

---

---

## Reaction Stoichiometry CHEM 10 Review Worksheet

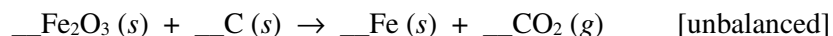
---

---

The problems on this worksheet are Chem 10 level problems. They are provided to assist your review of some topics covered in Chp 3 of the Zumdahl textbook. Note that Chem 11 problems will be more involved and more rigorous than these! An answer key is provided at the end of this worksheet.

### Reaction Stoichiometry

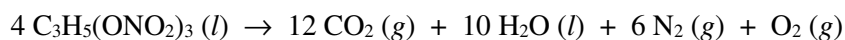
1. Iron metal is produced from the mineral hematite ( $\text{Fe}_2\text{O}_3$ ) and pure carbon, as given by the equation:



Balance this equation. Then, use the mole ratios therein to perform the calculations below.

- How many moles of C are required to completely react with 14.251 moles of  $\text{Fe}_2\text{O}_3$  (hematite)?
- How many moles of  $\text{Fe}_2\text{O}_3$  must react to generate 0.986 moles of pure iron?
- How many moles of  $\text{CO}_2$  will be generated if 2.774 moles of carbon completely reacts?

2. When nitroglycerin explodes, the following reaction occurs:



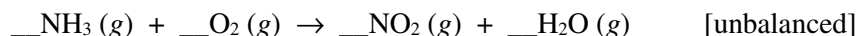
If 0.398 moles of nitroglycerine explodes, how many moles of each product would be formed?

3. The element phosphorus naturally occurs as  $\text{P}_4 (s)$ . It reacts readily with magnesium according to the following equation:



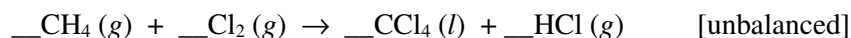
What mass (in g) of  $\text{P}_4$  is required to completely react with 73.4 grams of Mg?

4. Ammonia reacts with oxygen according to the following equation:



How many *molecules* of water will be generated by the complete reaction of 191.4 grams of ammonia?

5. Carbon tetrachloride may be produced via the reaction between methane and chlorine gases:



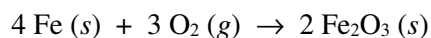
If this reaction generates 2.50 gallons of  $\text{CCl}_4$ , how many pounds (lbs) of HCl were also generated? The density of  $\text{CCl}_4$  is 1.5867 g/mL.

6. Aluminum reacts with bromine to produce aluminum bromide according to the following equation:



*In the lab* you perform this reaction using an excess of aluminum and 55.7 grams of bromine. You end up collecting 60.0 grams of product aluminum bromide. What is your percent yield?

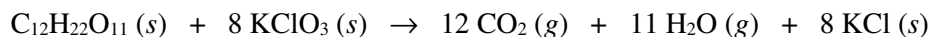
7. Iron reacts with oxygen to give iron(III) oxide according to the following balanced equation:



Identify the limiting reactant in each of the following reactant mixtures:

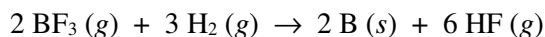
- 0.288 moles Fe and 0.240 moles  $\text{O}_2$
- 10.0 grams Fe and 10.0 grams  $\text{O}_2$
- $1.45 \times 10^{24}$  atoms of Fe and  $7.21 \times 10^{23}$  molecules of  $\text{O}_2$

8. Sucrose ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) reacts with potassium chlorate according to the following balanced equation:



Suppose 3.5 moles of  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  are mixed with 21.0 moles of  $\text{KClO}_3$ . Identify the limiting reactant, then calculate how many moles of each product ( $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and  $\text{KCl}$ ) will be formed in this reaction.

9. Boron trifluoride reacts with hydrogen according to the following balanced equation:



Suppose 40.00 grams of  $\text{BF}_3$  are mixed with 5.00 grams of  $\text{H}_2$ .

- Identify the limiting reactant.
- Calculate the mass of HF generated.
- Calculate the mass of excess reactant that remains when the reaction is complete.
- When this reaction is performed in the laboratory, the percent yield of HF is 72.6%. What was the experimental yield of HF?

10. Pure carbon reacts with sulfur dioxide gas producing liquid carbon disulfide and carbon monoxide gas.

- Write the balanced equation for this reaction.
- What mass of carbon monoxide will be produced if 40.0 grams of carbon are allowed to react with 95.0 grams of sulfur dioxide? What mass of excess reactant is left over?

## Answer Key

- $2 \text{ Fe}_2\text{O}_3 (s) + 3 \text{ C} (s) \rightarrow 4 \text{ Fe} (s) + 3 \text{ CO}_2 (g)$ 
  - 21.377 moles C
  - 0.493 moles  $\text{Fe}_2\text{O}_3$
  - 2.774 moles  $\text{CO}_2$
- $4 \text{ C}_3\text{H}_5(\text{ONO}_2)_3 (l) \rightarrow 12 \text{ CO}_2 (g) + 10 \text{ H}_2\text{O} (l) + 6 \text{ N}_2 (g) + \text{O}_2 (g)$ 

1.19 moles  $\text{CO}_2$ , 0.995 moles  $\text{H}_2\text{O}$ , 0.597 moles  $\text{N}_2$  and 0.0995 moles  $\text{O}_2$  would be formed.
- $6 \text{ Mg} (s) + \text{P}_4 (s) \rightarrow 2 \text{ Mg}_3\text{P}_2 (s)$ 

62.4 g  $\text{P}_4$
- $4 \text{ NH}_3 (g) + 7 \text{ O}_2 (g) \rightarrow 4 \text{ NO}_2 (g) + 6 \text{ H}_2\text{O} (g)$ 

$1.015 \times 10^{25}$  molecules  $\text{H}_2\text{O}$
- $\text{CH}_4 (g) + 4 \text{ Cl}_2 (g) \rightarrow \text{CCl}_4 (l) + 4 \text{ HCl} (g)$ 

31.4 lbs HCl
- $2 \text{ Al} (s) + 3 \text{ Br}_2 (l) \rightarrow 2 \text{ AlBr}_3 (s)$ 

Theoretical yield is 62.0 g, Percent yield is 96.8 %
- $4 \text{ Fe} (s) + 3 \text{ O}_2 (g) \rightarrow 2 \text{ Fe}_2\text{O}_3 (s)$ 
  - LR is Fe
  - LR is Fe
  - LR is  $\text{O}_2$
- $\text{C}_{12}\text{H}_{22}\text{O}_{11} (s) + 8 \text{ KClO}_3 (s) \rightarrow 12 \text{ CO}_2 (g) + 11 \text{ H}_2\text{O} (l) + 8 \text{ KCl} (s)$ 

LR is  $\text{KClO}_3$ , 31.5 moles  $\text{CO}_2$ , 28.9 moles  $\text{H}_2\text{O}$  and 21.0 moles KCl will be produced
- $2 \text{ BF}_3 (g) + 3 \text{ H}_2 (g) \rightarrow 2 \text{ B} (s) + 6 \text{ HF} (g)$ 
  - LR is  $\text{BF}_3$
  - 35.39 g HF generated
  - 3.21 g of  $\text{H}_2$  left over
  - Experimental yield is 25.69 g HF
- $5 \text{ C} (s) + 2 \text{ SO}_2 (g) \rightarrow \text{CS}_2 (l) + 4 \text{ CO} (g)$ 

LR is C, 74.6 g of CO are produced, and 9.73 g of  $\text{SO}_2$  are left over.