

TEXTBOOK PROBLEMS

16.86 and 16.88

16.86

$$.050 \text{ L soln} \left(\frac{.050 \text{ mole HCHO}_2}{1 \text{ L soln}} \right) \left(\frac{1 \text{ mole NaOH}}{1 \text{ mole HCHO}_2} \right) \left(\frac{1 \text{ L soln}}{.050 \text{ mole NaOH}} \right) = .050 \text{ L soln}$$

↑
vol NaOH soln
used in titration

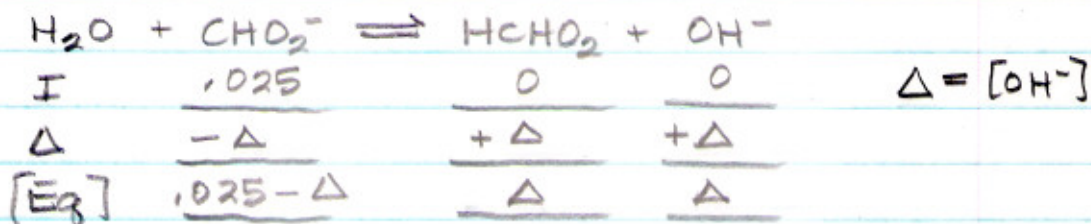
total vol. soln after titration:

$$50. \text{ mL soln} + 50 \text{ mL soln} = 100 \text{ mL soln}$$



All HCHO_2 converted to CHO_2^- , so M CHO_2^- at end of titration:

$$\frac{50 \text{ mL soln}}{100 \text{ mL soln}} \left(\frac{.050 \text{ mole HCHO}_2}{1 \text{ L soln}} \right) \left(\frac{1 \text{ mole CHO}_2^-}{1 \text{ mole HCHO}_2} \right) = 0.025 \text{ M CHO}_2^-$$



$$K_b = \frac{[\text{HCHO}_2][\text{OH}^-]}{[\text{CHO}_2^-]}$$

$$K_b = \frac{K_w}{K_a^{\text{HCHO}_2}} = \frac{1 \times 10^{-14}}{1.7 \times 10^{-4}} = 5.9 \times 10^{-11}$$

$$5.9 \times 10^{-11} = \frac{\Delta^2}{.025 - \Delta}$$

↑ assume negligible

$$\Delta = [\text{OH}^-] = 1.2 \times 10^{-6}$$

$$\text{pOH} = 5.92$$

$$\text{pH} = 14.00 - 5.92 = \underline{\underline{8.08}}$$

Question 16.88: What is the pH of a soln prepared by mixing 25.0 mL of .180 M $\text{HC}_2\text{H}_3\text{O}_2$ with 40.0 mL of 0.250 M NaOH

* but on the little slip of paper I put 0.400 M NaOH instead of .250 M NaOH

16.88

$$25.0 \text{ mL soln} + 40.0 \text{ mL soln} = 65.0 \text{ mL soln}$$

$$\frac{25.0 \text{ mL soln} (.180 \text{ mole HAC})}{65.0 \text{ mL soln} (1 \text{ L soln})} = 0.0692 \text{ M HAC}$$

$$\frac{40.0 \text{ mL soln} (0.400 \text{ mole NaOH})}{65.0 \text{ mL soln} (1 \text{ L soln})} \left(\frac{1 \text{ mole OH}^-}{1 \text{ mole NaOH}} \right) = 0.246 \text{ M OH}^-$$



before	<u>.0692</u>	<u>.246</u>	<u>0</u>
Δ	<u>-.0692</u>	<u>-.0692</u>	<u>+.0692</u>
after	<u>0</u>	<u>0.177</u>	<u>.0692</u>



I	<u>.0692</u>	<u>0</u>	<u>0.177</u>	$[\text{OH}^-] = .177 + \heartsuit$
Δ	<u>$-\heartsuit$</u>	<u>$+\heartsuit$</u>	<u>$+\heartsuit$</u>	$[\text{HAC}] = \heartsuit$
$[\text{Eq}]$	<u>$.0692 - \heartsuit$</u>	<u>\heartsuit</u>	<u>$.177 + \heartsuit$</u>	$[\text{Ac}^-] = .0692 - \heartsuit$

$$K_b = \frac{[\text{HAC}][\text{OH}^-]}{[\text{Ac}^-]}$$

$$K_b = \frac{K_w}{K_a} = \frac{1 \times 10^{-14}}{1.7 \times 10^{-5}} = 5.9 \times 10^{-10}$$

$$5.9 \times 10^{-10} = \frac{\heartsuit (.177 + \heartsuit)}{.0692 - \heartsuit}$$

assume negligible

$$\heartsuit = 4.8 \times 10^{-10}$$

$$[\text{OH}^-] = .177 + 4.8 \times 10^{-10} = .177$$

$$\text{pOH} = .752$$

$$\text{pH} = 14.000 - .752 = 13.248$$