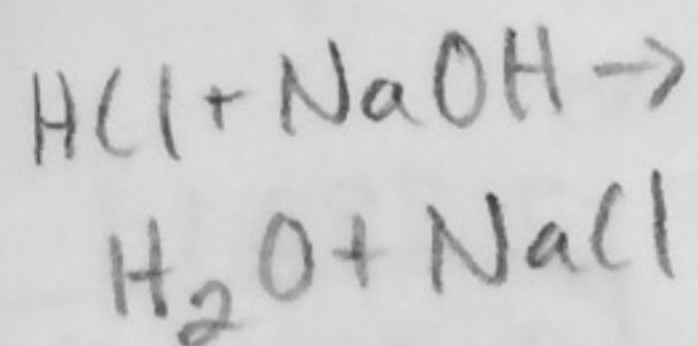


Key

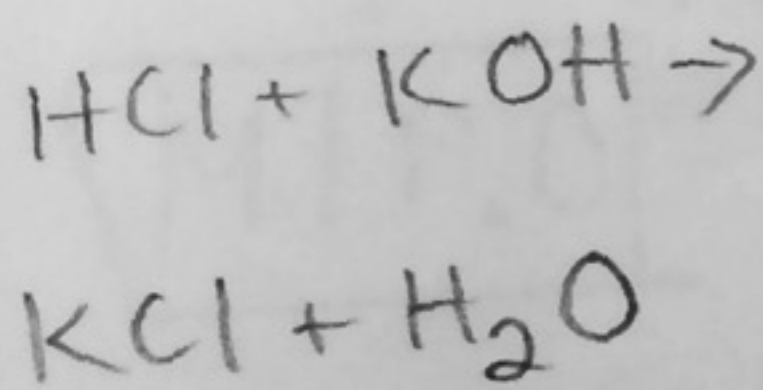
Titration Practice

1. If 15.0 ml of 0.50 M NaOH is used to neutralize 25.0 ml of HCl, what is the molarity of the acid solution?



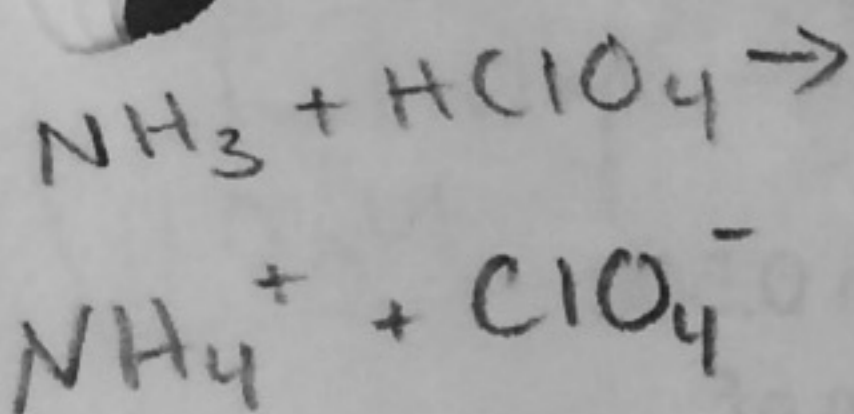
$$n = (.50 \text{ M})(.015 \text{ L}) = .0075 \text{ mol NaOH} \rightarrow \frac{.0075 \text{ mol HCl}}{.025 \text{ L}} = 0.30 \text{ M HCl}$$

