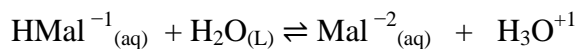
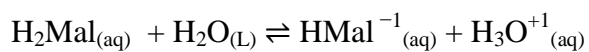


CHM 1046
Professor Fowler
Chapter 16 Homework

Malonic acid (H_2Mal) is diprotic and has $\text{pK}_{\text{a}1} = 2.83$ and $\text{pK}_{\text{a}2} = 5.70$.



1. Determine the expression (with H_2Mal and HMal^{-1}) and the numerical value for $\text{K}_{\text{a}1}$.
(1 pt)

2. Determine the expression (with HMal^{-1} and Mal^{-2}) and the numerical value for $\text{K}_{\text{a}2}$.
(1 pt)

3. Set up an equilibrium table for the first reaction when $[\text{H}_2\text{Mal}]_0 = 0.300 \text{ M}$. Determine both $[\text{H}_3\text{O}^{+1}]$ and $[\text{HMal}^{-1}]$. Then find the pH.
Finally, find the % dissociation using: $\left(\frac{[\text{HMal}^{-1}]}{[\text{H}_2\text{Mal}]_0} \right) \times 100\%$
(2 pts)

4. Review Polyprotic Acids and Example 16.04 in chapter 16 notes.
 Set up a similar equilibrium table for the second malonic acid reaction.
 Use “y” as the variable to determine $[\text{Mal}^{-2}]$. Show all three steps in the derivation for y from K_{a2} . Also, show with an equation that “y” does not affect pH. Finally, determine the % of the original H_2Mal concentration (0.3 M) that becomes Mal^{-2} :

$$\left(\frac{[\text{Mal}^{-2}]}{[\text{H}_2\text{Mal}]_0} \right) \times 100\% \quad (2 \text{ pts})$$

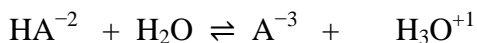
5. Review Triprotic Acids in chapter 16 notes. Suppose we have a triprotic acid (H_3A).
 If we solve the first and second equilibrium tables, we get:

$$[\text{H}_3\text{O}^{+1}] = [\text{H}_2\text{A}^{-1}] = x = \sqrt{(K_{a1}[\text{H}_3\text{A}]_0)} \text{ and } [\text{HA}^{-2}] = y = K_{a2}.$$

Finish the third table below and find z in terms of x, y, and $K_{a3} = \frac{[\text{A}^{-3}][\text{H}_3\text{O}^{+1}]}{[\text{HA}^{-2}]}$

Then, substitute the expressions for x and y above into your equation for z.

Actual number values are not necessary. (2 pts)



$$y \qquad \qquad 0 \qquad \qquad x$$

$$\underline{-z \qquad \qquad +z \qquad \qquad +z}$$

6. Review Buffers in the chapter 16 notes. Describe the two characteristics of a buffer solution. Then, describe the two components of a buffer solution. Next, use the Henderson-Hasselbalch equation to determine the pH of an HF and F^{-1} buffer solution where $[HF] = 1.00\text{ M}$ and $[F^{-1}] = 2.00\text{ M}$. Use $K_a = 6.8 \times 10^{-4}$ to find the pKa. (2 pts)