

Problem 8-14 Buffers

Buffer consisting of 0.2 mol dm^{-3} of acetic acid and 0.2 mol dm^{-3} of sodium acetate has $\text{pH} = 4.75$. What change will cause the addition of 0.05 mol dm^{-3} KOH solution?

$$[\text{pH}_1 = \text{p}K_{\text{HAc}} = 4.75, \text{pH}_2 = 4.97]$$

Solution:



conversion x

$$K_{\text{HAc}} = \frac{c_{\text{H}^+} \cdot c_{\text{Ac}^-}}{c_{\text{HAc}}}$$



completely dissociated

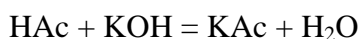
$$c_{\text{HAc}} = 0.2 \text{ mol dm}^{-3}$$

$$c_{\text{NaAc}} = c_{\text{Ac}^-} = 0.2 \text{ mol dm}^{-3} \text{ (} c_{\text{Ac}^-} \text{ which is formed by dissociation of the acid is negligible due to very small value of the dissociation constant)}$$

$$c_{\text{H}^+} = K_{\text{HAc}} \cdot \frac{c_{\text{HAc}}}{c_{\text{Ac}^-}} = K_{\text{HAc}} \cdot \frac{0.2}{0.2} = K_{\text{HAc}}$$

$$\text{pH}_1 = \text{p}K_{\text{HAc}} = 4.75$$

On addition of the strong base a reaction



will occur and 0.05 mol dm^{-3} of acid HAc converts to 0.05 mol dm^{-3} of sodium acetate

$$c_{\text{HAc}} = 0.2 - 0.05 = 0.15 \text{ mol dm}^{-3}$$

$$c_{\text{Ac}^-} = 0.2 + 0.05 = 0.25$$

$$c_{\text{H}^+} = K_{\text{HAc}} \cdot \frac{c_{\text{HAc}}}{c_{\text{Ac}^-}} = 1.78 \cdot 10^{-5} \cdot \frac{0.15}{0.25} = 1.068 \cdot 10^{-5} \text{ mol dm}^{-3}$$

$$\text{pH}_2 = -\log (1.068 \cdot 10^{-5}) = 4.9714$$

$$\text{pH increases by } \Delta\text{pH} = 4.9714 - 4.75 = 0.2214$$