

Thinking Like a Chemist About Acids and Bases

UNIT 6 DAY3

What are we going to learn today?

Thinking Like a Chemist in the
Context of the Chemical Equilibrium
Acids and Bases

Dredge up what you know about acids/bases
Weak Acids/Weak Bases vs Strong Acids/Bases
Behavior of these compounds in water

IMPORTANT INFORMATION

LM17

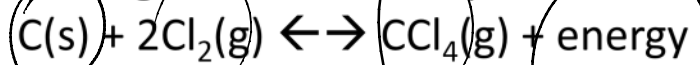
~~LM18~~ Strong Acids & Bases due Tue 9 AM

~~LM19~~ Weak Acids & Bases due Tue 9 AM

HW5 due Tue 9 AM

Individual Quiz Clicker Question; NO TALKING

The following reaction is at equilibrium:



The reaction will shift (left/right/not shift) when I add C(s) . The reaction will shift (left/right/not shift) when I increase the temperature.

- A) LEFT ; LEFT
- B) RIGHT ; LEFT
- C) NOT SHIFT ; NOT SHIFT
- D) NOT SHIFT ; LEFT

Quiz Clicker Question

What is the concentration of CH_3COO^- in a 0.2 M aqueous solution of CH_3COOH at equilibrium? _____

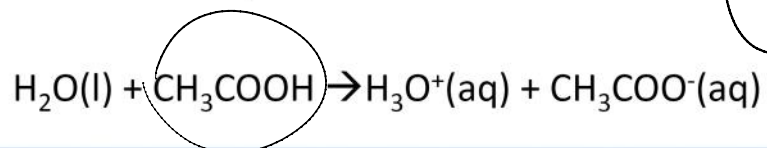
A. 0.2 M

B. 0.4 M

C. 1.89×10^{-3} M

D. 1.98×10^{-6} M

- Assume starting concentration of 0.2 M acetic acid. Calculate concentrations of all species at equilibrium. $K_a = 1.8 \times 10^{-5}$



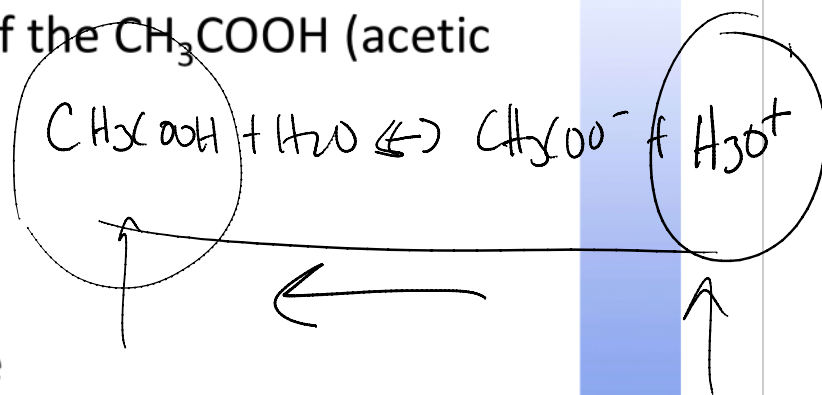
$$1.8 \times 10^{-5} = \frac{x^2}{.2}$$

Initial	.2	0	0
Change	-x	+x	x
Equilibrium	.2-x	x	x

Quiz Clicker Question

Assume that we can increase the concentration of the hydronium ion, (H_3O^+). What will happen to the concentration of the CH_3COOH (acetic acid)?

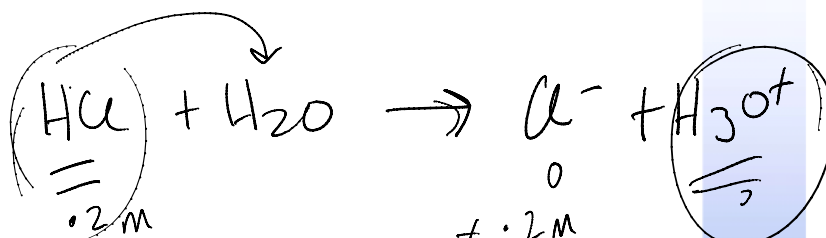
- A) Increase
- B) Decrease
- C) Stay the same



Quiz Clicker Questions

① What is the assumed concentration HCl in a 0.2 M aqueous solution of HCl at equilibrium?

- A) 0.2 M
- B) 0.1 M
- C) 0.4 M
- D) 0.0 M



② What is the assumed concentration of the hydronium ion in a 0.2 M aqueous solution of HCl at equilibrium?

