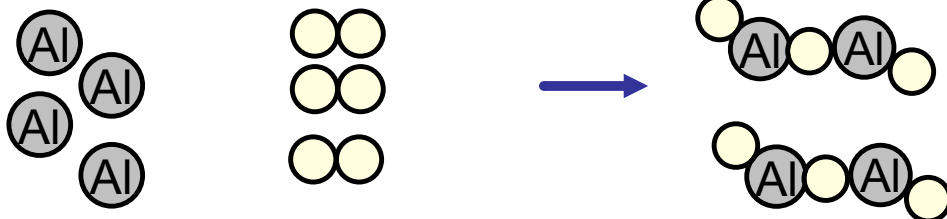Stoich with Moles

How do we determine amounts of reactants and products in moles?

What does an equation represent?

$$4\ Al(s)\ +\ 3\ O_2(g)\ \longrightarrow\ 2\ Al_2O_3(s)$$
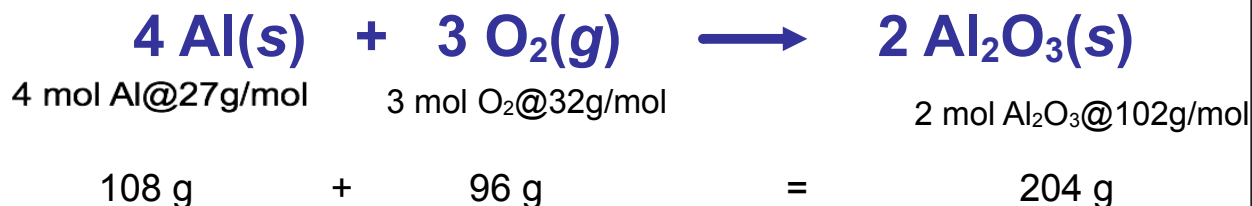
aluminum
oxide
sandpaper

Draw a representation of particles:

> 4 Al atoms + 3 O_2 molecules yield 2 molecules of Al_2O_3
> **or**
> 4 Al *moles* + 3 O_2 *moles* yield 2 *moles* of Al_2O_3

coefficients do not mean mass

4 g Al + 3 g O_2 yield 2 g Al_2O_3

Use moles to determine mass

$$4\ Al(s)\ +\ 3\ O_2(g)\ \longrightarrow\ 2\ Al_2O_3(s)$$

4 mol Al@27g/mol   3 mol O_2@32g/mol   2 mol Al_2O_3@102g/mol

108 g   +   96 g   =   204 g

Law of Conservation of Mass

Mass is never created or destroyed

Formation of Ammonia
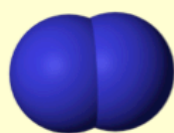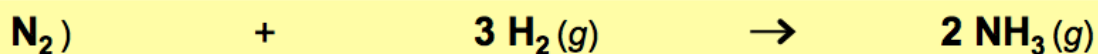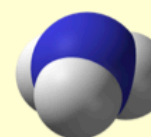
N_2)	+	$3\,H_2\,(g)$	→	$2\,NH_3\,(g)$
2 atoms N	+	6 atoms H	→	2 atoms N and 6 atoms H
1 molecule N_2	+	3 molecules H_2	→	2 molecules NH_3
10 molecule N_2	+	30 molecules H_2	→	20 molecules NH_3
$1 \times \left[\begin{array}{c}6.02 \times 10^{23} \\ \text{molecules } N_2\end{array}\right]$	+	$3 \times \left[\begin{array}{c}6.02 \times 10^{23} \\ \text{molecules } H_2\end{array}\right]$	→	$2 \times \left[\begin{array}{c}6.02 \times 10^{23} \\ \text{molecules } NH_3\end{array}\right]$
1 mol N_2	+	3 mol H_2	→	2 mol NH_3
28 g N_2	+	3×2 g H_2	→	2×17 g NH_3
		34 g reactants	→	34 g products
Assume STP 22.4 L	+	22.4 L 22.4 L 22.4 L	→	22.4 L 22.4 L
22.4 L N_2		67.2 L H_2		44.8 L NH_3

1.
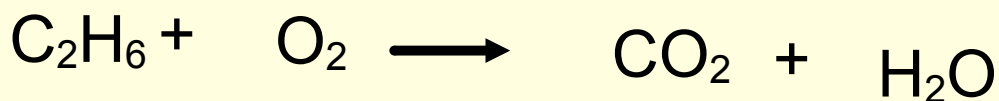
$$C_2H_6 + O_2 \longrightarrow CO_2 + H_2O$$

| 3.050 mol   7.00 mol

S

E

Determine limiting reactant/excess reactant

$$\frac{3.050 \text{ mol } C_2H_6}{} \left| \frac{CO_2}{C_2H_6} \right. = \quad \text{mol } CO_2$$

$$\frac{7.00 \text{ mol } O_2}{} \left| \frac{CO_2}{O_2} \right. = \quad \text{mol } CO_2$$

Determine proportions from limiting reactant

$$\frac{7.00 \text{ mol } O_2}{} \left| \frac{C_2H_6}{O_2} \right. = \quad \text{mol } C_2H_6$$

$$\frac{7.00 \text{ mol } O_2}{} \left| \frac{H_2O}{O_2} \right. = \quad \text{mol } H_2O$$

