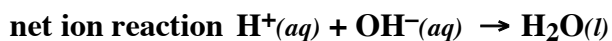
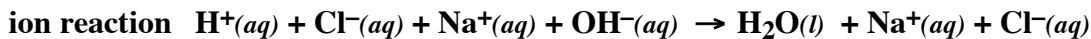
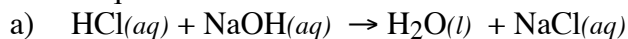
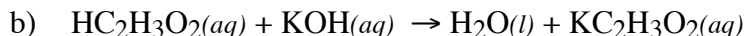


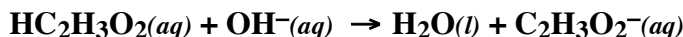
1. Write the ionic and net ionic equations for the following reactions, the equilibrium expression for the net ionic equation, and determine the magnitude of the equilibrium constant.



$$K = \frac{1}{[\text{H}^+][\text{OH}^-]} = \frac{1}{K_w} = \frac{1}{1 \times 10^{-14}} = 1.0 \times 10^{14}$$



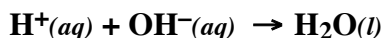
First we need to write the net ionic equation:



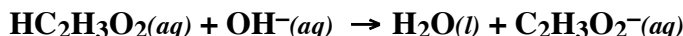
We need to break this equation into two equations whose K values we know. So looking at the net ionic equation I see $\text{HC}_2\text{H}_3\text{O}_2(aq)$ which is a weak acid, and I know how it dissociates;



The equilibrium constant for this reaction is $K_a(\text{HC}_2\text{H}_3\text{O}_2)$. The other equation has $\text{H}_2\text{O}(l)$ in it;



The equilibrium constant for this reaction is $\frac{1}{K_w}$. So if I add these two equations (I must multiply the equilibrium constants) I get the equation that we started with;

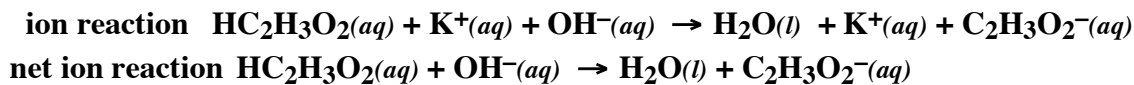


And the equilibrium constant for this reaction is;

$$K_a \cdot \frac{1}{K_w} = \frac{K_a}{K_w}$$

$$K_{\text{rxn}} = \frac{1.8 \times 10^{-5}}{1 \times 10^{-14}} = 1.8 \times 10^9$$

Another approach to solve this same problem is;



$$K_{\text{rxn}} = \frac{[\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{OH}^-][\text{HC}_2\text{H}_3\text{O}_2]}$$

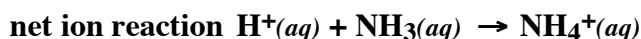
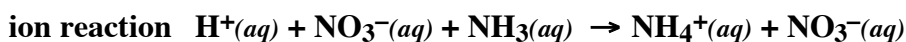
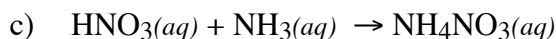
multiply the expression by $\frac{[\text{H}^+]}{[\text{H}^]}$

$$K_{\text{rxn}} = \frac{[\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{OH}^-][\text{HC}_2\text{H}_3\text{O}_2]} \cdot \frac{[\text{H}^+]}{[\text{H}^]}$$

$$K_{\text{rxn}} = \frac{[\text{C}_2\text{H}_3\text{O}_2^-][\text{H}^+]}{[\text{HC}_2\text{H}_3\text{O}_2]} \cdot \frac{1}{[\text{H}^+][\text{OH}^-]}$$

$$K_{\text{rxn}} = K_a \cdot \frac{1}{K_w} = \frac{K_a}{K_w}$$

$$K_{\text{rxn}} = \frac{1.8 \times 10^{-5}}{1 \times 10^{-14}} = 1.8 \times 10^9$$



$$K = \frac{[\text{NH}_4^+]}{[\text{H}^+][\text{NH}_3]}$$

multiply the expression by $\frac{[\text{OH}^-]}{[\text{OH}^-]}$

$$K = \frac{[\text{NH}_4^+]}{[\text{H}^+][\text{NH}_3]} \cdot \frac{[\text{OH}^-]}{[\text{OH}^-]}$$

$$K = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} \cdot \frac{1}{[\text{H}^+][\text{OH}^-]}$$

$$K = K_b \cdot \frac{1}{K_w} = \frac{K_b}{K_w}$$

$$K = \frac{1.8 \times 10^{-5}}{1 \times 10^{-14}} = 1.8 \times 10^9$$

What is the general conclusion which can be made from the magnitude of the equilibrium constant in all three examples above?

All three reaction have very large equilibrium constants, indicating that all three reactions proceed completely to products.