Example:

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

$$2\,HCl(aq) + Na_2CO_3(s) \longrightarrow H_2O(l) + CO_2(g) + 2\,NaCl(aq)$$

1 - Convert 25.0 g sodium carbonate to moles. User FORMULA WEIGHT.
2 - Convert moles sodium carbonate to moles HCl. Use CHEMICAL EQUATION.
3 - Convert moles HCl to volume. Use MOLARITY.

1 Na_2CO_3: Na : 2 x 22.99
C : 1 x 12.01
O : 3 x 16.00

105.99 g Na_2CO_3 = mol Na_2CO_3

$$25.0\,\cancel{g\,Na_2CO_3} \times \frac{mol\,Na_2CO_3}{105.99\,\cancel{g\,Na_2CO_3}} = 0.235871\,3086\ mol\ Na_2CO_3$$

2 2 mol HCl = mol Na_2CO_3

$$0.235871\,3086\,\cancel{mol\,Na_2CO_3} \times \frac{2\,mol\,HCl}{\cancel{mol\,Na_2CO_3}} = 0.471742\,6172\ mol\ HCl$$

Example:

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

$$2HCl(aq) + Na_2CO_3(s) \longrightarrow H_2O(l) + CO_2(g) + 2NaCl(aq)$$

1 - Convert 25.0 g sodium carbonate to moles. User FORMULA WEIGHT.
2 - Convert moles sodium carbonate to moles HCl. Use CHEMICAL EQUATION.
3 - Convert moles HCl to volume. Use MOLARITY.

3 6.00 mol HCl = L

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

We were asked to provide the volume in mL ... so we'll convert 0.0786 L to mL.

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

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

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:

$$NaOH + HC_2H_3O_2 \rightarrow NaC_2H_3O_2 + H_2O$$

What is the molar concentration of the acetic acid?

$$\frac{\text{mol } HC_2H_3O_2}{\text{L solution}} \leftarrow = 25.0 \text{ mL or } 0.0250 \text{ L}$$

1 - Convert 37.3 mL of sodium hydroxide solution to ,moles. Use MOLARITY.
2 - Convert moles NaOH to moles acetic acid. Use CHEMICAL EQUATION
3 - Convert moles acetic acid to MOLARITY by dividing by the solution volume.

1 $0.150 \text{ mol NaOH} = \text{L}$; $\text{mL} = 10^{-3}\text{ L}$ 2 $\text{mol NaOH} = \text{mol } HC_2H_3O_2$

$$37.3\ \text{m}\cancel{\text{L}} \times \underbrace{\frac{10^{-3}\ \cancel{\text{L}}}{\text{m}\cancel{\text{L}}} \times \frac{0.150\ \cancel{\text{mol NaOH}}}{\cancel{\text{L}}}}_{1} \times \underbrace{\frac{\text{mol } HC_2H_3O_2}{\cancel{\text{mol NaOH}}}}_{2} = 0.005595 \text{ mol } HC_2H_3O_2$$

$$M = \frac{\text{mol } HC_2H_3O_2}{\text{L solution}} = \frac{0.005595 \text{ mol } HC_2H_3O_2}{0.0250 \text{ L}} = \boxed{0.224\ M\ HC_2H_3O_2}$$

* Note for this week: This is the main calculation for Experiment 4C ...

$$\overset{42.081\ g/mol}{4\,C_3H_6} + 6\,NO \longrightarrow \overset{53.064\ g/mol}{4\,C_3H_3N} + 6\,H_2O + N_2$$

propylene acrylonitrile

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

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

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1 $42.081\ g\ C_3H_6 = mol\ C_3H_6$; $kg = 10^3 g$

2 $4\ mol\ C_3H_6 = 4\ mol\ C_3H_3N$

3 $53.064\ g\ C_3H_3N = mol\ C_3H_3N$

$$651\ \cancel{kg}\ \cancel{C_3H_6} \times \underbrace{\frac{10^3\ \cancel{g}}{\cancel{kg}} \times \frac{\cancel{mol\ C_3H_6}}{42.081\ \cancel{g\ C_3H_6}}}_{1} \times \underbrace{\frac{4\ \cancel{mol\ C_3H_3N}}{4\ \cancel{mol\ C_3H_6}}}_{2} \times \underbrace{\frac{53.064\ g\ C_3H_3N}{\cancel{mol\ C_3H_3N}}}_{3} =$$

$$= \boxed{821000\ g\ C_3H_3N} \quad (821\ kg)$$

$151.90\ g/mol$

$10FeSO_4 + 2KMnO_4 + 8H_2SO_4 \rightarrow 5Fe_2(SO_4)_3 + 2MnSO_4 + K_2SO_4 + 8H_2O$

How many mL of 0.250M potassium permangenate 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 permangenate. Use CHEMICAL EQUATION.
3 - Convert moles potassium permangenate to volume. Use MOLARITY.

1. $151.90\ g\ FeSO_4 = mol\ FeSO_4$
2. $10\ mol\ FeSO_4 = 2\ mol\ KMnO_4$
3. $0.250\ mol\ KMnO_4 = L$; $mL = 10^{-3}\ L$

$$3.36\ g\ FeSO_4 \times \underbrace{\frac{mol\ FeSO_4}{151.90\ g\ FeSO_4}}_{1} \times \underbrace{\frac{2\ mol\ KMnO_4}{10\ mol\ FeSO_4}}_{2} \times \underbrace{\frac{L}{0.250\ mol\ KMnO_4} \times \frac{mL}{10^{-3}\ L}}_{3} =$$

$$= \boxed{17.7\ mL\ \text{of}\ 0.250M\ KMnO_4}$$