$CuCl_2$ + $NaOH$ → $Cu(OH)_2$ + $NaCl$

2.22 mol   3.970 mol

I

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E

$$2.22 \text{ mol } \frac{CuCl_2}{} \frac{NaCl}{CuCl_2}$$

$$3.970 \text{ mol } \frac{NaOH}{} \frac{NaCl}{NaOH}$$

$$3.970 \text{ mol } \frac{NaOH}{} \frac{Cu(OH)_2}{NaOH} \qquad Cu(OH)_2$$

$$3.970 \text{ mol } \frac{NaOH}{} \frac{CuCl_2}{NaOH} \qquad CuCl_2$$

$CaCl_2 \rightarrow Ca + Cl_2$
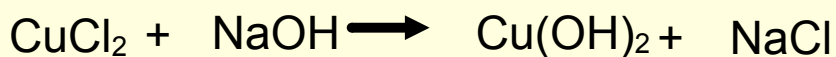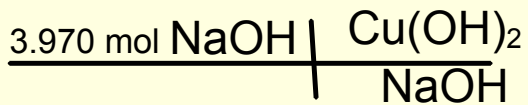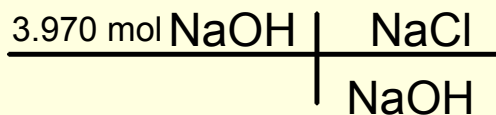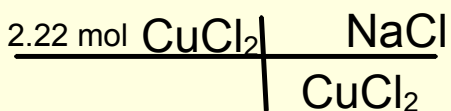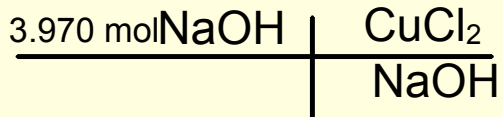
*How many moles of calcium metal are produced
from the decomposition of 8 mol of calcium chloride?*

*How many moles of chlorine gas are produced
from the decomposition of 8 mol of calcium chloride?*

How do we find
the mass of a mole of a certain element?

How do we use moles to determine reactants and product?

What 2 factors indicate Limiting Reactant
     1. quantity of reactant
     2. the rate that the reactant is used up
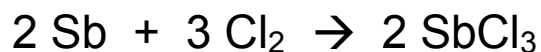
How do you figure out limiting reactant?
     Start with known quantities of each reactant
     Calculate amount of product each can make
     the smaller amount of product is the max amount of product and indicates the LR

If you start with 8 mol Sb and 9 mol Cl₂, how much product can be made?
What is the limiting reactant and excess reactant (amount) ?

$$2 \text{ Sb } + 3 \text{ Cl}_2 \rightarrow 2 \text{ SbCl}_3$$

How many moles of $SbCl_3$ are produced from 7.5 moles of Cl_2 and excess Sb?
How many moles of $SbCl_3$ are produced from 5 moles of antimony and excess Cl_2?
How many moles of chlorine gas are required to react with 5 moles of antimony?

What 2 factors indicate Limiting Reactant
    1. quantity of reactant
    2. the rate that the reactant is used up
 How do you figure out limiting reactant?
    Start with known quantities of each reactant
    Calculate amount of product each can make
    the smaller amount of product is the max amount of product and indicates the LR

$$2\ Sb\ +\ 3\ Cl_2\ \rightarrow\ 2\ SbCl_3$$

How many moles of chlorine gas are required to react with 5 moles of antimony?

How many moles of $SbCl_3$ are produced from 5 moles of antimony and excess Cl_2?

How many moles of $SbCl_3$ are produced from 7.5 moles of Cl_2 and excess Sb?

If 4.6 moles of KCl are available to react with 12.4 mol O_2, how much product can be made?

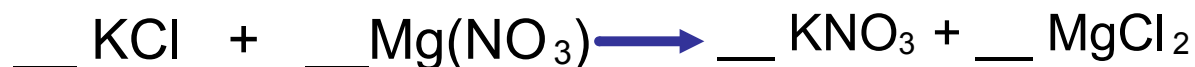Which reactant is limiting and which is in excess?

$$2 \text{ KCl} + 3 \text{ O}_2 \longrightarrow 2 \text{ KClO}_3$$

Practice:

1 mole = 6.022 x 10^{23} particles (atoms, molecules, ions)

1. Convert 22 moles C_3H_8 to number of molecules .
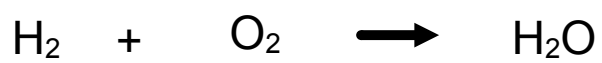
2. Convert 1.1 x 10^{24} H_2O to moles

3. LImiting Reactant?   Excess Reactant?   Amount of product?

__ KCl + __Mg(NO_3) ⟶ __ KNO_3 + __ $MgCl_2$

| 0.026 mol   0.062 mol

S

E

mole stoich

H_2 + O_2 ⟶ H_2O

| 5.00 mol   11 mol

S

E

Review

1. What is the first thing you must do in any stoichiometry problem?

2. How do you figure out the limiting reagent?

3. Once you have the limiting reagent,
how do you find the rest of the stoichiometric proportions
for the other (excess) reactant and the products?

$$1 \text{ mole} = 6.022 \times 10^{23} \text{ particles (atoms, molecules, ions)}$$

4. Convert 5.3 moles SO_4^{-2} to number of ions.

5. Convert 4.7×10^{25} Al atoms to moles