

Revised August 2011



HONORS WORKSHEET 4g: Stoichiometry Problems



QUESTION 1: Equation writing, molar ratios, limiting reactant and % yield

Propane gas (C_3H_8) burns in oxygen gas to produce carbon dioxide gas and water.

- (a) Write a **balanced** equation with **state symbols** for this reaction. (2)
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- (b) Calculate the number of **moles** of carbon dioxide that will be produced if 2.1 moles of propane are burned in **excess** oxygen? (2)

- (c) In another experiment 400. g of propane and 400. g of oxygen are ignited and allowed to react.

- (i) Which reagent is limiting? (2)

- (ii) Calculate the maximum mass of water that can be produced in this reaction? (2)

- (iii) If the experimental yield of water is actually 100. grams, calculate the percentage yield for this reaction. (2)

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Question 2: Empirical & molecular formula

Use the following data to calculate the empirical **AND** the molecular formula for compound R.

- Compound R has the following composition by mass;

K 35.56 %

Fe 17.02 %

C 21.88 %

N 25.53 %

- R has a molar mass of 329.0 g mol^{-1}

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Question 3: Hydrated salt analysis

Copper forms a hydrated salt with the formula $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$. A technician weighs out 24950. g of the hydrated salt and heats it to a constant mass. The final mass of the dehydrated salt is 15950. g.

- (a) What is meant by the term "heating to constant mass"?

- (b) What do you understand by the term dehydrated?

- (c) Calculate the value of x in the formula $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$.

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Question 4: Equation writing, moles, molar ratio and % yield

Sulfuric acid is an enormously important chemical with many applications in the real world. It is manufactured in the Contact process. One way of summarizing the Contact process is shown below.

1. Solid sulfur is burned in air (oxygen) to produce sulfur dioxide gas.
2. The sulfur dioxide gas produced in **part 1** is then burned in more oxygen gas to produce sulfur trioxide gas.
3. The sulfur trioxide gas is then dissolved in concentrated sulfuric acid to produce oleum ($\text{H}_2\text{S}_2\text{O}_7$).
4. The oleum is then dissolved in water to produce dilute sulfuric acid (H_2SO_4).

(a) Write an equation to summarize **part 1** of the process. Include state symbols. (2)

(b) How many grams of oxygen are required to completely burn 640. g of sulfur? (2)

(c) If there were a 60.0% yield in this reaction how much sulfur dioxide gas would be produced? (3)

(d) Write an equation to summarize **part 2** of the process. Include state symbols. (2)

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- (e) In a typical process 500. moles of sulfur trioxide is produced from 750. moles of sulfur dioxide and excess oxygen. Calculate the % yield of this reaction. (3)
- (f) Write an equation to summarize **part 3** of the process. (2)
- (g) How many moles of oleum in 1780. g of oleum? (1)
- (h) Write an equation to summarize **part 4** of the process. (2)
- (i) Assuming a 90.0% yield, how many grams of dilute sulfuric acid can be produced from 5.00 moles of oleum and excess water? (3)