2. A volume of 30.0 ml of 0.25 M HCl neutralizes a 50.0 ml sample of KOH solution. What is the concentration of KOH?



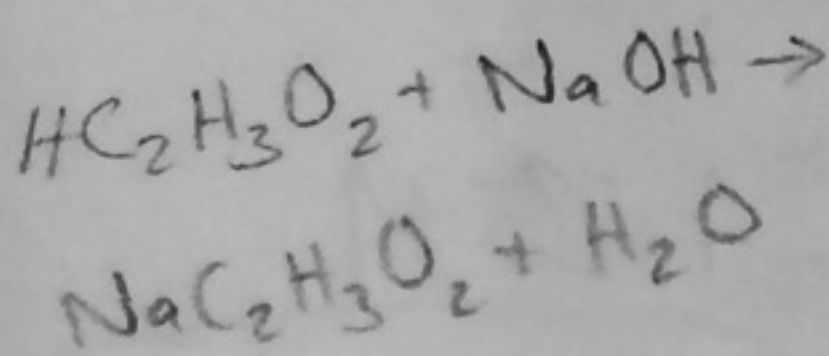
$$n = (.25 \text{ M})(.030 \text{ L}) = .0075 \text{ mol HCl} \rightarrow \frac{.0075 \text{ mol KOH}}{.050 \text{ L}} = 0.15 \text{ M KOH}$$

3. A volume of 9.0 ml of 0.70 M NH₃ neutralizes a 35.0 ml sample of HClO₄ solution. What is the concentration of HClO₄?



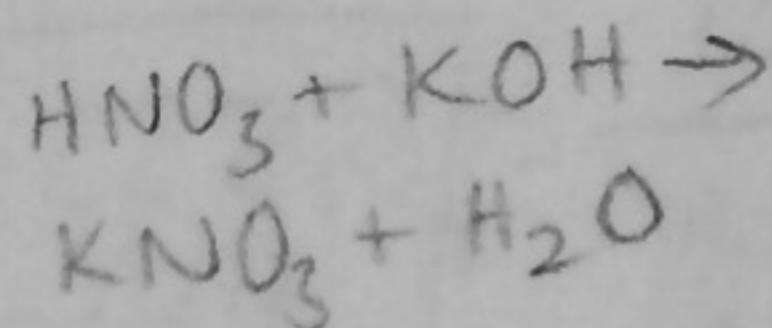
$$n = (.009 \text{ L})(0.70 \text{ M}) = .0063 \text{ mol NH}_3 \rightarrow \frac{.0063 \text{ mol HClO}_4}{.035 \text{ L}} = 0.18 \text{ M HClO}_4$$

4. In a titration of 40.0 ml of an acetic acid solution, the end point is reached when 35.0 ml of 1.00 M NaOH is added. Calculate the molarity of the acetic acid solution.



$$n = (1.00 \text{ M})(.035 \text{ L}) = .035 \text{ mol NaOH} \rightarrow \frac{.035 \text{ mol HC}_2\text{H}_3\text{O}_2}{.040 \text{ L}} = .875 \text{ M HC}_2\text{H}_3\text{O}_2$$

5. What volume of 0.300 M HNO₃ will be required to react with 24 ml of 0.250 M KOH?

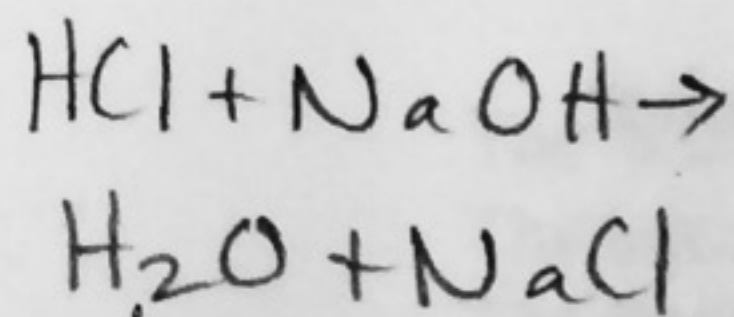


$$n = (.250 \text{ M})(.024 \text{ L}) = .006 \text{ mol KOH} \rightarrow .006 \text{ mol HNO}_3$$

$$M = \frac{n}{V} \quad V = \frac{n}{M} = \frac{.006 \text{ mol}}{.300 \text{ M}} = 0.020 \text{ L} = 20 \text{ mL}$$

(10)

