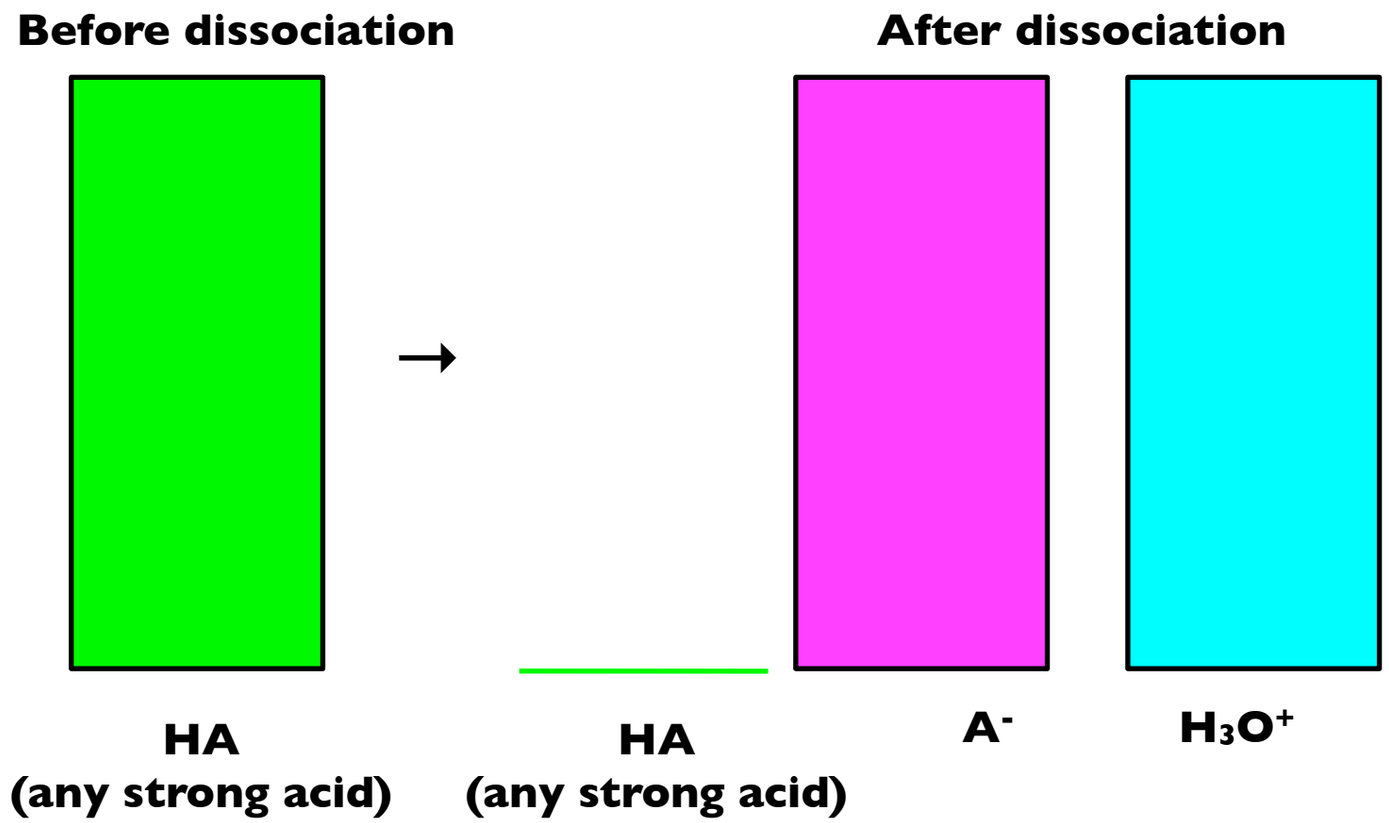
Weak acids, K_a

SCH4U

Chemical Equilibrium

Review

- Last class, we said **STRONG** acids dissociate 100% into ions

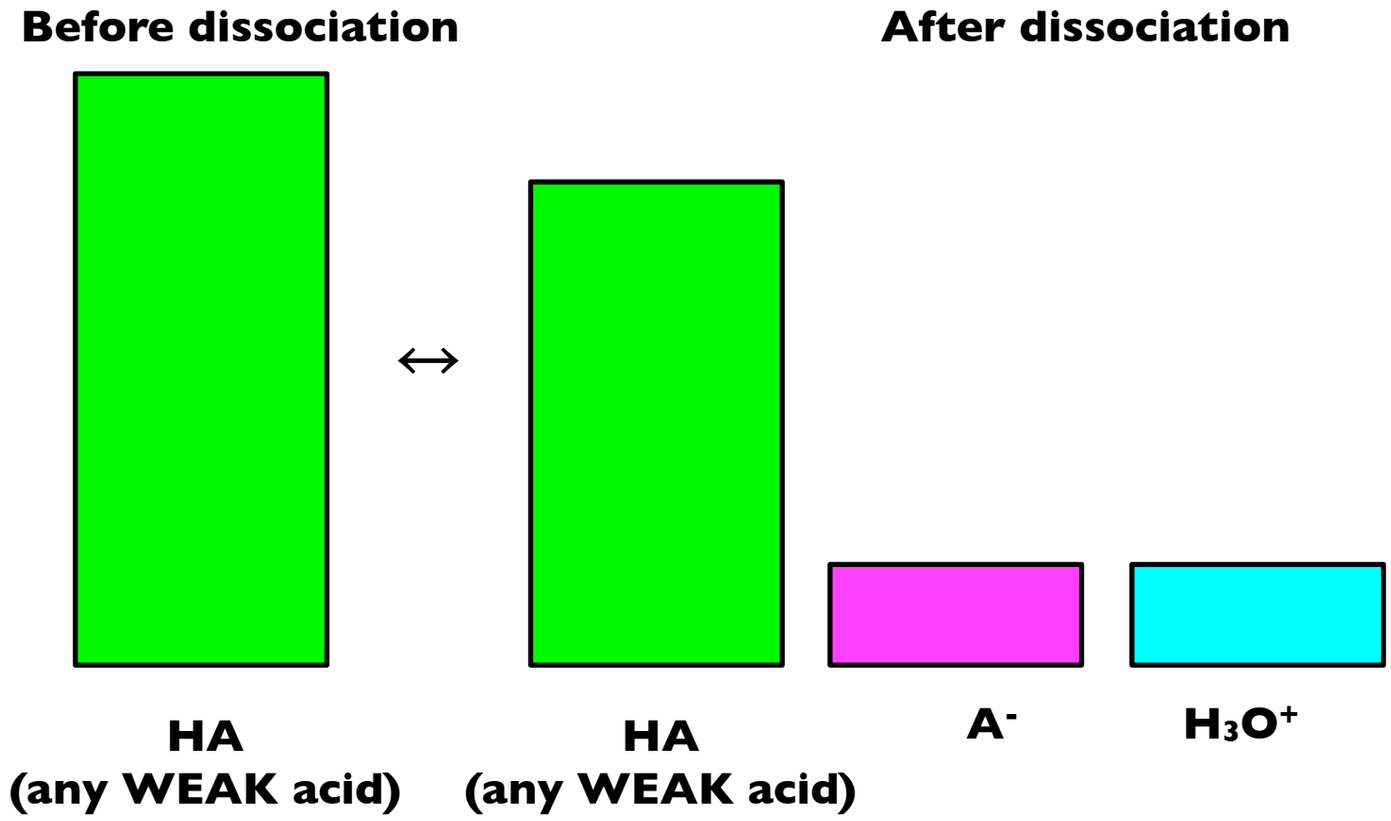


Working with Strong acids

- **Find the pH of a solution of 0.16M HBr.**

Weak acids

- Weak acids do **NOT** dissociate 100% into ions and are in **equilibrium**



Acid-Dissociation Constant, K_a

- $HA + H_2O \leftrightarrow A^- + H_3O^+$

$HC_2H_3O_{2(aq)} <====> H^+_{(aq)} + C_2H_3O_2^-{}_{(aq)}$

What is the formula for K_a?

Ionization Constant (K_a)

How do you suppose the K_a values of strong acids compare with weak acids?

1. Strong

2. Weak

pK_a

How are K_a and pK_a related?

$$pK_a = - \log K_a$$

small pK_a = more ionization; stronger acid

large pK_a = less ionization; weaker acid

Example #1

a) Calculate pK_a for acetic acid given $K_a = 1.8 \times 10^{-5}$

b) Calculate K_a for ammonium ion given pKa = 9.24.

Example #2

Hypoioidous acid has a pK_a of 10.6. The pK_a of hypobromous acid is 8.64. What is the chemical formula for each substance? Which is the weaker acid?

Calculations using pH

Two types of calculations:

1. Calculate K_a and pK_a from the pH of its solution given initial concentration.