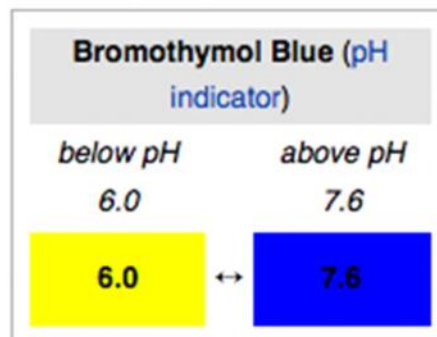
- A) 0.2 M
- B) 0.1 M
- C) 0.4 M
- D) 0.0 M



Chemical Equilibrium pH indicator

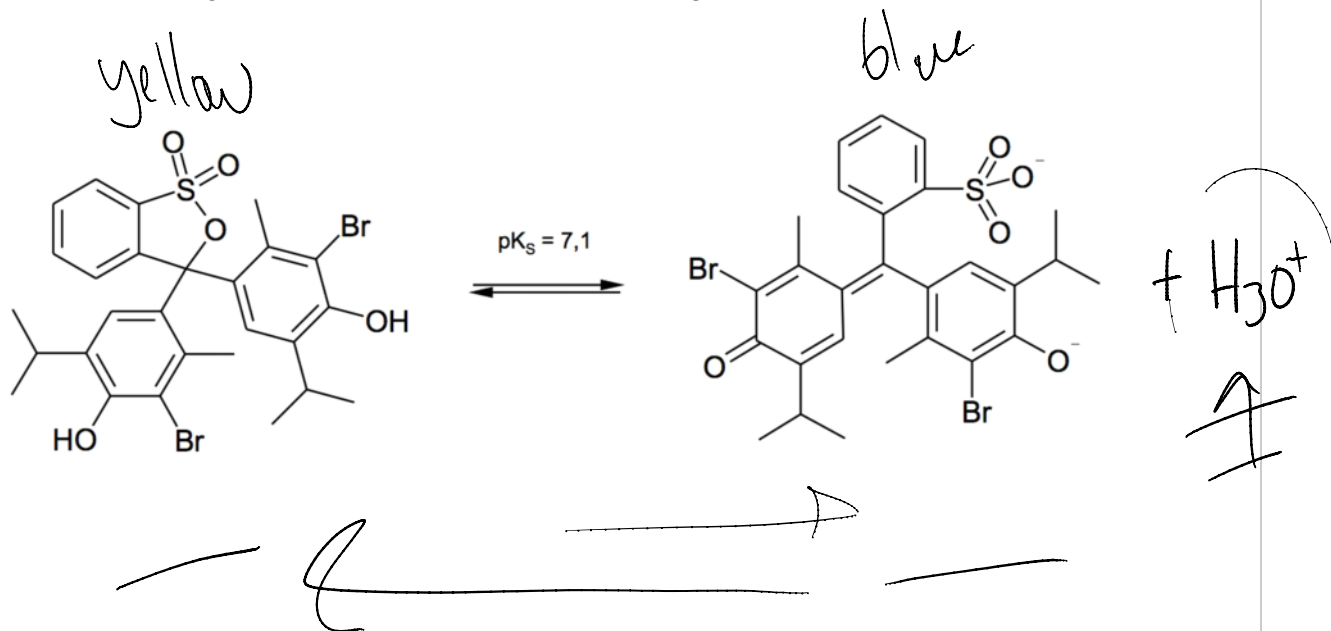


BTB indicator in acidic, neutral, and alkaline solutions (left to right).



CH302 Vanden Bout/LaBrake Spring 2012

Chemical Equilibrium pH indicator Bromothymol Blue



Brain Dump Acids and Bases

Acid - Corrosive, proton donor, sour, $\text{pH} < 7$
Yellow w/ BTB, conduct electricity in H_2O ,
 e^- pair acceptor, Litmus RED (pink)

Neutralize each other maybe?
base - $\text{pH} > 7$, bitter, $\uparrow [\text{OH}^-]$ in H_2O , proton acceptor
Litmus Blue, Slippery, Cleaning Supplies
Strong bases ionize completely, bases do conduct
elect. in H_2O , e^- pair donor, $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$

All Group I and some Group II hydroxides are strong bases!
Brain Dump Acids and Bases

Acid is PROTON donor

Base is PROTON acceptor

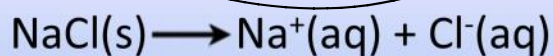
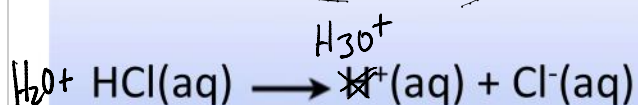
Strength Depends on Extent of Ionization

