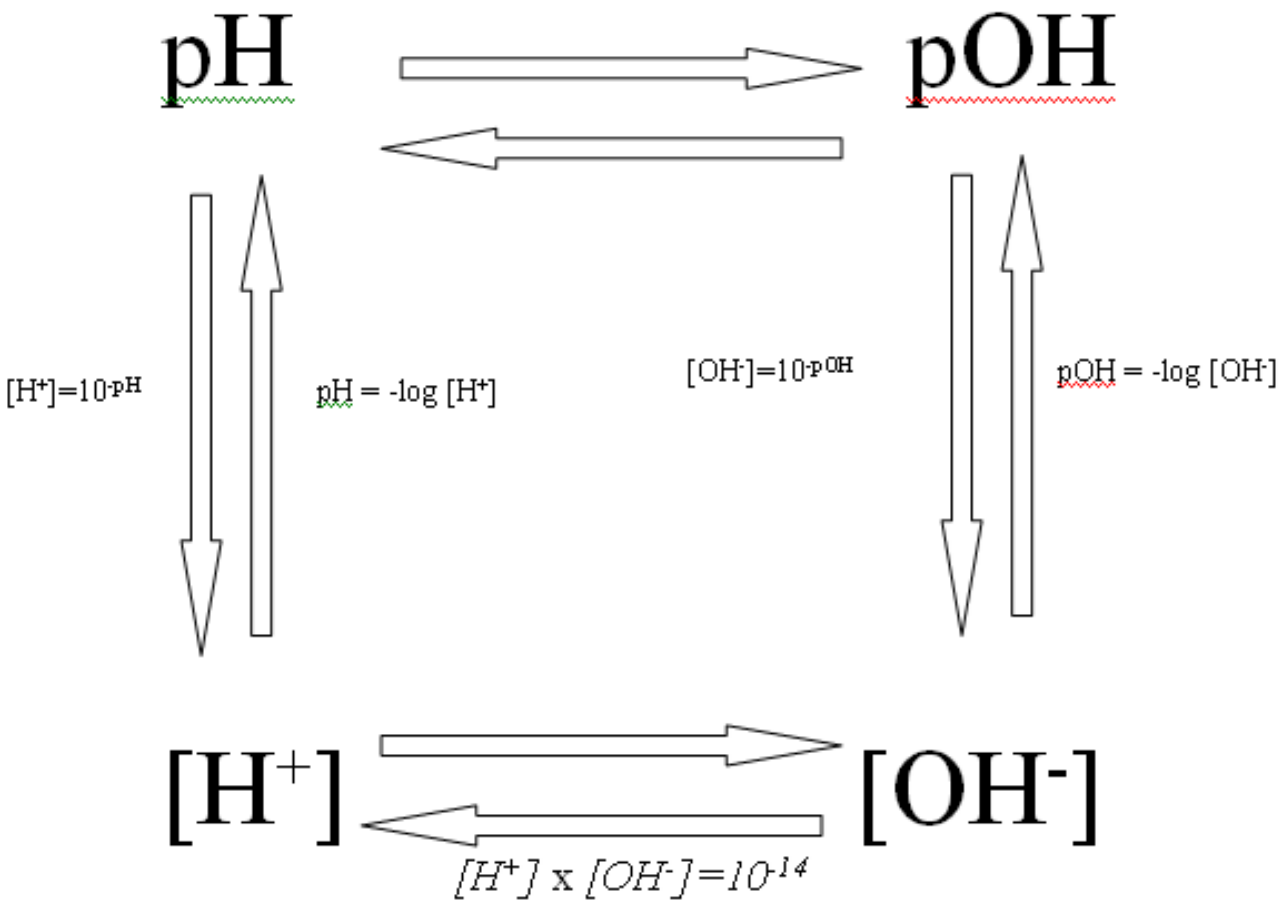
A phrase to help you name ternary (3 element) acids

- I –**ATE** something –**IC**ky and got a disease called **-ITE -OUS**.