6. What is the concentration of a 15 ml sample of HCl if 28.2 ml of 0.150 M NaOH is needed to titrate it?

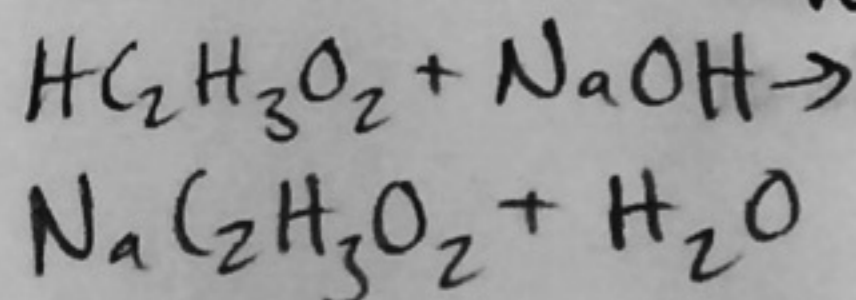


$$n = (.150 \text{ M})(.0282 \text{ L}) = .00423 \text{ mol NaOH} \rightarrow \frac{.00423 \text{ mol HCl}}{.015 \text{ L}} = 0.282 \text{ M} = \boxed{0.28 \text{ M HCl}}$$

7. A 10.0 ml sample of an acid is titrated with 45.5 ml of 0.200 M NaOH. What is the concentration of the acid?

$$n = (0.200 \text{ M})(.0455 \text{ L}) = .0091 \text{ mol NaOH} \rightarrow \frac{.0091 \text{ mol acid}}{.0100 \text{ L}} = \boxed{0.91 \text{ M}}$$

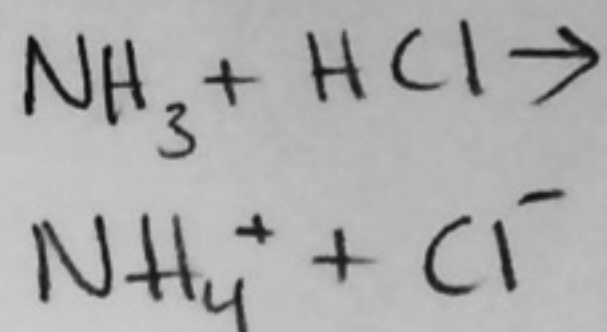
8. A 5.00 ml sample of vinegar has a concentration of 0.800 M. What volume of 0.150 M NaOH is required to complete the titration?



$$n = (.800 \text{ M})(.00500 \text{ L}) = 4.00 \times 10^{-3} \text{ mol HC}_2\text{H}_3\text{O}_2 \rightarrow 4.00 \times 10^{-3} \text{ mol NaOH}$$

$$V = \frac{n}{M} = \frac{4.00 \times 10^{-3} \text{ mol}}{.150 \text{ M}} = 0.0266 \dots \text{ L} = \boxed{26.7 \text{ mL NaOH}}$$

9. A 10.0 ml sample of household ammonia, $\text{NH}_3(\text{aq})$, is titrated with 0.500 M HCl. If 25.7 ml of acid is required, what is the concentration of the household ammonia?



$$n = (.500 \text{ M})(.0257 \text{ L}) = 0.01285 \text{ mol HCl} \rightarrow \frac{.01285 \text{ mol NH}_3}{.0100 \text{ L}} = 1.285 \text{ M} = \boxed{1.29 \text{ M NH}_3}$$

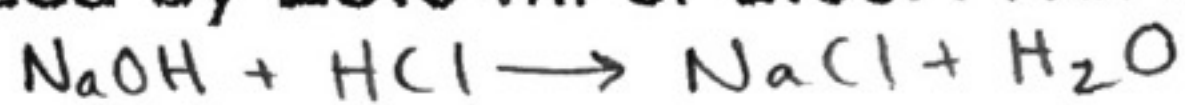
10. What is the concentration of a 10.0 ml sample of HCl if 35.5 ml of 0.150 M NaOH is needed to titrate it to a pink endpoint?

$$n = (.150 \text{ M})(.0355 \text{ L}) = .005325 \text{ mol NaOH} \rightarrow \frac{.005325 \text{ mol HCl}}{.0100 \text{ L}} = \boxed{0.533 \text{ M HCl}}$$

