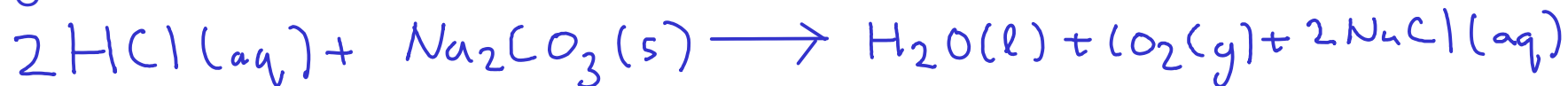


Example:

How many milliliters of 6.00M hydrochloric acid is needed to completely react with 25.0 g of sodium carbonate?



1 - Convert 25.0 grams sodium carbonate to moles. Use formula weight.

2 - Convert moles sodium carbonate to moles HCl. Use balanced chemical equation.

3 - Convert moles HCl to volume using the concentration (6.00 M).

$$\textcircled{1} \quad \text{Na}_2\text{CO}_3 : \quad \text{Na} \quad 2 \times 22.99$$

$$\quad \quad \quad \text{C} \quad 1 \times 12.01$$

$$\quad \quad \quad \text{O} \quad 3 \times 16.00$$

$$\quad \quad \quad \underline{\quad \quad \quad} \quad 105.99 \text{ g Na}_2\text{CO}_3 = \text{mol Na}_2\text{CO}_3$$

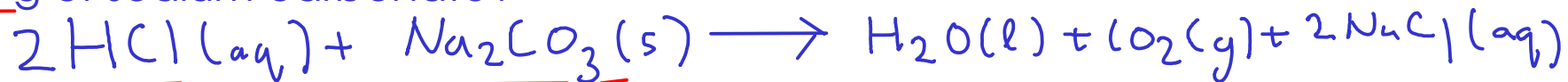
$$25.0 \text{ g Na}_2\text{CO}_3 \times \frac{\text{mol Na}_2\text{CO}_3}{105.99 \text{ g Na}_2\text{CO}_3} = 0.235871 \text{ mol Na}_2\text{CO}_3$$

$$\textcircled{2} \quad 2 \text{ mol HCl} = \text{mol Na}_2\text{CO}_3$$

$$0.235871 \text{ mol Na}_2\text{CO}_3 \times \frac{2 \text{ mol HCl}}{\text{mol Na}_2\text{CO}_3} = 0.471743 \text{ mol HCl}$$

Example:

How many milliliters of 6.00M hydrochloric acid is needed to completely react with 25.0 g of sodium carbonate?

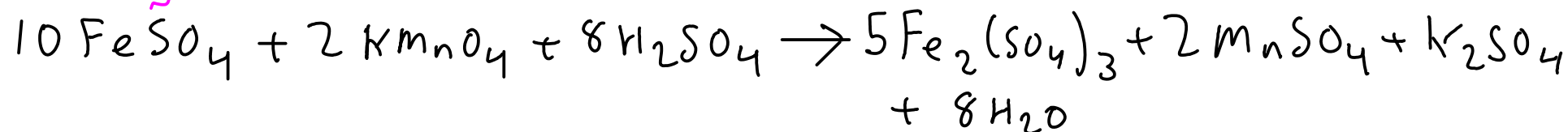


- 1 - Convert 25.0 grams sodium carbonate to moles. Use formula weight.
 - 2 - Convert moles sodium carbonate to moles HCl. Use balanced chemical equation.
 - 3 - Convert moles HCl to volume using the concentration (6.00 M).
-

$$\textcircled{3} \quad 6.00 \text{ M} : \quad 6.00 \text{ mol HCl} = 1 \text{ L} \quad \text{mL} = 10^{-3} \text{ L}$$

$$0.471743 \text{ mol HCl} \times \frac{1 \text{ L}}{6.00 \text{ mol HCl}} \times \frac{1000 \text{ mL}}{10^{-3} \text{ L}} = \boxed{78.6 \text{ mL of } 6.00 \text{ M HCl}}$$

$$151.90 \text{ g/mol}$$



How many mL of 0.250M potassium permanganate are needed to react with 3.36 g of iron(II) sulfate?

- 1 - Convert mass iron(II) sulfate to moles. Use formula weight.
- 2 - Convert moles iron(II) sulfate to moles potassium permanganate. Use chemical equation.
- 3 - Convert moles potassium permanganate to volume using concentration.

