$$2\,Al(s) + 3\,Br_2(l) \longrightarrow 2\,AlBr_3(s)$$

* 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 $Br_2 = \frac{2 \times 79.90}{159.80}$

$159.80\ g\ Br_2 = \_\_\_\ mol\ Br_2$

$$25.0\ g\ Br_2 \times \frac{mol\ Br_2}{159.80\ g\ Br_2} = 0.15645\ mol\ Br_2$$

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

$2\ mol\ Al = 3\ mol\ Br_2$

$$0.15645\ mol\ Br_2 \times \frac{2\ mol\ Al}{3\ mol\ Br_2} = 0.10430\ mol\ Al$$

(3) Convert moles aluminum to mass: Need formula weight $Al = 26.98$

$26.98\ g\ Al = \_\_\_\ mol\ Al$

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

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

① $159.80\ g\ Br_2 = mol\ Br_2$ ② $2\ mol\ Al = 3\ mol\ Br_2$ ③ $26.98\ g\ Al = mol\ Al$

$$25.0\ g\ Br_2 \times \underbrace{\frac{mol\ Br_2}{159.80\ g\ Br_2}}_{①} \times \underbrace{\frac{2\ mol\ Al}{3\ mol\ Br_2}}_{②} \times \underbrace{\frac{26.98\ g\ Al}{mol\ Al}}_{③} = \boxed{2.81\ g\ Al}$$

Things we can do:

If we have ...	... and we need ...	Use ...
MASS	MOLES	FORMULA WEIGHT
SOLUTION VOLUME	MOLES	MOLAR CONCETRATION (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?

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

---

1 - Convert 25.0 g sodium carbonate to moles. Use FORMULA WEIGHT.
2 - Convert moles sodium carbonate to moles HCl. Use CHEMICAL EQUATION.
3 - Convert moles HCl to volume. Use MOLARITY. (6.00M)

---

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

$$25.0\ g\ Na_2CO_3 \times \frac{mol\ Na_2CO_3}{105.99\ g\ Na_2CO_3} = 0.235871306\ mol\ Na_2CO_3$$

---

② $2\ mol\ HCl = mol\ Na_2CO_3$

$$0.235871306\ mol\ Na_2CO_3 \times \frac{2\ mol\ HCl}{mol\ Na_2CO_3} = 0.471742612\ mol\ HCl$$

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. Use FORMULA WEIGHT.
2 - Convert moles sodium carbonate to moles HCl. Use CHEMICAL EQUATION.
3 - Convert moles HCl to volume. Use MOLARITY. (6.00M)

---

(3) 6.00 mol HCl = L

$$0.471742617 2 \text{ mol HCl} \times \frac{\text{L}}{6.00 \text{ mol HCl}} = 0.0786 \text{ L of 6.00M HCl}$$

We have an answer in L, but we're asked for mL. Do a quick unit conversion.

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

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

42.081 g/mol 53.064 g/mol

$$4\,C_3H_6 + 6\,NO \longrightarrow 4\,C_3H_3N + 6\,H_2O + N_2$$

propylene acrylonitrile

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 grams acrylonitrile. Use FORMULA WEIGHT.

---

① 42.081 g C_3H_6 = mol C_3H_6 ② 4 mol C_3H_6 = 4 mol C_3H_3N

③ 53.064 g C_3H_3N = mol C_3H_3N

$$651\text{ g } C_3H_6 \times \underset{①}{\frac{\text{mol } C_3H_6}{42.081\text{ g } C_3H_6}} \times \underset{②}{\frac{4\text{ mol } C_3H_3N}{4\text{ mol } C_3H_6}} \times \underset{③}{\frac{53.064\text{ g } C_3H_3N}{\text{mol } C_3H_3N}} =$$

$$= \boxed{821\text{ g } C_3H_3N}$$

151.90 g/mol

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

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

---

1 - Convert 3.36 g 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 (0.250M)

---

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

$$3.36\,g\,FeSO_4 \times \frac{mol\,FeSO_4}{151.90\,g\,FeSO_4}\ (①) \times \frac{2\,mol\,KMnO_4}{10\,mol\,FeSO_4}\ (②) \times \frac{L}{0.250\,mol\,KMnO_4}\ (③) =$$

$$= 0.0177\,L$$

Convert to mL

$mL = 10^{-3} L$

$$0.0177\,L \times \frac{mL}{10^{-3} L} = \boxed{17.7\,mL\ of\ 0.250\,M\ KMnO_4}$$