$pH + pOH = 14$



pH and pOH

[H+]	pH	[OH-]	pOH	Acid or Base
10^{-5}				

pH and pOH

[H+]	pH	[OH-]	pOH	Acid or Base
10^{-5}	5	10^{-9}	9	acid
			6	

pH and pOH

[H+]	pH	[OH-]	pOH	Acid or Base
10^{-5}	5	10^{-9}	9	acid
10^{-8}	8	10^{-6}	6	base
10^{0}				

pH and pOH

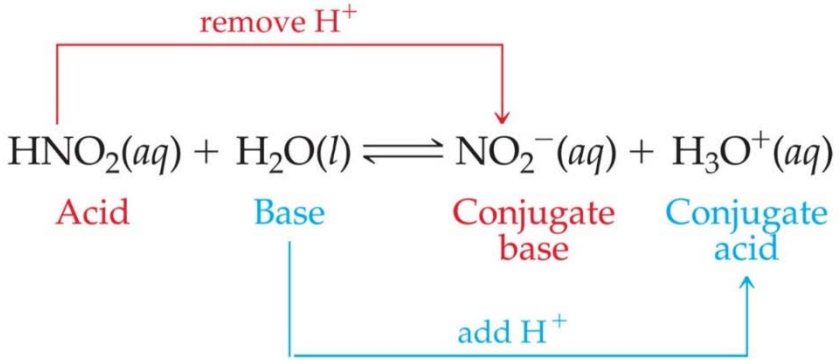
[H+]	pH	[OH-]	pOH	Acid or Base
10^{-5}	5	10^{-9}	9	Base
10^{-8}	8	10^{-6}	6	Acid
10^{0}	0	10^{-14}	14	Base
				Neutral

pH and pOH

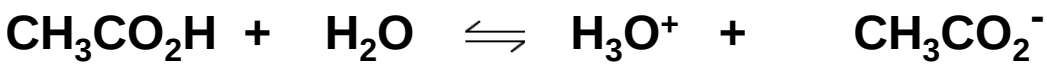
[H+]	pH	[OH-]	pOH	Acid or Base
10^{-5}	5	10^{-9}	9	acid
10^{-8}	8	10^{-6}	6	base
10^{0}	0	10^{-14}	14	acid
10^{-7}	7	10^{-7}	7	neutral

Conjugate Acids and Bases:

- Reactions between acids and bases always yield their conjugate bases and acids.



$$HNO_2 + H_2O \rightleftharpoons [NO_2^- \cdots H^+ \cdots H_2O] \rightleftharpoons NO_2^- + H_30^+$$



Acetic Acid

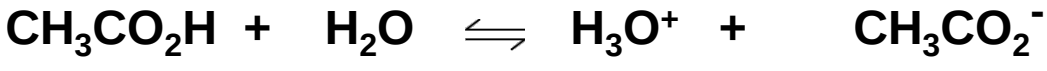
Acetate Ion

Pairs 1

1 2 2

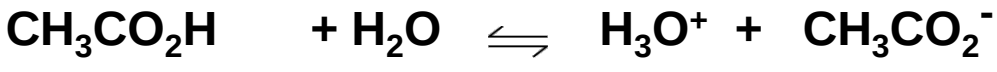
acid base acid base

Point of View #1



acid base Conjugate acid of H_2O Conjugate base of CH_3CO_2H

Point of View #2



Conjugate acid of $CH_3CO_2^-$ Conjugate base of H_3O^+ acid base

Label the Acid, Base, Conjugates

- $HCN + H_2O \rightarrow H_3O^+ + CN^-$
- Acid + base → CA + CB
- $NaHCO_3 + HBr \rightarrow NaBr + H_2CO_3$
- Base + Acid → CB + CA
- $H_2O + NH_3 \rightarrow NH_4^+ + OH^-$
- Acid + Base → CA + CB

Strong Acids & Strong Bases

- A strong acid is one that completely dissociates in a solution. In water, one mole of a strong acid HA dissolves yielding one mole of H^+ (as hydronium ion H_3O^+) and one mole of the conjugate base, A^-.
  - Essentially, none of the non-ionized acid HA remains.

- The Arrhenius definition of a base, a base is a compound that breaks apart to make hydroxide ions (OH-) in solution.
  - A strong base is a base that breaks apart 100% in solution producing the generic B ion and the OH- ion.

7 STRONG ACIDS

8 STRONG BASES

Acids
pH Calculations

pH Equations

You must know the following equations, which are all based on the ionization of water at 25^0 C!

$H_2O \rightleftarrows H^+ + OH^-$

$Kw=[H^+][OH^-] = 1.00 \times 10^{-14}$

$pH=-Log[H^+]$ $\quad$ $pOH= -Log[OH^-]$

$[H^+] = 10^{-pH}$ $\quad$ $[OH^-] = 10^{-pOH}$

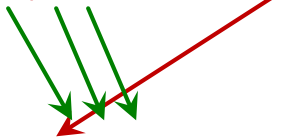
$pH + pOH=14.000$

Operation	Inverse
+	-
÷	x
10^x	Log

Sig Figs and pH

1.00 x 10^{-4} M **3 sig figs**

-Log **1.00** x 10^{-4}



= 4.**000** **3 sig figs**

The 4 is from the 10^{-4} which does not count for sig figs

For **pH** or **POH** only digits **after** the **decimal** are **significant**

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M			

Calculation

pH Calculations

$[H^+]$ **$[OH^-]$** **pH** **pOH**

2.5×10^{-4} M

Calculation **The number of sig figs are 2**

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M			

Calculation $pH = -\log[H^+]$

$pH = -\log[2.5 \times 10^{-4}]$

$pH = 3.60$ The **digit before** the **decimal** does **not** count as a **sig fig**. Both **digits after** the **decimal count** for **2 sig figs**.

