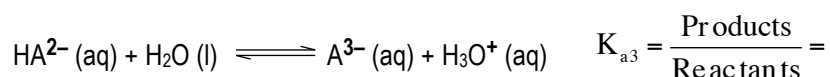
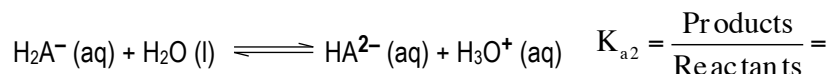
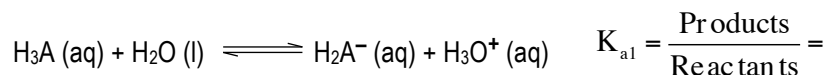


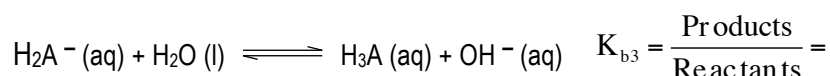
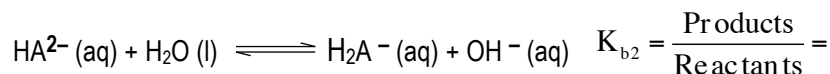
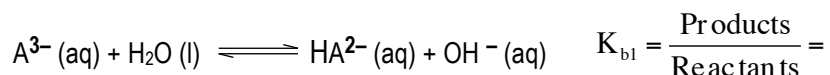
CONCEPT: POLYPROTIC ACIDS

Our understanding of diprotic acids and bases can be used to understand polyprotic acids and bases.

For polyprotic acids _____ their equations can be illustrated by:



For polyprotic bases _____ their equations can be illustrated by:



As a result of these equations for polyprotic acids and bases the relationship between K_a and K_b will be:

$$K_{a1} \cdot K_{b3} = K_w$$

$$K_{a2} \cdot K_{b2} = K_w$$

$$K_{a3} \cdot K_{b1} = K_w$$

When dealing with polyprotic acids:

- H_3A can be treated as a monoprotic acid and we use _____ can be used to find pH.
- A^{3-} represents the basic form and we use _____ can be used to find pH.

$$\boxed{\text{H}_2\text{A}^-} \quad [\text{H}^+] \approx \sqrt{\frac{K_{a1}K_{a2}[\text{A}^{3-}]_0 + K_{a1}K_w}{K_{a1} + [\text{A}^{3-}]_0}}$$

$$\boxed{\text{HA}^{2-}} \quad [\text{H}^+] \approx \sqrt{\frac{K_{a2}K_{a3}[\text{A}^{3-}]_0 + K_{a2}K_w}{K_{a2} + [\text{A}^{3-}]_0}}$$

PRACTICE: POLYPROTIC ACID CALCULATIONS 1

EXAMPLE 1: Calculate the equilibrium concentrations of H_3PO_4 , H_2PO_4^- , HPO_4^{2-} , PO_4^{3-} , and H_3O^+ for 0.35 M H_3PO_4 .

$K_{a1} = 7.2 \times 10^{-3}$, $K_{a2} = 6.3 \times 10^{-8}$, and $K_{a3} = 4.2 \times 10^{-13}$.

PRACTICE: POLYPROTIC ACID CALCULATIONS 2

EXAMPLE 1: Determine the pH of 0.250 M sodium hydrogen phosphate, Na_2HPO_4 . Phosphoric acid, H_3PO_4 , contains $K_{a1} = 7.5 \times 10^{-3}$, $K_{a2} = 6.2 \times 10^{-8}$ and $K_{a3} = 4.2 \times 10^{-13}$.

EXAMPLE 2: Determine the pH of 0.150 M citric acid, $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$. It possesses $K_{a1} = 7.4 \times 10^{-4}$, $K_{a2} = 1.7 \times 10^{-5}$ and $K_{a3} = 4.0 \times 10^{-7}$.