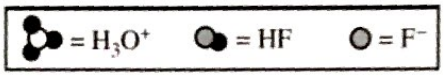
FR Practice #4 (2018 #5, 4 points)

$$HF(aq) + H_2O(l) \leftrightarrow F^-(aq) + H_3O^+(aq)$$

4. The ionization of HF(aq) in water is represented by the equation above. In a 0.0350 M HF(aq) solution, the percent ionization of HF is 13.0 percent.

   a. Two particulate representations of the ionization of HF molecules in the 0.0350 M HF(aq) solution are shown below in Figure 1 and Figure 2. Water molecules are not shown. Explain why the representation of ionization of HF molecules in water in Figure 1 is more accurate than the representation in Figure 2. (1 point)

   (The key below identifies the particles in the representations.)



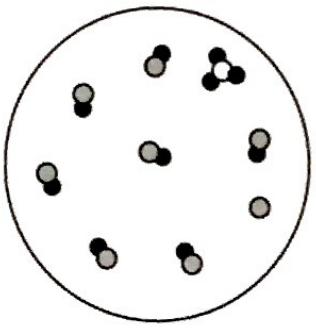


Figure 1

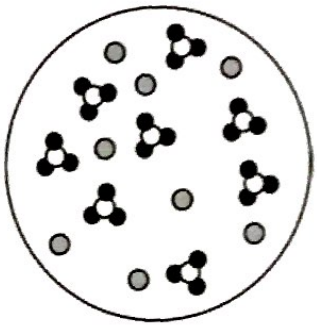


Figure 2

   b. Use the percent ionization data above to calculate the value of K_a for HF. (2 points)

   c. If 50.0 mL of distilled water is added to 50.0 mL of 0.0350 M HF(aq), will the percent ionization of HF(aq) in the solution increase, decrease, or remain the same? Justify your answer with an explanation or a calculation. (1 point)

a.) HF is a weak acid, + thus has a low % ionization, as shown in Figure 1. Figure 2 shows 100% of the HF particles dissociating, + that only happens with strong acids.

b.) $HF_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + F^-_{(aq)}$

$$K_a = \frac{[H_3O^+][F^-]}{[HF]} = \frac{x^2}{0.0350 - x} = \frac{(0.00455)^2}{0.0350 - 0.00455} = \boxed{6.80 \times 10^{-4}}$$

13.0% ionization $\Rightarrow x = 0.0350(0.130) = 0.00455$

c.) Increase! Diluting the sol'n will ↓ concentration of all aqueous terms in K_a expression. Since two terms decrease on top and only 1 on bottom, $Q < K$ so the reaction must shift right to re-establish equilibrium, ↑ % ionization.