Limiting Reagent/Reactant and INXS Problems

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

2 eggs + 1 c of flour → 1 cake

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

HAD HAD

What is the maximum number of cakes can I bake?

this is the max # of cakes I can make

4 eggs (LR) × 1 cake / 2 eggs = 2 cakes

6 cups flour (INXS) × 1 cake / 1 cup flour = 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) 4 eggs × 1 cup flour / 2 eggs = 2 cups flour USED!!

2) 2 cakes × 1 cup flour / 1 cake = 2 cups flour USED

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

6 cups flour HAD
− 2 cups flour USED
4 cups flour LEFT OVER

A **BCE** is a recipe involving a **ratio of moles.**

2 Mg(s) + O_2(g) → 2 MgO(s)

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?

max amt that can be made

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

∴ Mg = LR

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

fake #! can't be made!

Answer: 24.88g MgO

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_2

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

Swap

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

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

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

HAD 15.00g O_2

USED − 9.878g O_2

5.12g O_2 LEFT OVER

63.55 + 32 + 16×4 = 64 } 159.55 g/mol

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

$$2\,Al + 3\,CuSO_4 \rightarrow Al_2(SO_4)_3 + 3\,Cu$$

1) What is the maximum number of grams of copper can form? 1.99g Cu

2) What is the limiting reagent? CuSO4

3) What is the reactant that is in excess? Al

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

INXS

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

LR

$$5.00\,g\,CuSO_4 \times \frac{1\,mol\,CuSO_4}{159.55\,g} \times \frac{3\,mol\,Cu}{3\,mol\,CuSO_4} \times \frac{63.55\,g}{1\,mol\,Cu} = 1.99\,g\,Cu$$

max made

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

5.00g Al that you started with
− 0.563g Al that reacted with all 5.00g of CuSO4
4.44g Al left over.