

## Limiting Reagent/Reactant and INXS Problems

We are going to bake a cake--the recipe is as follows:



HAD

HAD

I looked in my fridge and found 4 eggs and I looked in my cupboard and found 6 cups of flour.

What is the maximum number of cakes can I bake?

$$\text{LR } \frac{4 \text{ eggs}}{2 \text{ eggs}} \times \frac{1 \text{ cake}}{1} = 2 \text{ cakes}$$

$$\frac{6 \text{ cups flour}}{\text{INXS } 1 \text{ cup flour}} \times \frac{1 \text{ cake}}{1} = 6 \text{ cakes}$$

*this is the max # of cakes I can make*

~~6 cakes~~ *this is just a # on paper*

Answer: 2 cakes

Which ingredient is **limiting** or stopping us from making more cakes?

4 eggs = too few

Which ingredient is "**in excess**" i.e. which one is there too much of?

6 cups flour = too much

How much of the **INXS** ingredient was used to make the cakes?

*2 ways*

$$1) \frac{4 \text{ eggs}}{2 \text{ eggs}} \times 1 \text{ cup flour} = 2 \text{ cups flour USED!!}$$

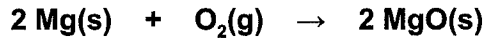
$$2) 2 \text{ cakes} \times \frac{1 \text{ cup flour}}{1 \text{ cake}} = 2 \text{ cups flour USED}$$

How much of the **INXS** ingredient was **left over**?

$$\begin{array}{r} 6 \text{ cups flour HAD} \\ - 2 \text{ cups flour USED} \\ \hline \end{array}$$

4 cups flour LEFT OVER

A BCE is a recipe involving a ratio of moles.



2 mole of Mg atoms will react with 1 mole of oxygen to  
produce 2 moles of magnesium oxide

15.00 g of magnesium reacts with 15.00 g of oxygen.

What maximum mass of magnesium oxide will form?

$$15.00 \text{ g Mg} \times \frac{1 \text{ mol Mg}}{24.3 \text{ g}} \times \frac{2 \text{ mol MgO}}{2 \text{ mol Mg}} \times \frac{40.3 \text{ g}}{1 \text{ mol MgO}} = 24.88 \text{ g MgO}$$

$\therefore \text{Mg} = \text{LR}$

$$15.00 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32 \text{ g}} \times \frac{2 \text{ mol MgO}}{1 \text{ mol O}_2} \times \frac{40.3 \text{ g}}{1 \text{ mol MgO}} = \cancel{37.78 \text{ g MgO}}$$

Answer: 24.88 g MgO

max amt  
that can be  
made

fake #!  
can't be  
made!

Which reactant (reagent) is limiting the mass of magnesium oxide that forms?

Mg

Which reactant (reagent) is in excess (or is there too much of)?

O<sub>2</sub>

How much of the INXS reagent was used (reacted) to make the magnesium oxide?

swap

$$1) 15.00 \text{ g Mg} \times \frac{1 \text{ mol Mg}}{24.3 \text{ g}} \times \frac{1 \text{ mol O}_2}{2 \text{ mol Mg}} \times \frac{32 \text{ g}}{1 \text{ mol O}_2} = 9.877 \text{ g O}_2$$

$$2) 24.88 \text{ g MgO} \times \frac{1 \text{ mol MgO}}{40.3 \text{ g}} \times \frac{1 \text{ mol O}_2}{2 \text{ mol MgO}} \times \frac{32 \text{ g}}{1 \text{ mol O}_2} = 9.878 \text{ g O}_2$$

How much of the INXS reagent was left over at the end of the reaction?

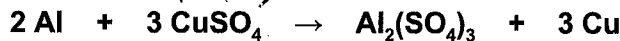
$$\begin{array}{r} \text{HAD} \quad 15.00 \text{ g O}_2 \\ \text{USED} \quad - 9.878 \text{ g O}_2 \\ \hline \end{array}$$

so 5.12 g O<sub>2</sub> LEFT OVER

USED

USED

5.00 g of aluminum reacts with 5.00 g of copper (II) sulfate according to the following reaction:



63.55  
32  
16 x 4 = 64 } 159.55 g  
1 mol.

1) What is the maximum number of grams of copper can form?

1.99g Cu

2) What is the limiting reagent?

CuSO<sub>4</sub>

3) What is the reactant that is in excess?

Al

4) How many grams of the excess reagent is left over?

\_\_\_\_\_

INXS

$$5.00 \text{g Al} \times \frac{1 \text{ mol Al}}{26.99 \text{g}} \times \frac{3 \text{ mol Cu}}{2 \text{ mol Al}} \times \frac{63.55 \text{g}}{1 \text{ mol Cu}} = 17.7 \text{g Cu}$$

$$5.00 \text{g CuSO}_4 \times \frac{1 \text{ mol CuSO}_4}{159.55 \text{g}} \times \frac{3 \text{ mol Cu}}{3 \text{ mol CuSO}_4} \times \frac{63.55 \text{g}}{1 \text{ mol Cu}} = 1.99 \text{g Cu}$$

LR

$$1.99 \text{g Cu} \times \frac{1 \text{ mol Cu}}{63.55 \text{g}} \times \frac{2 \text{ mol Al}}{3 \text{ mol Cu}} \times \frac{26.99 \text{g}}{1 \text{ mol Al}} = 0.563 \text{g Al used.}$$

max made

$$\begin{array}{r} 5.00 \text{g Al that you started with} \\ - 0.563 \text{g Al that reacted with all 5.00g of CuSO}_4 \\ \hline 4.44 \text{g Al left over.} \end{array}$$