



$$K_{a1} = \frac{[\text{H}^+][\text{HSO}_3^-]}{[\text{H}_2\text{SO}_3]}$$



$$K_{a2} = \frac{[\text{H}^+][\text{SO}_3^{2-}]}{[\text{HSO}_3^-]}$$



$$I \quad 0.007 \qquad \qquad 0 \qquad \qquad 0$$

$$C \quad -x \qquad \qquad +x \qquad \qquad +x$$

$$E \quad 0.007 - x \qquad \qquad x \qquad \qquad x$$

$$K_{a1} = \frac{[\text{H}^+][\text{H}_2\text{PO}_4^-]}{[\text{H}_3\text{PO}_4]} = 7.5 \times 10^{-3} = \frac{x^2}{0.007 - x}$$

$$x = 7.5 \times 10^{-3} \text{ M}$$

$$\% \alpha = \frac{7.5 \times 10^{-3}}{7.5 \times 10^{-3}} \times 100 = 100\%$$

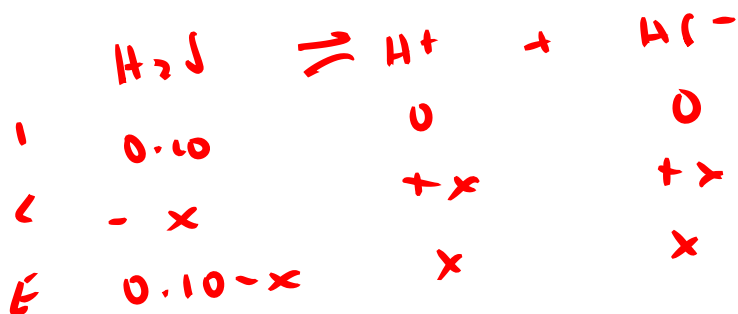
$$y^2 = 5 \times 10^{-5} - (7.5 \times 10^{-3})x$$

$$y^2 + (7.5 \times 10^{-3})x - (5 \times 10^{-5}) = 0$$

$$x = [\text{H}^+] = 4 \times 10^{-3} \text{ M} \qquad \text{pH} = -\log(4 \times 10^{-3}) = 2.4$$

if  $K_{a1}$  is much larger than  $K_{a2} + K_{a3}$   
 so  $\text{H}^+$  contributed from  $\text{H}_2\text{PO}_4^-$  and  $\text{HPO}_4^{2-}$   
 can be ignored

10) because  $K_{a2}$  for  $H_2S$  is so small, we can ignore the  $H^+$  contributed from the  $K_{a2}$  reaction

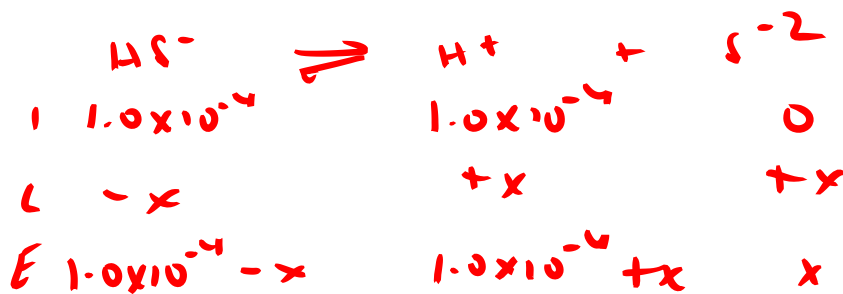


$$K_{a1} = \frac{[H^+][HS^-]}{[H_2S]} = 1.0 \times 10^{-7} = \frac{x^2}{0.10-x}$$

$$x = 1.0 \times 10^{-4}$$

$$\% \alpha_1 = \frac{1.0 \times 10^{-4}}{0.10} \times 100 = 0.10\% \checkmark$$

$$pH = -\log(1.0 \times 10^{-4}) = 4.00$$



$$K_{a2} = \frac{[H^+][S^{2-}]}{[HS^-]} = 1.0 \times 10^{-14} = \frac{(1.0 \times 10^{-4} + x)(x)}{(1.0 \times 10^{-4} - x)}$$

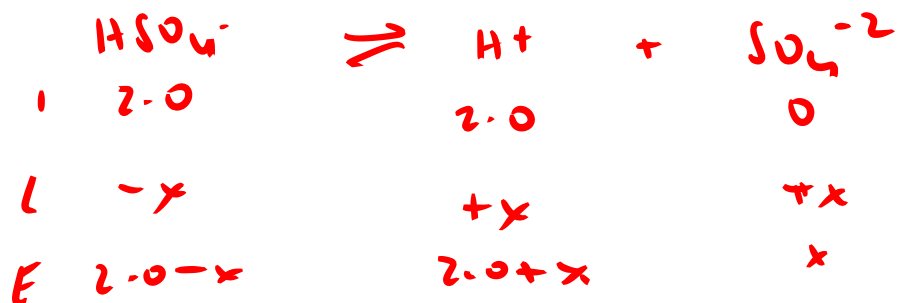
$$x = [S^{2-}] = 1.0 \times 10^{-14}$$

$$\% \alpha_2 = \frac{1.0 \times 10^{-14}}{1.0 \times 10^{-4}} \times 100$$

$$1.0 \times 10^{-13}\% \checkmark$$



$$[\text{H}_2\text{SO}_4]_0 = [\text{H}^+] = [\text{HSO}_4^-] = 2.0 \text{ M}$$



$$K_{a2} = \frac{[\text{H}^+][\text{SO}_4^{2-}]}{[\text{HSO}_4^-]} = 1.2 \times 10^{-2} = \frac{(2.0+x)(x)}{(2.0-x)}$$

$$x = [\text{SO}_4^{2-}] = 1.2 \times 10^{-2} \text{ M}$$

$$\% = \frac{1.2 \times 10^{-2}}{2.0} \times 100 = 0.6\%$$

$$\text{pH} = -\log(2.0) = -0.30$$

$\text{H}^+$  from second reaction is insignificant.

For more diluted  $\text{H}_2\text{SO}_4$  solutions... not the case