Exercise 01 **Name:** Key

Consider the unbalanced reaction:

$$Mg\ (s) + CO_2\ (s) \rightarrow MgO\ (s) + C\ (s)$$

If 15.0 g of Mg reacts with 25.0 g of CO_2, what mass of MgO can be produced?

First, balance the chemical equation:

$$2\ Mg\ (s) + CO_2\ (s) \rightarrow 2\ MgO\ (s) + C\ (s)$$

Second, determine the limiting reactant:

Method 1	Method 2
$15.0\ g\ Mg \times \frac{1\ mol\ Mg}{24.31\ g\ Mg} = 0.617\ mol\ Mg$ $25.0\ g\ CO_2 \times \frac{1\ mol\ CO_2}{44.01\ g\ CO_2} = 0.568\ mol\ CO_2$	$15.0\ g\ Mg \times \frac{1\ mol\ Mg}{24.31\ g\ Mg} \times \frac{2\ mol\ MgO}{2\ mol\ Mg} = 0.617\ mol\ MgO$ $25.0\ g\ CO_2 \times \frac{1\ mol\ CO_2}{44.01\ g\ CO_2} \times \frac{2\ mol\ MgO}{1\ mol\ CO_2} = 1.14\ mol\ MgO$
Method 3	
$15.0\ g\ Mg \times \frac{1\ mol\ Mg}{24.31\ g\ Mg} \times \frac{1\ mol\ CO_2}{2\ mol\ Mg} = 0.309\ mol\ CO_2$	

Method 1: Expected Mg:CO_2 = 2:1, but have 1.09:1 Method 2: 15.0 g Mg makes less products than 25.0 g CO_2 Method 3: Have more CO_2 than we need	**∴Mg limiting reactant**

Finally, determine the theoretical yield of MgO from the limiting reactant:

$$15.0\ g\ Mg \times \frac{1\ mol\ Mg}{24.31\ g\ Mg} \times \frac{2\ mol\ MgO}{2\ mol\ Mg} \times \frac{40.31\ g\ MgO}{1\ mol\ MgO} = \mathbf{24.9\ g\ MgO}$$