Stoichiometry

- Consider: $4NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$
- Recall that many conversion factors exist: 4 mol NH_3/5 mol O_2, 6 mol H_2O/4 mol NH_3, etc
- In words, this tells us that for every 4 moles of NH_3, 5 moles of O_2 are required, etc.
- "Stoichiometry" refers to the relative quantities of moles. It also refers to calculations that make use of mole ratios.
- Recall also that molar masses provide factors:
- 1 mol NH_3 / 17 g NH_3, 32 g O_2 / 1 mol O_2
- Is 4 g NH_3 / 5 g O_2 a conversion factor?

Stoichiometry questions (1)

$4NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$

- How many moles of H_2O are produced if 0.176 mol of O_2 are used?
- How many moles of NO are produced in the reaction if 17 mol of H_2O are also produced?

Notice that a correctly balanced equation is essential to get the right answer

Stoichiometry questions (2)

$4NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$

- How many grams of H_2O are produced if 1.9 mol of NH_3 are combined with excess oxygen?
- How many grams of O_2 are required to produce 0.3 mol of H_2O?

Stoichiometry questions (3)

$4NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$

- How many grams of NO is produced if 12 g of O_2 is combined with excess ammonia?

Converting grams to grams

- Notice that we cannot directly convert from grams of one compound to grams of another. Instead we have to go through moles.
- Many stoichiometry problems follow a pattern: grams(x) ↔ moles(x) ↔ moles(y) ↔ grams(y)
- We can start anywhere along this path depending on the question we want to answer

Q- for the reaction $2H_2 + O_2 \rightarrow 2H_2O$ what is the path we would take for the following

- Given 2 moles H_2O, calculate grams H_2O?
- Moles O_2 required for 36 g H_2?
- Grams of H_2O produced from 6 grams O_2?

Moving along the stoichiometry path

- We always use the same type of information to make the jumps between steps:

Molar mass of x ↓ — Molar mass of y ↓

grams (x) ↔ moles (x) ↔ moles (y) ↔ grams (y)

↑ Mole ratio from balanced equation

Given: $4NH_3 + 5O_2 \rightarrow 6H_2O + 4NO$

a) How many moles of H_2O can be made using 0.5 mol NH_3?
b) what mass of NH_3 is needed to make 1.5 mol NO?
c) how many grams of NO can be made from 120 g of NH_3?

More Stoichiometry Questions

Follow the rules for significant digits. Show all calculations.

1. $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$
   a) what mass of O_2 will react with 400 g C_4H_{10}?
   b) how many moles of water are formed in a)?
2. $3\ HCl + Al(OH)_3 \rightarrow 3\ H_2O + AlCl_3$
   How many grams of aluminum hydroxide will react with 5.3 moles of HCl?
3. $Ca(ClO_3)_2 \rightarrow CaCl_2 + 3\ O_2$
   What mass of O_2 results from the decomposition of 1.00 kg of calcium chlorate?
4. The reaction of Ca with water can be predicted using the activity series. What mass of water is needed to completely react with 2.35 g of Ca?
5. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$.
   a) How many moles of carbon monoxide are required to react with 163.0 g of iron(III) oxide?
   b) How many grams of CO_2 are produced from a reaction that also produces 23.9 grams of Fe?
6. $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$
   a) how many moles of copper(II) nitrate can be prepared from 17.0 moles of Cu?
   b) how many grams of copper(II) nitrate can be prepared using 3.8 moles of HNO_3?
   c) what mass of water results from the reaction of 8.50 kg of copper metal?