

Lecture 23 Problems

Problem 1

We see that, at equivalence, moles $\text{OH}^- = \text{moles H}^+$; by extension
moles $\text{NaOH} = \text{moles OH}^- = \text{moles H}^+ = \text{moles HCl}$

$$\frac{15.4 \text{ ml HCl}}{1} \cdot \frac{1 \text{ L}}{1000 \text{ ml}} \cdot \frac{1 \text{ mole}}{1 \text{ L}} \Rightarrow 0.0154 \text{ moles H}^+$$

Then,

$$\frac{0.0154 \text{ moles OH}^-}{0.05 \text{ L}} \Rightarrow 0.308 \text{ M NaOH in the bottle.}$$

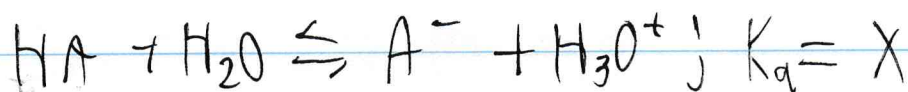
Problem 2

(a) The equivalence point is where moles acid = moles base;

$$\frac{0.1 \text{ moles NaOH}}{1 \text{ L}} \cdot 400 \text{ mL} = \cancel{\text{X moles A}} \cdot 0.295 \text{g} \cdot \frac{\text{X moles}}{1 \text{g}}$$

implies a molar weight of 73.75 g/mol

(b) We see that



The 30 ml of 0.1 M NaOH provides

$$\frac{0.1 \text{ moles OH}^-}{1 \text{ L}} \cdot \frac{1 \text{ L}}{1000 \text{ ml}} \cdot 30 \text{ ml} = 0.003 \text{ moles OH}^-$$

$$\text{pH} = 5.37 = -\log \left(\frac{0.003 \text{ moles OH}^- - \text{X moles H}_3\text{O}^+}{70 \text{ mL}} \right)$$

eventually implies $K_a = 3.28 \cdot 10^{-9}$

Problem 3

(a): Begin by writing the reaction:



Given $K_a = 1.74 \cdot 10^{-5} \Rightarrow K_b = 5.75 \cdot 10^{-10}$

$$1.74 \cdot 10^{-5} = \frac{(0.1-x) \cdot x^2}{(0.1-x)}$$

$$0.174 = x^2 \Rightarrow \text{pH} = 2.88$$

(b): By subtracting due to the 0.002 moles of OH^- ,

$$\text{pH} = 4.68$$

(c): The equivalence volume is $25 \text{ ml} / 2 = 12.5 \text{ ml}$

(d): Similar to (b): $\text{pH} = 4.76$