2. Calculate pH or $[H^+]$ of a solution given the initial concentration and K_a or pK_a.

Percent Dissociation

- Weak acids only partially dissociate
- Percent dissociation is used to express how much the weak acid ionizes
- It is the percent of the acid that actually turned into ions

$$\text{Percent dissociation} = \frac{[HA]\ \text{dissociated}}{[HA]\ \text{initial}} \times 100\%$$

Example #3

- Propanoic acid is a weak acid used to inhibit mould formation in bread. A student makes a 0.10 M solution and it is found to have a pH of 2.96. What is the Ka and percent dissociation of this weak acid?
- $HA + H_2O \leftrightarrow A^- + H_3O^+$

Example #4

A 0.100 M solution of the weak acid HF was found to have an $[H_3O+] = 0.008$ M at equilibrium. Calculate the K_a and pK_a for HF.

Determining pH using Ka

- A chemist prepares a 0.050 M solution of nitrous acid, HNO_2. Find the pH (Ka is 5.6×10^{-4})
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19. Calculate the pH of a sample of vinegar that contains 0.83 mol/L acetic acid. What is the percent dissociation of the vinegar?

$$\text{Percent dissociation} = \frac{[HA]\ \text{dissociated}}{[HA]\ \text{initial}} \times 100\%$$

Try it!

- Weak acid problems
- p. 26 in workbook