Phthalic acid is a diprotic acid (H₂P). Determine the pH of a 0.01004 M solution of Potassium Hydrogen Phthalate (KHP), given the following data.

\( K_{a1} = 1.12 \times 10^{-3} \)
\( K_{a2} = 3.90 \times 10^{-6} \)

If you can not remember the formula, estimate the answer and justify your answer.
Phthalic acid is a diproptic acid (H$_2$P). 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.

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

$$[H^+] = \left\{ \frac{(K_{a1}K_{a2}F + K_{a1}Kw)}{(K_{a1}+F)} \right\}^{1/2}$$

$$= \left\{ \frac{(1.12 \cdot 10^{-3})(3.90 \cdot 10^{-6})(0.01004)+(1.12 \cdot 10^{-3})(1.01 \cdot 10^{-14})}{(1.12 \cdot 10^{-3} + 0.01004)} \right\}^{1/2}$$

$$= 6.26 \cdot 10^{-5} \text{ M}$$

pH = 4.203

estimate

$pK_{a1} = 2.951$

$pK_{a2} = 5.409$

pH = (2.950 + 5.408)/2 = 4.179 = 4.2$

For an intermediate species, the average of the pKa’s is a reasonable estimate!!!