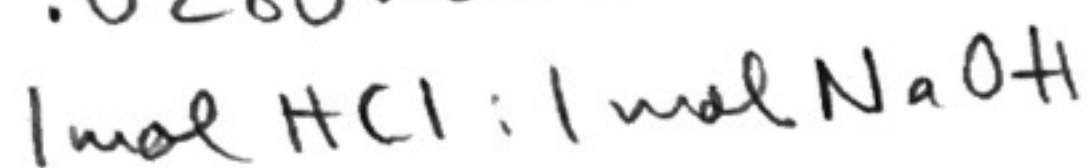
Titration Calculations (Round Two)

Name: Key

1. What is the molarity of sodium hydroxide if 20.0 ml of the solution is neutralized by 28.0 ml of 1.00M HCl solution?

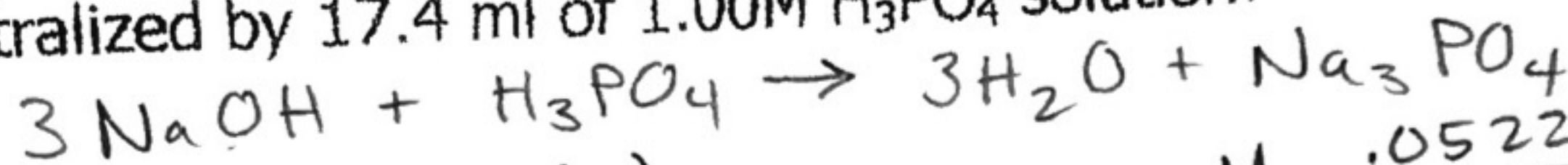


$$n = (1.00 \text{ M})(.0280 \text{ L}) = .0280 \text{ mol HCl}$$



$$M = \frac{.0280 \text{ mol NaOH}}{.0200 \text{ L}} = \boxed{1.4 \text{ M NaOH}}$$

2. What is the molarity of sodium hydroxide if 20.0 ml of the solution is neutralized by 17.4 ml of 1.00M H₃PO₄ solution?

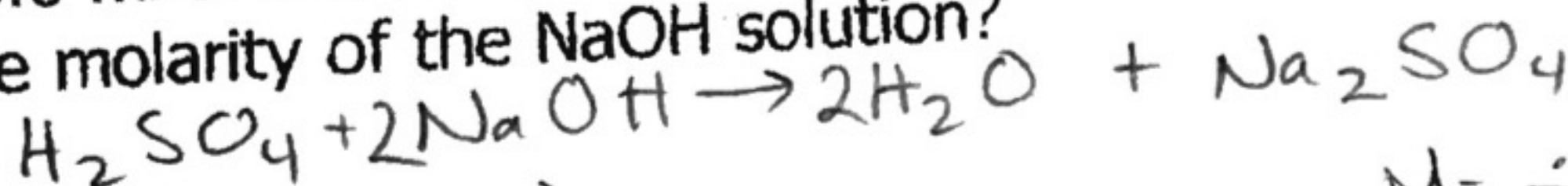


$$n = (1.00 \text{ M})(.0174 \text{ L}) = .0174 \text{ mol H}_3\text{PO}_4$$

$$.0174 \text{ mol H}_3\text{PO}_4 \times \frac{3 \text{ mol NaOH}}{1 \text{ mol H}_3\text{PO}_4} = 0.0522 \text{ mol NaOH}$$

$$M = \frac{.0522 \text{ mol NaOH}}{.0200 \text{ L}} = \boxed{2.61 \text{ M NaOH}}$$

