

Acids and Bases



#7

Calculate the pH of a solution of 1.116 g KOAc in 250 mL solution.

Solution

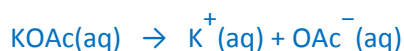
KOAc:

$$1.116 \text{ g} = \frac{1.116 \text{ g}}{98.1 \frac{\text{g}}{\text{mol}}} = 0.0114 \text{ mol}$$

$$\frac{0.0114 \text{ mol}}{0.250 \text{ L}} = 0.0456 \frac{\text{mol}}{\text{L}}$$

KOAc:

= salt, completely dissociated



K^+ = weak acid, weaker than water

OAc^- = weak base



$$K_{\text{b OAc}^-} = \frac{[\text{HOAc}] \times [\text{OH}^-]}{[\text{OAc}^-]} = \frac{1.0 \times 10^{-14}}{K_{\text{a HOAc}}} = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.6 \times 10^{-10}$$

$\frac{\text{mol}}{\text{L}}$	OAc^-	HOAc	OH^-
Start	0.456	0	0*
Δ	-x	+x	+x
Equilibrium	0.456 - x	x	x

(*) The hydroxide ions delivered by the ionization of water are neglected. The weak base OAc^- ($K_{\text{b}} = 5.6 \times 10^{-10}$) is much stronger than the weak base H_2O ($K_{\text{b}} = 1.0 \times 10^{-14}$).

$$K_{\text{b OAc}^-} = \frac{x^2}{0.456 - x} = 5.6 \times 10^{-10}$$
$$\Rightarrow x^2 + 5.6 \times 10^{-10} x - 2.5 \times 10^{-10} = 0$$
$$\Rightarrow x = 1.6 \times 10^{-5}$$

$\frac{\text{mol}}{\text{L}}$	OAc^-	HOAc	OH^-
Equilibrium	0.131	1.6×10^{-5}	1.6×10^{-5}

$$\Rightarrow \text{pOH} = 4.80 \Rightarrow \text{pH} = 9.20$$