"Strong" means one thing

The substance dissociates 100% in water

Strong Acid

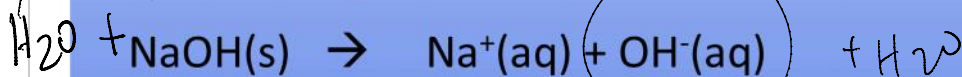
Strong Electrolyte



$$K_a = \text{BIG} = \infty$$

$$K_{sp} = \infty$$

Strong Base



MEMORIZE STRONG ACIDS

Hydrochloric

Hydrobromic

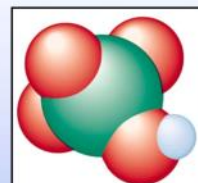
Hydroiodic

Perchloric

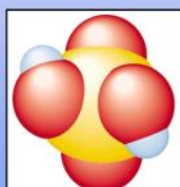
Chloric

Sulfuric

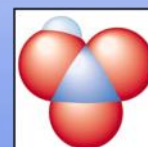
Nitric



Perchloric acid
(HClO_4)



Sulfuric acid
(H_2SO_4)



Nitric acid
(HNO_3)

MEMORIZE STRONG BASES

Group IA Hydroxides & some Group IIA Hydroxides

LiOH

NaOH

KOH

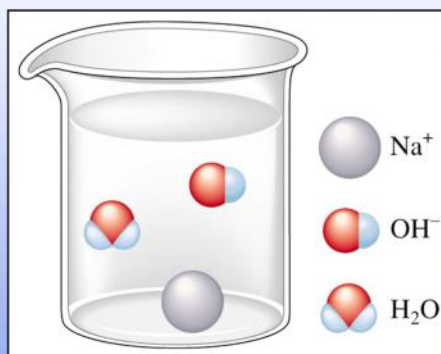
RbOH

CsOH

Ca(OH)₂

Sr(OH)₂

Ba(OH)₂



Strength Depends on Extent of Ionization

"WEAK" means one thing

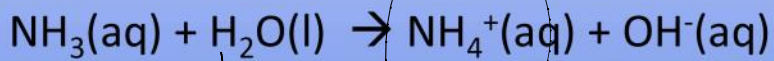
The substance **IONIZES** to a limited extent in water

Weak Acid



$$K_a = 3 \times 10^{-8}$$

Weak Base



$$K_b = 1.8 \times 10^{-5}$$

RECOGNIZE WEAK ACIDS

Often Carboxylic Acids or some OxyAcids

Acetic Acid
Formic Acid
Benzoic Acid

Nitrous Acid
Chlorous Acid
Hypochlorous Acid

Hydroflouric Acid
Hydrocyanic Acid

RECOGNIZE WEAK BASES

Derivatives of Ammonia

Base

ammonia, NH_3

trimethylamine, $(\text{CH}_3)_3\text{N}$ + $\text{H}_2\text{O} \leftrightarrow$

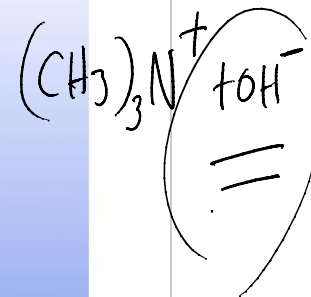
methylamine, CH_3NH_2

dimethylamine, $(\text{CH}_3)_2\text{NH}$

ethylamine, $\text{C}_2\text{H}_5\text{NH}_2$

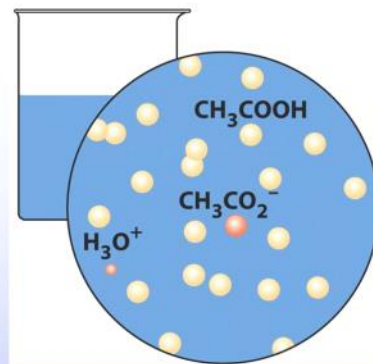
triethylamine, $(\text{C}_2\text{H}_5)_3\text{N}$

hydrazine, NH_2NH_2



Brønsted-Lowry Definition

Acid is PROTON donor



Base is PROTON acceptor

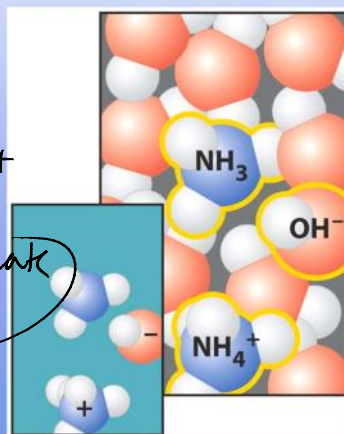


ACID
A

BASE
B

Conjugate
Base

Conjugate
Acid



Brønsted-Lowry Acid-Base-Conjugate Partners

1st label reactants as acid or base

2nd label products as conjugate acid or base



What is the conjugate acid of OH^- ?

What is the conjugate base of HPO_4^{2-} ?

What did we learn today?

Acid is Proton Donor

Acid is considered strong or weak

Base is a Proton Acceptor

Base is considered strong or weak

The extent of ionization is described by the equilibrium constant, K .

Must memorize common strong acids and bases, and recognize common weak acids and bases.