3. If 35.0 ml of 0.2 M H₂SO₄ is required to neutralize 25.0 ml of NaOH, what is the molarity of the NaOH solution?

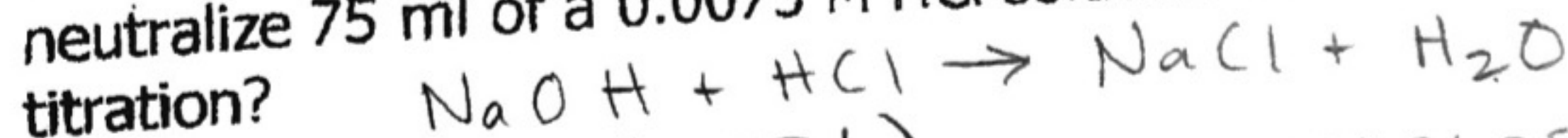


$$n = (.2 \text{ M})(.0350 \text{ L}) = .007 \text{ mol H}_2\text{SO}_4$$

$$.007 \text{ mol H}_2\text{SO}_4 \times \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4} = .014 \text{ mol NaOH}$$

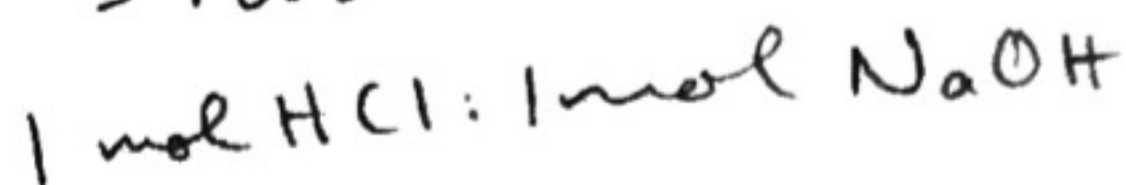
$$M = \frac{.014 \text{ mol NaOH}}{.0250 \text{ L}} = 0.28 \text{ M NaOH} = \boxed{0.3 \text{ M NaOH}}$$

4. What is the molarity of the sodium hydroxide solution that must be added to neutralize 75 ml of a 0.0075 M HCl solution if 50 mL of NaOH is used in the titration?



