

Chemistry – Stoichiometry and Limiting Reagents

Excel Activity

Name: _____ Date: _____ Period: _____

Introduction:

In this activity you will be using balanced chemical equations and reactant masses to investigate the concept of the mole. You will also investigate what it means to have “leftovers” (excess reagent) due to running out of one or more of the reactants (the limiting reagent(s)), and how running out of a reactant “limits” the amount of product that can be produced.

Procedure:

Part I:

1. Begin by opening up the Excel spreadsheet entitled *StoiPrac.xls* from the location given by your instructor.
2. Make sure that the **Stoichiometry Tab** at the bottom of the spreadsheet is selected (and not the Concentrations tab).
3. At the top you will see an equation for the reaction between calcium and oxygen to produce calcium oxide. The grams of calcium and oxygen can be changed arbitrarily, for which the mass of the product as well as the moles of reactants and product and any leftover reactant mass will be automatically calculated for you.
4. Type in 10.00g each for calcium and oxygen (don't forget to hit enter or click outside of the box to update the calculations).
 - a. How many moles of calcium and oxygen does this represent (look at their corresponding mole boxes)?

Ca = _____ moles O₂ = _____ moles

- b. Are the mole ratios for the 10.00g each consistent with the ratio of the coefficients for the reactants in the balanced equation? Explain and show your calculation for determining this in the space below.

Work Area:

Under these conditions:

- c. How many grams of calcium oxide (CaO) can be produced? _____ g CaO
- d. Which one of the two reactants is the limiting reagent (i.e. no leftovers)? _____
- e. Which reactant had excess mass left over? _____
- f. How many grams of that reactant were left over? _____ g

5. Subtract the amount of grams of excess from the original mass available (10.00g) then re-enter the result of that calculation for the grams available for that substance.

a. What value did you enter in for the mass? _____ g. Which reactant was this for? _____

b. Are there any grams of either reactant leftover now? _____

c. Are the number of grams of product greater, less than or equal to the amount of grams of product before you subtracted the excess amount? _____

d. What are the number of grams of Calcium: _____g, Oxygen: _____g and Calcium oxide: _____g?

e. Is mass conserved in the reaction (i.e. Is the sum of the reactant masses equal to the product mass)?: _____

f. Are these masses in a ratio consistent with the coefficients of the balanced equation? _____ (Show your calculations for determining these ratios in the space below)

g. What are the number of moles of Calcium: _____mol, Oxygen: _____mol and Calcium oxide: _____mol?

h. Are these moles in a ratio consistent with the coefficients of the balanced equation (within limits of rounding)? _____ (Show your calculations for determining these ratios in the space below)

6. Return the original reactant masses back to 10.00g each.

a. Begin adding mass to the reactant that **does not** have any grams of excess until neither reactant is showing any grams of excess in the purple box.

b. What are the number of grams of Calcium: _____g, Oxygen: _____g and Calcium oxide: _____g?

c. Are these masses in a ratio consistent with the coefficients of the balanced equation? _____

d. What are the number of moles of Calcium: _____mol, Oxygen: _____mol and Calcium oxide: _____mol?

e. Are these moles in a ratio consistent with the coefficients of the balanced equation (within limits of rounding)? _____

7. What can you conclude about the coefficients of a balanced chemical equation as it relates to masses and moles? _____

8. By arbitrarily varying the amount of grams of reactants:

a. Determine how many grams of each reactant are required to produce 50.00g of product with no excess grams.

Ca: _____g O₂: _____g

b. How many moles of each does this correspond to?

Ca: _____ mol O₂: _____ mol

c. Are the ratios still consistent with what would be expected from the coefficients of the balanced equation?

d. Verify that the number of moles you reported in 8b. above is truly correct for the grams reported in 8a. above by converting from grams to moles for each reactant via the molar mass in the space given below (box in your answer):

9. Now that you have had experience working with the first chemical equation, use the second equation on the same spreadsheet by manipulating reactant masses to fill in the missing information in each of the tables below. **Be sure that there are no "excess grams" of either reactant.** In the last line of each table, determine the nearest integer mole ratio for the moles involved in the reaction. (Note: In the last table you may get a very slight amount of "leftover mass" that you can't get rid of, due to a rounding issue in the program.)

C ₂ H ₅ OH	+	3O ₂	→	2CO ₂	+	3H ₂ O	
30.00	grams		grams		grams		grams
	moles		moles		moles		moles
	:		:		:		

C ₂ H ₅ OH	+	3O ₂	→	2CO ₂	+	3H ₂ O	
	grams		grams		grams		grams
	moles		moles	5.00	moles		moles
	:		:		:		

C ₂ H ₅ OH	+	3O ₂	→	2CO ₂	+	3H ₂ O	
	grams	7.50	grams		grams		grams
	moles		moles		moles		moles
	:		:		:		

C ₂ H ₅ OH	+	3O ₂	→	2CO ₂	+	3H ₂ O	
	grams		grams		grams		grams
	moles		moles		moles	14.25	moles
	:		:		:		

10. The reaction you just worked with above is known as a combustion reaction. In this type of reaction a compound reacts with oxygen producing carbon dioxide and water. In the combustion reaction above, ethanol (C₂H₅OH) is the compound reacting with oxygen. This same type of reaction occurs with the compound propane (C₃H₈). In the section below, you will write a balanced equation for the combustion reaction between propane

and oxygen to produce carbon dioxide and water and then determine the missing information in the tables related to that reaction from the information given and the balanced equation.

a. On the line below, write the balanced chemical equation for the combustion of propane:

b. Fill in the missing information on the following tables so that in the first three tables there are no excess (leftover) masses. Use the area designated as "Work Area" to show the calculations you used to determine your answers. In the last table, two arbitrary masses for reactants are given. Determine which reactant (if any) is in excess and by how much (in addition to the other information in the table).

Reactants				Products			
C_3H_8		O_2		CO_2		H_2O	
6.50	grams		grams		grams		grams
	moles		moles		moles		moles
	:		:		:		

Work Area:

Reactants				Products			
C_3H_8		O_2		CO_2		H_2O	
	grams	11.00	grams		grams		grams
	moles		moles		moles		moles
	:		:		:		

Work Area:

Reactants				Products			
C_3H_8		O_2		CO_2		H_2O	
	grams		grams		grams		grams
	moles		moles	5.50	moles		moles

Work Area:

Reactants				Products			
C_3H_8		O_2		CO_2		H_2O	
2.00	grams	5.00	grams		grams		grams
	moles		moles		moles		moles
	g excess		g excess				

Work Area:

c. Were the number of "reacting" moles in each of the tables above consistent with the coefficients of your balanced equation? Elaborate.