^{-10}



You can convert back and forth from Ka to Kb using this equation:

$K_w = K_a \times K_b$

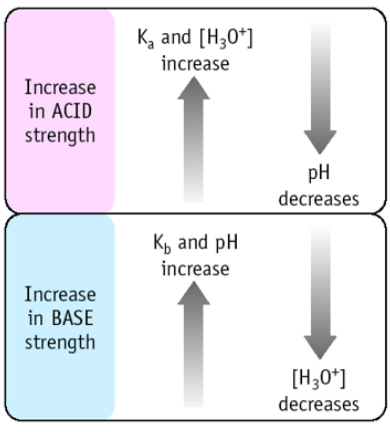
Strong Acid (Large Ka) $\xrightarrow{makes\ a}$ **Weak Conj. Base** (Small Kb)

Weak Acid (Small Ka) $\xrightarrow{makes\ a}$ **Strong Conj. Base** (Large Kb)

Strong Base (Large Kb) $\xrightarrow{makes\ a}$ **Weak Conj. Acid** (Small Ka)

Weak Base (Small Kb) $\xrightarrow{makes\ a}$ **Strong Conj. Acid** (Large Ka)

COMMON WEAK BASES			
Base	**Formula**	**Conj. Acid**	**K_b**
Ammonia	NH_3	NH_4^+	1.8×10^{-5}
Methylamine	CH_3NH_2	$CH_3NH_3^+$	4.38×10^{-4}
Ethylamine	$C_2H_5NH_2$	$C_2H_5NH_3^+$	5.6×10^{-4}
Diethylamine	$(C_2H_5)_2NH$	$(C_2H_5)_2NH_2^+$	1.3×10^{-3}
Triethylamine	$(C_2H_5)_3N$	$(C_2H_5)_3NH^+$	4.0×10^{-4}
Hydroxylamine	$HONH_2$	$HONH_3^+$	1.1×10^{-8}
Hydrazine	H_2NNH_2	$H_2NNH_3^+$	3.0×10^{-6}
Aniline	$C_6H_5NH_2$	$C_6H_5NH_3^+$	3.8×10^{-10}
Pyridine	C_5H_5N	$C_5H_5NH^+$	1.7×10^{-9}



Weak Acids and Bases Calculations

- Dissociation is a reversible reaction!
- So use Equilibrium Expressions, K values, and Ice Tables to find [ ]'s before doing pH type calculations
- Equilibrium Expression still $\frac{Products}{Reactants}$ which will be $\frac{[Dissociated\ Ions]}{[Undissociated\ Molecule]}$
- To find pH (or pOH) of something you first have to know the $[H_3O_+]$ (or $[OH^-]$)
    - For weak acids/bases you need to do the following steps to find those [ ]'s
        - Step 1 – ICE Table
        - Step 2 – Write a Ka expression (or Kb depending on the problem)
        - Step 3 – Solve for x using either quadratic or 5% rule
        - Step 4 – put x back into ICE Table to find the actual [ ] answers
        - Step 5 – use your $[H_3O^+]$ (or $[OH^-]$) to find the pH (or pOH)

Monoprotic vs. Polyprotic – How many ions come off?

- Monoprotic acids/bases → only have one H^+ or OH^-
- Diprotic acids/bases → have two H^+ or OH^-
- Triprotic acids/bases → have three H^+ or OH^-

- <u>Strong Bases</u>
    - all OH^- come off
        - Take that into account with your stoichiometry when finding the $[OH^-]$
            - 1 M $Ca(OH)_2$ = 2 M of OH^- ions

- <u>Strong Acids</u>
    - The first H^+ comes off and it would be a normal strong acid type pH calculation
        - No Ka value needed
        - No ICE Table needed.
    - The second/third/etc H^+ might come off <u>BUT</u>
        - That would be a weak reaction and you would need:
            - Ka value for that second H^+ coming off
            - Would need to do an ICE table
            - Then add the $[H^+]$ from the ICE Table calculation to the $[H^+]$ you found from the first H^+ coming off.
    - Example: $H_2SO_4 \rightarrow H^+ + HSO_4^-$
      Only assume one H^+ comes off unless given Ka value for $HSO_4^- \rightarrow H^+ + SO_4^{2-}$

- <u>Weak Acids/Bases</u>
    - For the given Ka or Kb value assume only one H^+/OH^- comes off.
    - You would need a second Ka or Kb value to do a second ICE Table for the second H^+/OH^- coming off, and then would need to add your [ ]'s from each ICE Table calculation.