

Exercise 18.3b

The Common Ion Effect in Acids

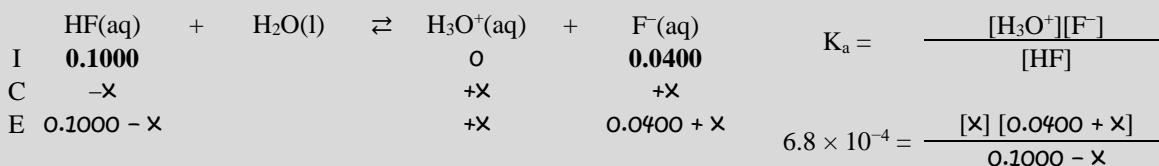
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ICE Tables & the Common Ion Effect

When a salt containing an ion common to one involved in an acid-base equilibrium system is added to the system, LeChâtelier's Principle states that the equilibrium will shift to reestablish equilibrium. The presence of an anion common to a weak acid, therefore, has the effect of reducing the ionization of the acid. The effect of this ion on equilibrium may be determined by using the concentration of the salt (assuming it is a strong electrolyte) as the initial concentration of the anion present in the acid equilibrium system.

Example: Calculate the pH of a solution that is 0.1000M HF and 0.0400M NaF. ($K_a = 6.8 \times 10^{-4}$)



The quadratic equation may be used to determine the exact value of 'x'. It is however, usually acceptable to assume the change in concentration caused by 'x' is negligible.

$$6.8 \times 10^{-4} = \frac{[\text{x}][0.0400]}{0.1000}$$

DIRECTIONS: Answer the following in the space provided.

1. What is the pH of a 0.020 M solution of the weak acid hydrocyanic acid, HCN? ($K_a = 4.9 \times 10^{-10}$)
 - a. What is the pH of the solution if 0.0030 moles of NaCN are added to 1.00 liter of the HCN solution? Assume the volume of the solution is unchanged.

2. Calculate the pH of a 0.015 M acetic acid solution. The value of K_a is 1.8×10^{-5} for acetic acid.
 - a. What is the pH of the solution if 0.010 moles of NaC₂H₃O₂ are added to 1.00 liter of the HC₂H₃O₂ solution? Assume the volume of the solution is unchanged.

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- Calculate the pH of a solution that is 0.295 M in sodium formate (NaHCO_2) and 0.205 M in formic acid (HCO_2H). The K_a of formic acid is 1.77×10^{-4} .
- Calculate the pH of a solution that is 0.25M in carbonic acid, H_2CO_3 , and 0.10M in sodium bicarbonate, NaHCO_3 . ($K_a = 4.3 \times 10^{-7}$)
- Nicotinic acid, $\text{HC}_2\text{H}_4\text{NO}_2$ is a B vitamin. It is also a weak acid with $K_a = 1.4 \times 10^{-5}$. What is the $[\text{H}^+]$ and the pH of a 0.010 M solution?
- Calculate the concentration of sodium benzoate that must be present in a 0.20 M solution of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) to produce a pH of 4.00. K_a of benzoic acid is 6.3×10^{-5} .
- What is the pH of a 0.85 M solution of the strong acid chloric acid, HClO_3 ?