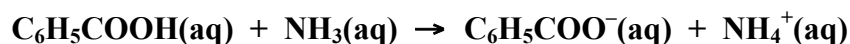


Marks
5

Write the equation for the reaction that occurs when benzoic acid reacts with ammonia?



Write the expression for the equilibrium constant for the reaction of benzoic acid with ammonia?

$$K = \frac{[\text{C}_6\text{H}_5\text{COO}^-(\text{aq})][\text{NH}_4^+(\text{aq})]}{[\text{C}_6\text{H}_5\text{COOH}(\text{aq})][\text{NH}_3(\text{aq})]}$$

What is the value of the equilibrium constant for the reaction of benzoic acid with ammonia? Hint: multiply the above expression by $[\text{H}^+]/[\text{H}^+]$.

Multiplying the expression above by $[\text{H}^+]/[\text{H}^+]$ gives:

$$\begin{aligned} K &= \frac{[\text{C}_6\text{H}_5\text{COO}^-(\text{aq})][\text{NH}_4^+(\text{aq})]}{[\text{C}_6\text{H}_5\text{COOH}(\text{aq})][\text{NH}_3(\text{aq})]} \cdot \frac{[\text{H}^+(\text{aq})]}{[\text{H}^+(\text{aq})]} \\ &= \frac{[\text{H}^+(\text{aq})][\text{C}_6\text{H}_5\text{COO}^-(\text{aq})]}{[\text{C}_6\text{H}_5\text{COOH}(\text{aq})]} \cdot \frac{[\text{NH}_4^+(\text{aq})]}{[\text{NH}_3(\text{aq})][\text{H}^+(\text{aq})]} \\ &= K_a \times \frac{K_b}{[\text{H}^+(\text{aq})][\text{OH}^-(\text{aq})]} = \frac{K_a \times K_b}{K_w} \\ &= \frac{(10^{-4.20}) \times 10^{-4.76}}{(10^{-14})} = 1.1 \times 10^5 \end{aligned}$$

Answer: 1.1×10^5

What are the major species in the solution that results from adding together equal amounts of solutions A and B?

The equilibrium strongly favours products so the major species are:

