

Chem 311
Fall 2007
Quiz 5

Name:

Phthalic acid is a diprotic acid (H_2P). Determine the pH of a 0.01004 M solution of Potassium Hydrogen Phthalate (KHP), given the following data.

$$K_{a1} = 1.12 \cdot 10^{-3}$$

$$K_{a2} = 3.90 \cdot 10^{-6}$$

If you can not remember the formula, estimate the answer and justify your answer.

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KHP dissociates in water to HP^- , which is the intermediate species.

$$\begin{aligned} [H^+] &= \{(K_{a1}K_{a2}F + K_{a1}K_w)/(K_{a1}+F)\}^{1/2} \\ &= \{[(1.12 \cdot 10^{-3})(3.90 \cdot 10^{-6})(0.01004) + (1.12 \cdot 10^{-3})(1.01 \cdot 10^{-14})]/(1.12 \cdot 10^{-3} + 0.01004)\}^{1/2} \\ &= 6.26742 \cdot 10^{-5} \text{ M} \end{aligned}$$

$$\text{pH} = 4.203$$

estimate

$$\text{p}K_{a1} = 2.951$$

$$\text{p}K_{a2} = 5.409$$

$$\text{pH} = (2.950 + 5.408)/2 = 4.179 = 4.2$$

For an intermediate species, the average of the $\text{p}K_a$'s is a reasonable estimate!!!