

* Given that we have 25.0 g of liquid bromine, how many grams of aluminum would we need to react away all of the bromine?

① Convert grams of bromine to moles: Need formula weight $\text{Br}_2 : \frac{2 \times 79.90}{159.80}$

$$159.80 \text{ g Br}_2 = \text{mol Br}_2$$

$$25.0 \text{ g Br}_2 \times \frac{\text{mol Br}_2}{159.80 \text{ g Br}_2} = 0.15645 \text{ mol Br}_2$$

② Use the chemical equation to relate moles of bromine to moles of aluminum

$$2 \text{ mol Al} = 3 \text{ mol Br}_2$$

$$0.15645 \text{ mol Br}_2 \times \frac{2 \text{ mol Al}}{3 \text{ mol Br}_2} = 0.10430 \text{ mol Al}$$

③ Convert moles aluminum to mass: Need formula weight $\text{Al} : 26.98$

$$26.98 \text{ g Al} = \text{mol Al}$$

$$0.10430 \text{ mol Al} \times \frac{26.98 \text{ g Al}}{\text{mol Al}} = \boxed{2.81 \text{ g Al}}$$

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



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

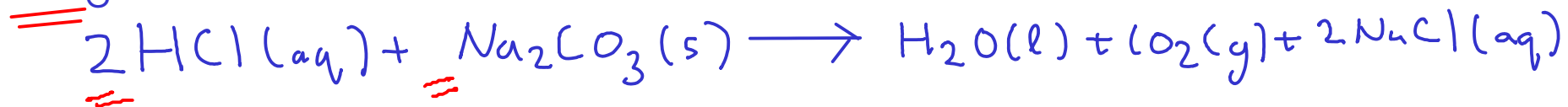
① ② ③

Things we can do:

If we have and we need ...	Use ...
MASS	MOLES	FORMULA WEIGHT
SOLUTION VOLUME	MOLES	MOLAR CONCENTRATION (MOLARITY)
MOLES OF A	MOLES OF B	BALANCED CHEMICAL EQUATION

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 6.00 M solution. Use MOLARITY

$$\begin{array}{l} \text{Na}_2\text{CO}_3: \quad \text{Na} : 2 \times 22.99 \\ \quad \quad \quad \quad \text{C} : 1 \times 12.01 \\ \quad \quad \quad \quad \text{O} : 3 \times 16.00 \\ \hline 105.99 \text{ g Na}_2\text{CO}_3 = \text{mol Na}_2\text{CO}_3 \end{array}$$

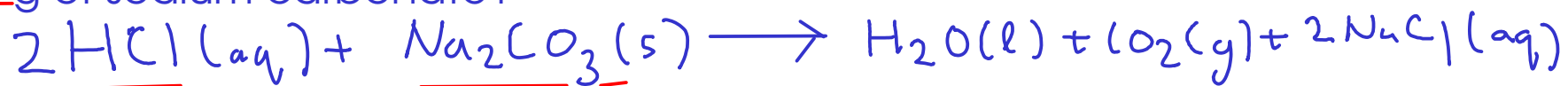
$$\textcircled{1} \quad 25.0 \text{ g Na}_2\text{CO}_3 \times \frac{\text{mol Na}_2\text{CO}_3}{105.99 \text{ g Na}_2\text{CO}_3} = 0.2358713086 \text{ mol Na}_2\text{CO}_3$$

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

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

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 6.00 M solution. Use MOLARITY

$$6.00 \text{ mol HCl} = \text{L}$$

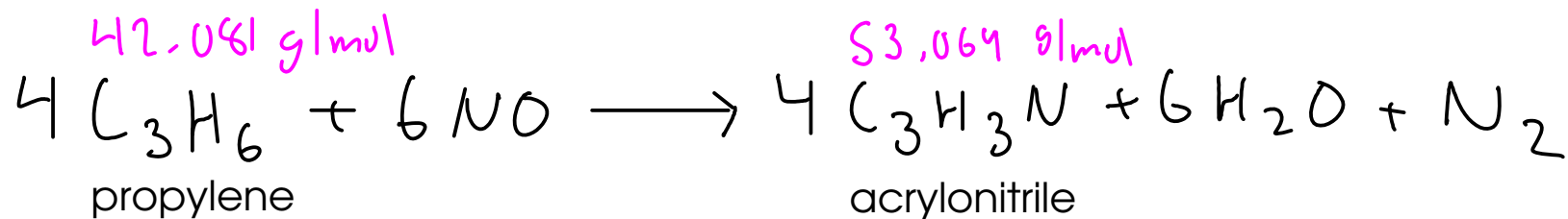
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$$0.4717426172 \text{ mol HCl} \times \frac{\text{L}}{6.00 \text{ mol HCl}} = 0.0786 \text{ L of } 6.00 \text{ M HCl}$$

Since this calculation gave us the volume in LITERS, we'll need to do a unit conversion to get the answer in the units the problem asks us for ...

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

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



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

- 1 - Convert 651 g propylene to moles. Use FORMULA WEIGHT.
- 2 - Convert moles propylene to moles acrylonitrile. Use CHEMICAL EQUATION.
- 3 - Convert moles acrylonitrile to mass acrylonitrile. Use FORMULA WEIGHT.

$$\textcircled{1} \quad 42.081 \text{ g C}_3\text{H}_6 = \text{mol C}_3\text{H}_6$$

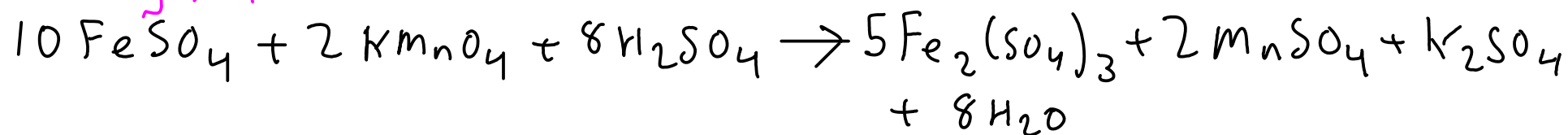
$$\textcircled{2} \quad 4 \text{ mol C}_3\text{H}_6 = 4 \text{ mol C}_3\text{H}_3\text{N}$$

$$\textcircled{3} \quad 53.064 \text{ g C}_3\text{H}_3\text{N} = \text{mol C}_3\text{H}_3\text{N}$$

$$651 \text{ g C}_3\text{H}_6 \times \frac{\text{mol C}_3\text{H}_6}{42.081 \text{ g C}_3\text{H}_6} \times \frac{4 \text{ mol C}_3\text{H}_3\text{N}}{4 \text{ mol C}_3\text{H}_6} \times \frac{53.064 \text{ g C}_3\text{H}_3\text{N}}{\text{mol C}_3\text{H}_3\text{N}} =$$

$$= \boxed{821 \text{ g C}_3\text{H}_3\text{N}}$$

151.90 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 g 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 MOLARITY (0.250 M).

$$\textcircled{1} 151.90 \text{ g FeSO}_4 = \text{mol FeSO}_4 \quad \textcircled{2} 10 \text{ mol FeSO}_4 = 2 \text{ mol KMnO}_4$$

$$\textcircled{3} 0.250 \text{ mol KMnO}_4 = \text{L}$$

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

$$= 0.0177 \text{ L}$$

Like before, we'll need to put this in mL:

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

$$0.0177 \text{ L} \times \frac{1 \text{ mL}}{10^{-3} \text{ L}} = \boxed{17.7 \text{ mL of } 0.250 \text{ M KMnO}_4}$$