	Marks
Write the equation for the reaction that occurs when benzoic acid reacts with ammonia?	**5**

$C_6H_5COOH(aq) + NH_3(aq) \rightarrow C_6H_5COO^-(aq) + NH_4^+(aq)$
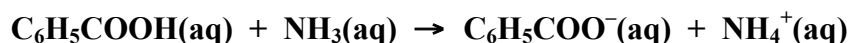
Write the expression for the equilibrium constant for the reaction of benzoic acid with ammonia?

$$K = \frac{[C_6H_5COO^-(aq)][NH_4^+(aq)]}{[C_6H_5COOH(aq)][NH_3(aq)]}$$

What is the value of the equilibrium constant for the reaction of benzoic acid with ammonia?

Multiplying the expression above by [H$^+$] / [H$^+$] gives:

$$K = \frac{[C_6H_5COO^-(aq)][NH_4^+(aq)]}{[C_6H_5COOH(aq)][NH_3(aq)]} \cdot \frac{[H^+(aq)]}{[H^+(aq)]}$$

$$= \frac{[H^+(aq)][C_6H_5COO^-(aq)]}{[C_6H_5COOH(aq)]} \cdot \frac{[NH_4^+(aq)]}{[NH_3(aq)][H^+(aq)]}$$

$$= K_a \times \frac{K_b}{[H^+(aq)][OH^-(aq)]} = \frac{K_a \times K_b}{K_w}$$

$$= \frac{(10^{-4.20}) \times 10^{-4.76}}{(10^{-14})} = 1.1 \times 10^5$$

Answer: **1.1×10^5**

What are the major species in the solution that results from dissolving equimolar amounts of benzoic acid and ammonia in water?

The equilibrium strong favours products so the major species are:

$C_6H_5CO_2^-(aq)$, $NH_4^+(aq)$, $H_2O(l)$

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.