17 • Aqueous Equilibria

17.1 The Common Ion Effect

Le Châtelier's principle says that if a product is added to a system at equilibrium, the reaction equilibrium will shift toward the reactants. Consider the ionization of acetic acid in water.

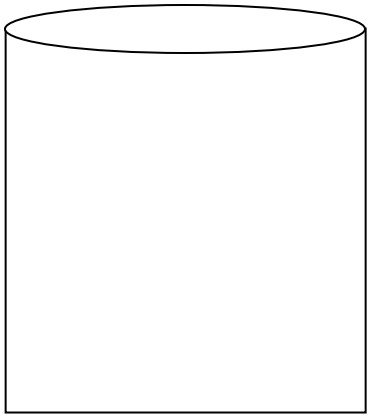
$$HC_2H_3O_2(aq) \rightleftharpoons H^+(aq) + C_2H_3O_2^-(aq)$$

- The addition of either product, hydrogen ion or acetate ion, would shift this equilibrium to the left, resulting in less ionization of acetic acid.
- One way to add a product to this equilibrium is to add a salt of acetic acid, such as sodium acetate ($NaC_2H_3O_2$). Being a soluble ionic compound, sodium acetate dissociates completely in aqueous solution to give aqueous sodium ions and aqueous acetate ions.
- The addition of acetate ions causes the equilibrium reaction to shift to the left.
- In this example acetic acid and sodium acetate have the acetate ion in common. This sort of shift in equilibrium is called the **common-ion effect**.
- In general, the ionization of a weak electrolyte is diminished by the addition of a strong electrolyte that has a common ion with the weak electrolyte.

Lecture Example #1

What is the pH of a solution made by adding 0.30 mol of acetic acid, $HC_2H_3O_2$, ($K_a = 1.8 \times 10^{-5}$) and 0.30 mol of sodium acetate, $NaC_2H_3O_2$, to enough water to make a 1L solution?

Draw a picture of what's occurring.



Make a Table

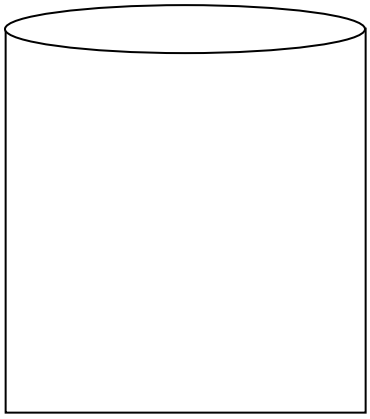
	$HC_2H_3O_2$	H_3O^+	$C_2H_3O_2^-$
Start			
Change			
Equilibrium			

Write Equations

Lecture Example #2

Calculate the fluoride-ion concentration and pH of a solution containing 0.10 mol of HCl and 0.20 mol of HF ($K_a = 6.8 \times 10^{-4}$) in 1.0 L of solution.

Draw a picture of what's occurring.



Make a Table

	HF	H_3O^+	F^-
Start			
Change			
Equilibrium			

Write Equations

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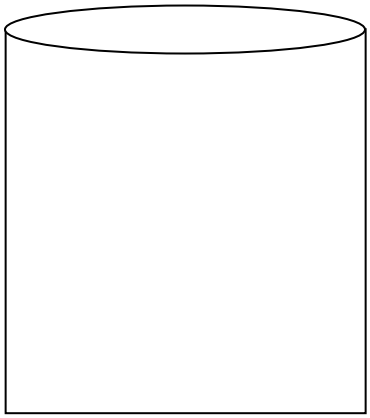
16.1 Common Ion Effect Practice Problems

1. Calculate the pH of a solution containing 0.085 M nitrous acid, HNO_2 ($Ka = 4.5 \times 10^{-4}$), and 0.10 M potassium nitrite, KNO_2.

Draw a picture of what's occurring.



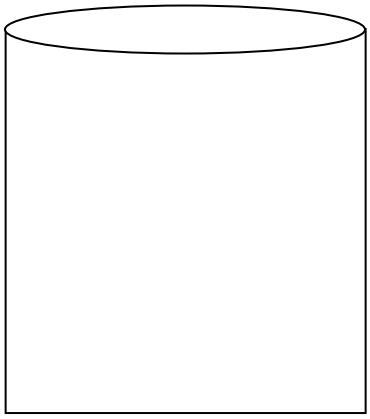
Write Equations

Make a Table

Start			
Change			
Equilibrium			

2. Calculate the formate-ion concentration and pH of a solution that is 0.050 M in formic acid, $HCHO_2$ (Ka = 1.8×10^{-4}), and 0.10 M in HNO_3

Draw a picture of what's occurring.



Write Equations

Make a Table

Start			
Change			
Equilibrium			