$$n = (.0075 \text{ M HCl})(.075 \text{ L}) = .0005625 \text{ mol HCl}$$

$$.0005625 \text{ mol HCl}$$

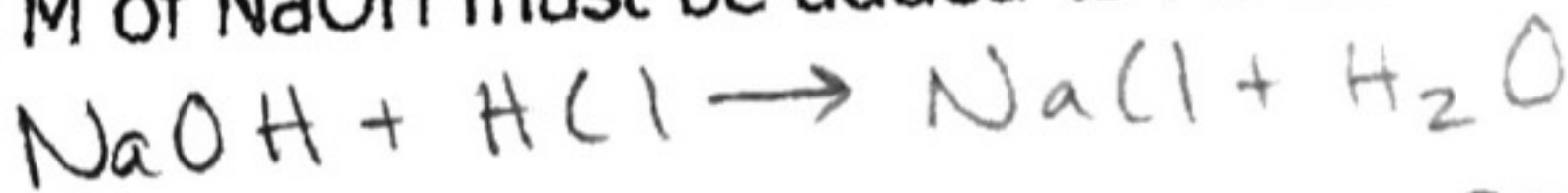


$$M = \frac{.0005625 \text{ mol NaOH}}{.05 \text{ L}}$$

$$= 0.01125 \text{ M NaOH}$$

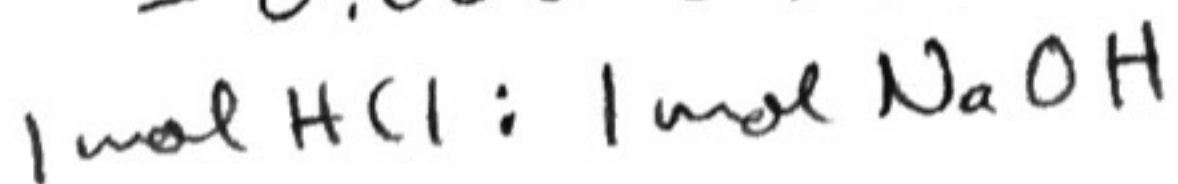
$$= \boxed{0.011 \text{ M NaOH}}$$

5. How many mL of 0.02 M of NaOH must be added to 75 mL of 0.05M HCl to a neutral solution?



$$n = (.05 \text{ M})(.075 \text{ L}) = 0.00375 \text{ mol HCl}$$

$$0.00375 \text{ mol HCl}$$



$$V = \frac{n}{M} = \frac{.00375 \text{ mol NaOH}}{.02 \text{ M}}$$

$$= 0.1875 \text{ L}$$

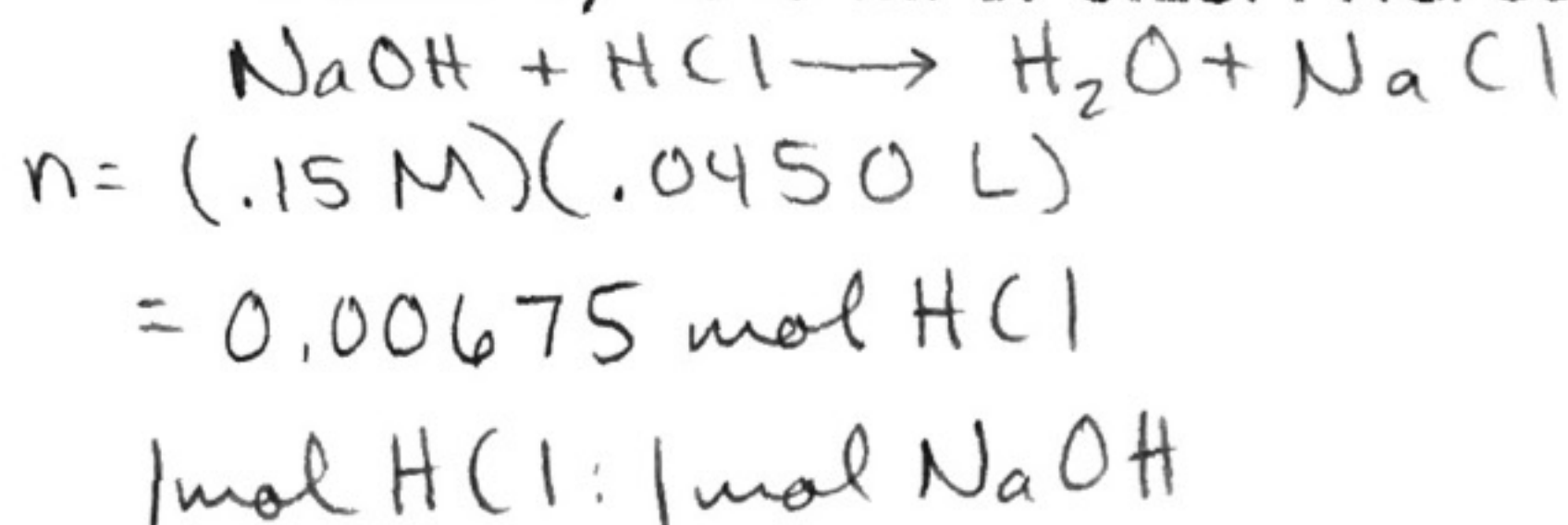
$$= \frac{187.5 \text{ mL}}{\approx \boxed{200 \text{ mL NaOH}}}$$

Titration Calculations (Round Three)