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M		3.60	

Calculation

$pH = -Log[H^+]$

$pH = -Log[2.5 \times 10^{-4}]$

$pH = 3.60$ keep **all digits** on the calculator- **do not round**!

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M		3.60	

Calculation

$$pH + pOH = 14.00$$
$$3.60 + pOH = 14.00$$
$$pOH = 10.40$$

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M		3.60	10.40

Calculation

$[OH^-] = 10^{-pOH}$

$[OH^-] = 10^{-10.40}$

$[OH^-] = 4.0 \times 10^{-11}$ M

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40

Calculation

Note that **all** of the **entries** in the last line have **two sig figs!**

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
		9.435	

Calculation

$$pH + pOH = 14.000$$
$$9.435 + pOH = 14.000$$
$$pOH = 4.565$$

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
		9.435	4.565

Calculation

$[OH^-] = 10^{-pOH}$

$[OH^-] = 10^{-4.565}$

$[OH^-] = 2.72 \times 10^{-5}$ M

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
	2.72×10^{-5} M	9.435	4.565

Calculation

$[H^+][OH^-] = 1.00 \times 10^{-14}$

$[H^+][2.72 \times 10^{-5}] = 1.00 \times 10^{-14}$

$[H^+] = 3.67 \times 10^{-10}$ M

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565

Calculation

Note that **all** of the **entries** in the last line have **three sig figs!**

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
	2.6×10^{-4} M		

Calculation

$pOH = -Log[OH^-]$

$pOH = -Log[2.6 \times 10^{-4}]$

$pOH = 3.59$

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
	2.6×10^{-4} M		3.59

Calculation

$$pH + pOH = 14.000$$
$$pH + 3.59 = 14.000$$
$$pOH = 10.41$$

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
	2.6×10^{-4} M	10.41	3.59

Calculation

$[H^+] = 10^{-pH}$

$[H^+] = 10^{-10.41}$

$[H^+] = 3.8 \times 10^{-11}$ M

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59

Calculation

Note that **all** of the **entries** in the last line have **two sig figs!**

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59
			8.40

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59
	4.0×10^{-9} M		8.40

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59
	4.0×10^{-9} M		8.40

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59
2.5×10^{-6} M	4.0×10^{-9} M		8.40

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59
2.5×10^{-6} M	4.0×10^{-9} M	5.60	8.40

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59
2.5×10^{-6} M	4.0×10^{-9} M	5.60	8.40

Calculation

Note that **all** of the **entries** in the last line have **two sig figs!**

pH Calculations

$[H^+]$	$[OH^-]$	pH	pOH	
2.5×10^{-4} M	4.0×10^{-11} M	3.60	10.40	acid
3.67×10^{-10} M	2.72×10^{-5} M	9.435	4.565	basic
3.8×10^{-11} M	2.6×10^{-4} M	10.41	3.59	basic
2.5×10^{-6} M	4.0×10^{-9} M	5.60	8.40	acid

If the pH is **lower than 7**, the solution is **acidic!**
If the pH is **greater than 7**, the solution is **basic!**

Calculate the pH of 0.40 M HI

$HI \rightarrow H^+ + I^-$

0.40 M	0.40 M	0.40 M

$pH = -Log[H^+]$

$pH = -Log[0.40]$

$pH = 0.40$

Calculate the pH of 0.030 M $Ba(OH)_2$

$Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$

0.030 M	0.030 M	0.060 M

$pOH = -Log[OH^-]$

$pOH = -Log[0.060]$

$pOH = 1.22$

$pH + pOH = 14.000$

$pH + 1.22 = 14.000$

$pH = 12.78$

Calculate the pH of 100.0 mL of 1.0 M HCl after 300.0 mL of water is added to it.

	HCl	$\rightarrow$	H^+	+	Cl^-
100	1.0 M				
400			0.25 M		0.25 M

pH = 0.60

http://youtube.com/watch?v=xbf0HdLwLZA