

You can combine all three steps on one line if you like!

$$25.0 \text{ g Br}_2 \times \frac{1 \text{ mol Br}_2}{159.80 \text{ g Br}_2} \times \frac{2 \text{ mol Al}}{3 \text{ mol Br}_2} \times \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = 2.81 \text{ g Al}$$

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You can solve the second part of the question using CONSERVATION OF MASS - since there's only a single product and you already know the mass of all reactants.

$$\begin{array}{r} 25.0 \text{ g Br}_2 \\ + 2.81 \text{ g Al} \\ \hline 27.8 \text{ g AlBr}_3 \end{array}$$

But ...

...what would you have done to calculate the mass of aluminum bromide IF you had NOT been asked to calculate the mass of aluminum FIRST?

$$25.0 \text{ g Br}_2 \times \frac{1 \text{ mol Br}_2}{159.80 \text{ g Br}_2} \times \frac{2 \text{ mol AlBr}_3}{3 \text{ mol Br}_2} \times \frac{266.694 \text{ g AlBr}_3}{1 \text{ mol AlBr}_3} = 27.8 \text{ g AlBr}_3$$

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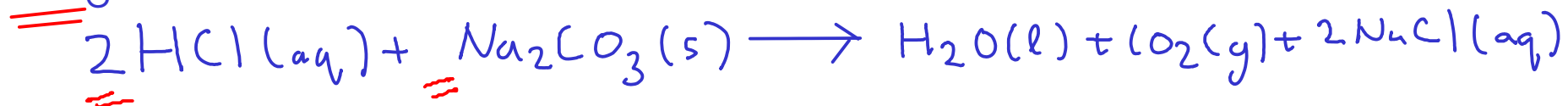
convert mass  
bromine  
to moles

convert moles  
bromine to  
moles aluminum  
bromide

convert moles  
aluminum  
bromide  
to mass

## 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 CHEMICAL EQUATION.
- 3 - Convert moles HCl to volume HCl solution. Use MOLAR CONCENTRATION.

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

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

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

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

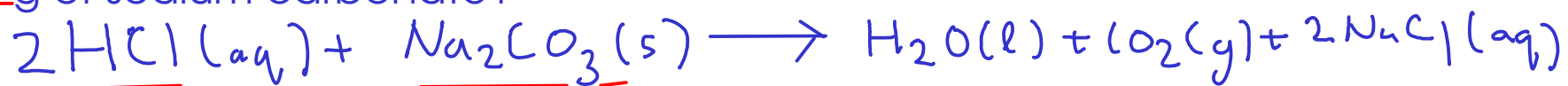
$$25.0 \text{ g Na}_2\text{CO}_3 \times \frac{\text{mol Na}_2\text{CO}_3}{105.99 \text{ g Na}_2\text{CO}_3} = 0.2358713086 \text{ mol Na}_2\text{CO}_3$$

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

$$0.2358713086 \text{ mol Na}_2\text{CO}_3 \times \frac{2 \text{ mol HCl}}{\text{mol Na}_2\text{CO}_3} = 0.4717426172 \text{ mol HCl}$$

102 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 CHEMICAL EQUATION.
- 3 - Convert moles HCl to volume HCl solution. Use MOLAR CONCENTRATION.

$$\textcircled{3} \quad 6.00 \text{ mol HCl} = \text{L}$$

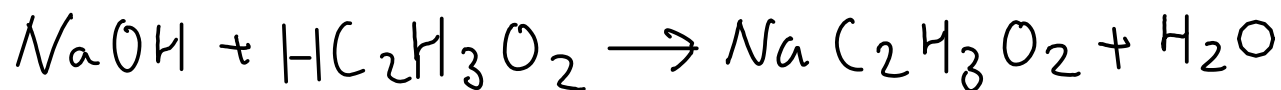
$$0.4717426172 \text{ mol HCl} \times \frac{\text{L}}{6.00 \text{ mol HCl}} = 0.0786 \text{ L of } 6.00 \text{ M HCl}$$

Notice the problem statement asks us for MILLILITERS and we have LITERS. No big problem here ... we just need to do a quick unit conversion.

$$1 \text{ mL} = 10^{-3} \text{ L}$$

$$0.0786 \text{ L} \times \frac{\text{mL}}{10^{-3} \text{ L}} = \boxed{78.6 \text{ mL of } 6.00 \text{ M HCl}}$$

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?

$$\frac{\text{L mol HC}_2\text{H}_3\text{O}_2}{\text{L Solution}} \leftarrow = 25.0 \text{ mL or } 0.0250 \text{ L}$$

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$$\text{L Solution} \leftarrow = 25.0 \text{ mL or } 0.0250 \text{ L}$$

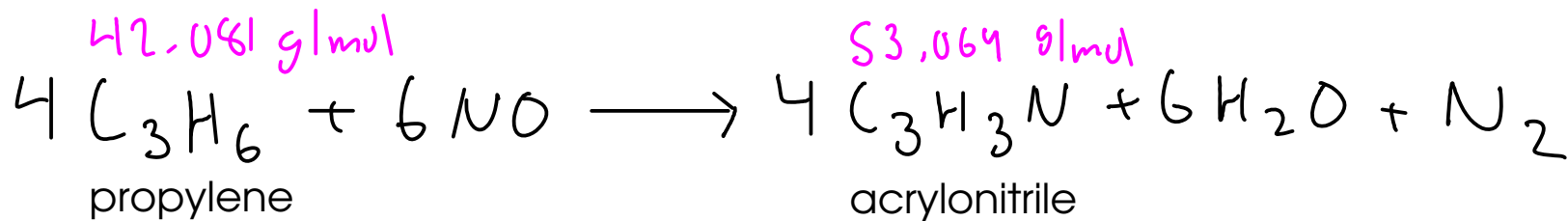
Since we already know the volume of the acetic acid solution, we just need to find out the moles acetic acid in order to get the concentration. How do we find THAT? Start with the 37.3 mL of sodium hydroxide. Since we know the concentration, we can relate that volume to moles...

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

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

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

\*Note for later: This is how the main calculation for EXPERIMENT 4C will be done!



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

- 1 - Convert mass propylene to moles. Use FORMULA WEIGHT of propylene (and kg->g conversion)
- 2 - Convert moles propylene to moles acrylonitrile. Use CHEMICAL EQUATION
- 3 - Convert moles acrylonitrile to mass acrylonitrile. Use FORMULA WEIGHT of acrylonitrile.

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

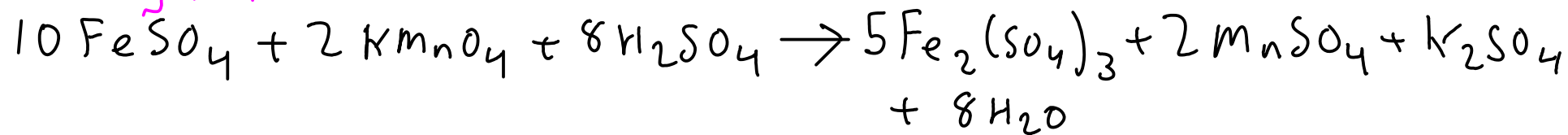
$$53.064 \text{ g C}_3\text{H}_3\text{N} = \text{mol C}_3\text{H}_3\text{N} \quad | \quad \text{Kg} = 10^3 \text{ g}$$

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

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

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



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

- 1 - Convert 3.36 grams 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. Use MOLAR CONCENTRATION.

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

$$0.250 \text{ mol KMnO}_4 = \text{L} \quad | \quad \text{mL} = 10^{-3} \text{ L}$$

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

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