Name: Key

1. What is the molarity of sodium hydroxide if 15.0 ml of the solution is neutralized by 45.0 ml of 0.15M HCl solution?

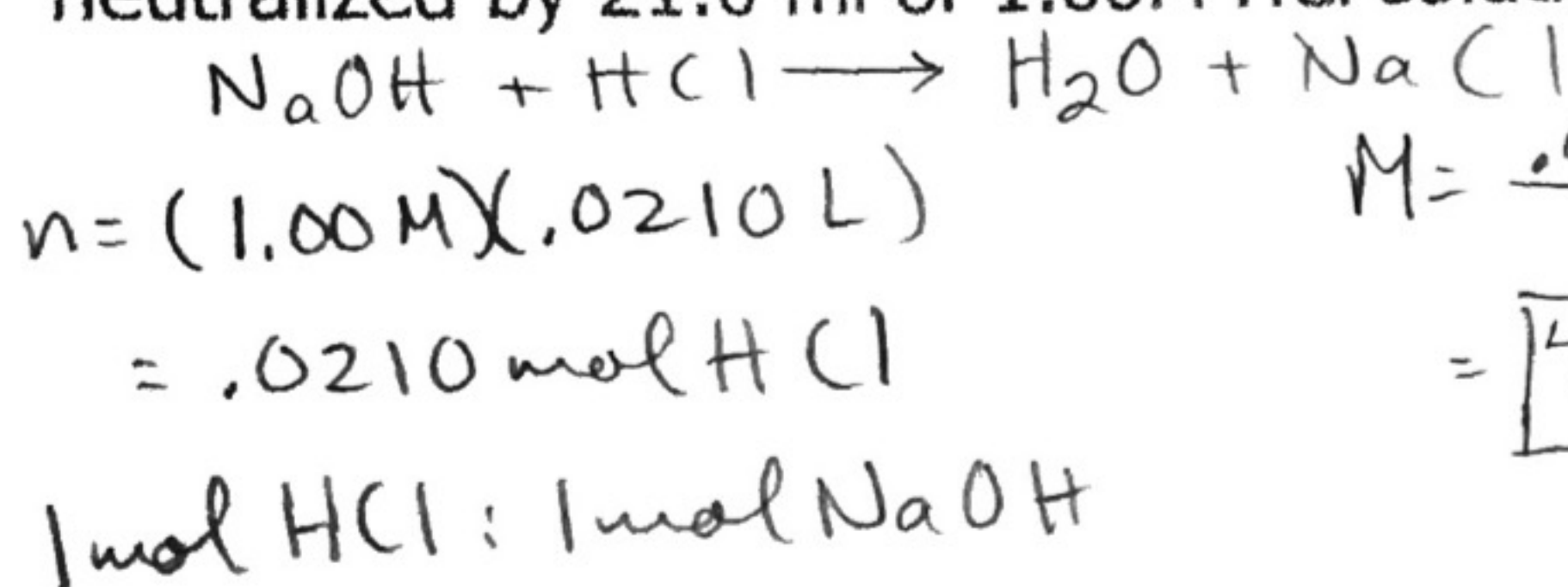
$n = M \cdot V$



$$M = \frac{n}{V} = \frac{.00675 \text{ mol NaOH}}{.0150 \text{ L}}$$

$$= \boxed{0.450 \text{ M NaOH}}$$

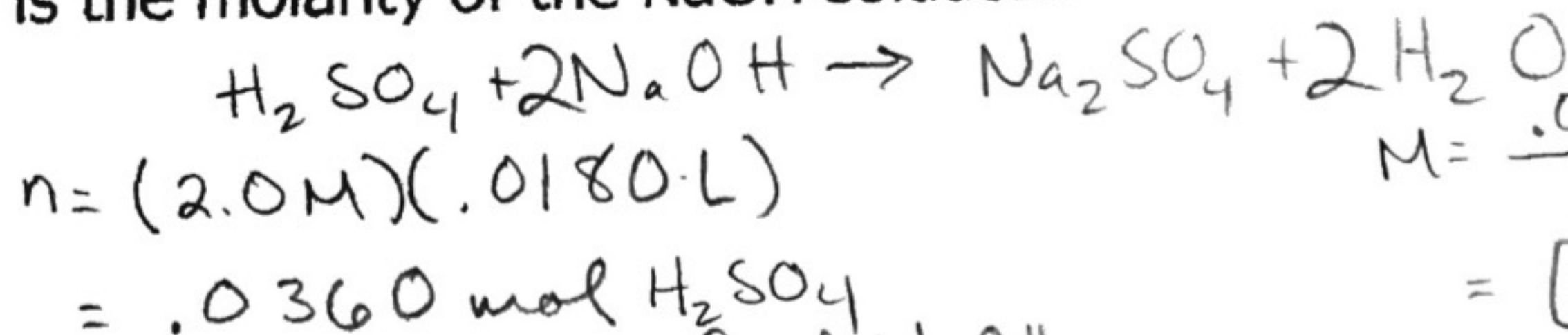
2. What is the molarity of sodium hydroxide if 5.0 ml of the solution is neutralized by 21.0 ml of 1.00M HCl solution?