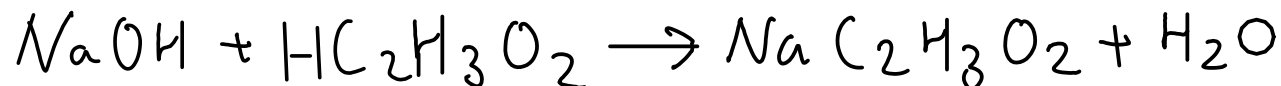
$$151.90 \text{ g FeSO}_4 = \text{mol FeSO}_4 \quad | \quad 10 \text{ mol FeSO}_4 = 2 \text{ mol KMnO}_4 \quad | \quad 0.250 \text{ mol KMnO}_4 = \text{L}$$

$$\text{mL} = 10^{-3} \text{ L}$$

$$3.36 \text{ g FeSO}_4 \times \frac{\text{mol FeSO}_4}{151.90 \text{ g FeSO}_4} \times \frac{2 \text{ mol KMnO}_4}{10 \text{ mol FeSO}_4} \times \frac{\text{L}}{0.250 \text{ mol KMnO}_4} \times \frac{\text{mL}}{10^{-3} \text{ L}} =$$

$$= 17.7 \text{ mL of } 0.250 \text{ M KMnO}_4$$

25.0 mL of acetic acid solution requires 37.3 mL of 0.150 M sodium hydroxide for complete reaction. The equation for this reaction is:



What is the molar concentration of the acetic acid?

$$\frac{\text{mol HC}_2\text{H}_3\text{O}_2}{\text{L solution}}$$

Since we already know the volume of acetic acid solution, we actually need to calculate the number of moles of acetic acid IN the solution!

$$0.150 \text{ mol NaOH} = \text{L} \quad \text{mol NaOH} = \text{mol HC}_2\text{H}_3\text{O}_2 \quad \text{mL} = 10^{-3} \text{ L}$$

First, find moles of acetic acid:

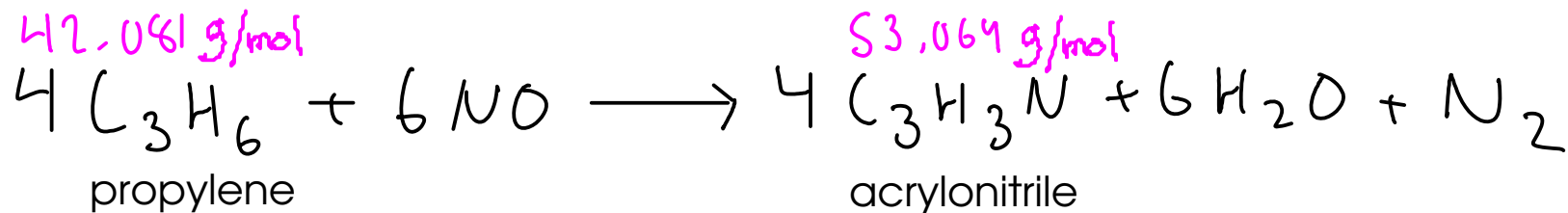
$$37.3 \text{ mL} \times \frac{10^{-3} \text{ L}}{\text{mL}} \times \frac{0.150 \text{ mol NaOH}}{\text{L}} \times \frac{\text{mol HC}_2\text{H}_3\text{O}_2}{\text{mol NaOH}} = 0.005595 \text{ mol HC}_2\text{H}_3\text{O}_2$$

Then, get the volume of acetic acid in the right units:

$$25.0 \text{ mL} \times \frac{10^{-3} \text{ L}}{\text{mL}} = 0.0250 \text{ L}$$

To get molarity, divide moles acetic acid / L acetic acid solution

$$M = \frac{\text{mol HC}_2\text{H}_3\text{O}_2}{\text{L solution}} = \frac{0.005595 \text{ mol HC}_2\text{H}_3\text{O}_2}{0.0250 \text{ L}} = \boxed{0.224 \text{ M HC}_2\text{H}_3\text{O}_2}$$



Calculate how many grams of acrylonitrile could be obtained from 651 kg of propylene, assuming there is excess NO present.

- 1 - Convert 651 kg propylene to moles. Use formula weight.
- 2 - Convert moles propylene to moles acrylonitrile using chemical equation.
- 3 - Convert moles propylene to mass acrylonitrile using formula weight.

$$42.081 \text{ g C}_3\text{H}_6 = 1 \text{ mol C}_3\text{H}_6 \quad | \quad 4 \text{ mol C}_3\text{H}_6 = 4 \text{ mol C}_3\text{H}_3\text{N} \quad |$$

$$53.064 \text{ g C}_3\text{H}_3\text{N} = 1 \text{ mol C}_3\text{H}_3\text{N} \quad | \quad \text{Kg} = 10^3 \text{ g}$$

$$651 \text{ kg C}_3\text{H}_6 \times \frac{10^3 \text{ g}}{\text{Kg}} \times \frac{1 \text{ mol C}_3\text{H}_6}{42.081 \text{ g C}_3\text{H}_6} \times \frac{4 \text{ mol C}_3\text{H}_3\text{N}}{4 \text{ mol C}_3\text{H}_6} \times \frac{53.064 \text{ g C}_3\text{H}_3\text{N}}{1 \text{ mol C}_3\text{H}_3\text{N}} =$$

①
②
③

$$= \boxed{821000 \text{ g C}_3\text{H}_3\text{N}} \quad (821 \text{ kg})$$