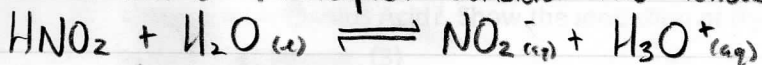18. A buffer is a solution containing a weak acid and its conjugate base. It resists pH changes in solution through Le Chateliers Principle. Consider the following reaction:

$$HNO_2 + H_2O_{(\ell)} \rightleftharpoons NO_{2}^{-}{}_{(aq)} + H_3O^{+}{}_{(aq)}$$

The acid, HNO_2 and its conjugate base NO_2^- act as a buffer to resist pH changes in their solution. This is ③ done by NO_2 neutralizing the addition of any strong acid. If a strong base is added the H_3O^+ will react and neutralize the strong base. Both work to mantain a constant pH. The buffer system remains effective according to Le Chateliers Principle due to either the NO_2^- or H_3O^+ concentrations being restored in accordance to the shifting equilibrium. ✓

19. a) C_6H_5COOH $K_a = 6.4 \times 10^{-5}$

$$C_6H_5COOH + H_2O_{(\ell)} \rightleftharpoons C_6H_5COO^{-}{}_{(aq)} + H_3O^{+}{}_{(aq)}$$ ⑥

$$K_B = \frac{K_w}{K_A} = \frac{1.0 \times 10^{-14}}{6.4 \times 10^{-5}} = 1.5_6 \times 10^{-10}$$
$$\longrightarrow 1.6 \times 10^{-10}$$

b) $$H_3BO_3 + H_2O_{(\ell)} \rightleftharpoons H_2BO_3^{-}{}_{(aq)} + H_3O^{+}{}_{(aq)}$$

$$K_B = \frac{K_w}{K_A} = \frac{1.0 \times 10^{-14}}{5.8 \times 10^{-10}} = 1.7_2 \times 10^{-5}$$
$$\longrightarrow 1.7 \times 10^{-5}$$

c) $$K_A = \frac{K_w}{K_B} = \frac{1.0 \times 10^{-14}}{3.5 \times 10^{-7}} = 2.8_5 \times 10^{-8}$$
$$\longrightarrow 2.9 \times 10^{-8}$$