$$M = \frac{.0210 \text{ mol NaOH}}{.0050 \text{ L}}$$

$$= \boxed{4.2 \text{ M NaOH}}$$

3. If 18.0 ml of 2.0 M H₂SO₄ is required to neutralize 36.0 ml of NaOH, what is the molarity of the NaOH solution?

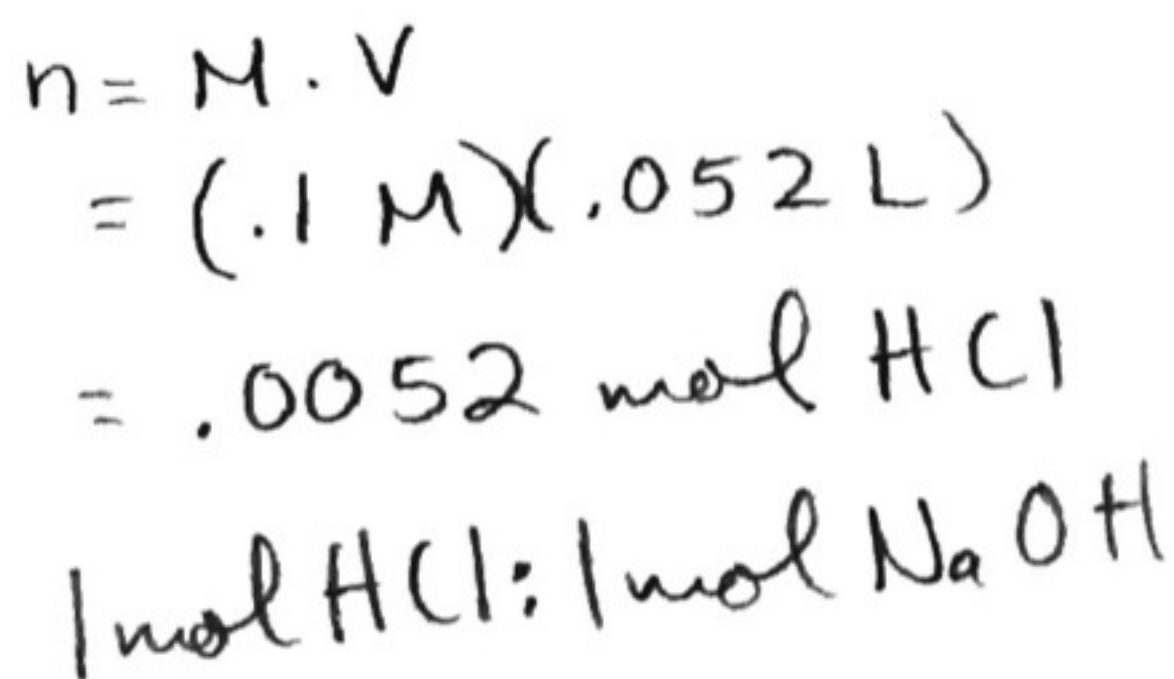


$$M = \frac{.0720 \text{ mol NaOH}}{.0360 \text{ L}}$$

$$= \boxed{2.0 \text{ M NaOH}}$$

$$.0360 \text{ mol H}_2\text{SO}_4 \times \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4} = .0720 \text{ mol NaOH}$$

4. What is the molarity of the sodium hydroxide solution that must be added to neutralize 52 ml of a 0.1 M HCl solution if 109 mL of NaOH is used in the titration?



$$M = \frac{n}{V}$$

$$= \frac{.0052 \text{ mol NaOH}}{.109 \text{ L}}$$

$$= 0.0477 \text{ M NaOH}$$

$$= \boxed{0.05 \text{ M NaOH}}$$