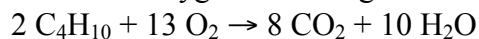


Topic A Problems

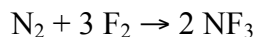
- 1) A sample of magnesium phosphate contains x moles of $\text{Mg}_3(\text{PO}_4)_2$. Express each of the following quantities in terms of x .
 - a) The number of moles of phosphate ions in this sample
 - b) The number of moles of oxygen atoms in this sample
 - c) The number of phosphorus atoms in this sample
 - d) The mass of the sample, in grams
 - e) The number of grams of magnesium in this sample
- 2) You have x grams of $\text{Na}_2\text{Cr}_2\text{O}_7$. Express each of the following quantities in terms of x .
 - a) The number of moles of $\text{Na}_2\text{Cr}_2\text{O}_7$
 - b) The number of moles of O
 - c) The number of grams of O
 - d) The number of O atoms
- 3) You have a sample of $\text{Al}_2(\text{CO}_3)_3$ that contains x aluminum atoms. How many oxygen atoms does it contain?
- 4) For each of the following questions (parts a and b), tell which box contains more atoms. In each case, you may assume that x represents the same number.
 - a) Box 1: x grams of Na Box 2: x grams of Mg
 - b) Box 1: x grams of O_2 Box 2: x grams of O_3
- 5) In problem 4 part b, which box contains more molecules?
- 6) 0.03774 moles of a mystery element weighs 7.363 grams. What element is this?
- 7) A compound contains 31.89% carbon, 5.35% hydrogen, and 62.76% chlorine. What is the empirical formula of this compound?
- 8) 10.000 g of boron (B) combines with hydrogen to form 11.554 g of a pure compound. What is the empirical formula of this compound?
- 9) The compound in problem 8 is known to have a molar mass between 60 and 80 g/mol. What is the molecular formula of this compound?
- 10) A group 2A element combines with iodine to form a compound that contains 64.9% I. Which group 2A element is this?
- 11) A chemist has just discovered a new compound, called dunlinol. A 1.9747 g sample of dunlinol is subjected to combustion analysis, producing 3.8602 g of CO_2 and 0.3951 g of H_2O as the only products. What is the empirical formula of dunlinol?
- 12) What mass of Fe_2O_3 would react with 20.00 g of Zn? The chemical equation for this reaction is:
$$3 \text{ Zn} + \text{Fe}_2\text{O}_3 \rightarrow 2 \text{ Fe} + 3 \text{ ZnO}$$

13) x moles of C_4H_{10} reacts with oxygen according to the following equation:



- a) How many moles of water are formed?
- b) How many moles of oxygen are consumed?

14) 10.00 g of N_2 is mixed with 33.61 g of F_2 , and the elements react according to the following equation:

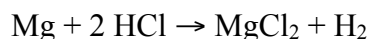


- a) Which element is the limiting reactant?
- b) What is the theoretical yield of NF_3 ?
- c) If the reaction goes to completion, how many grams of the excess reactant will remain?
- d) Set up an ICE table for this reaction.

15) a) If 58.26 g of iodine reacts with excess aluminum, what is the theoretical yield of aluminum iodide? The reaction is $2 \text{Al} + 3 \text{I}_2 \rightarrow 2 \text{AlI}_3$.

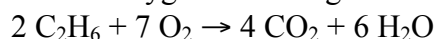
b) If 56.11 g of aluminum iodide is actually formed in the reaction in part a, what is the percent yield of aluminum iodide?

16) A chemist mixes 16.00 g of HCl with 10.00 g of Mg and obtains an 81.3% yield of MgCl_2 . What mass of MgCl_2 did the chemist obtain? The chemical reaction is:



17) How many milliliters of liquid Br_2 (density = 3.1 g/mL) will react with 6.143 g of Cr , if the product of this reaction is CrBr_3 ?

18) Ethane (C_2H_6) reacts with oxygen according to the following chemical equation:

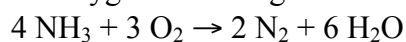


a) If you mix 5 moles of C_2H_6 with 13 moles of O_2 , how many moles of each substance will you end up with, assuming the reaction goes to completion? Include an ICE table in your answer.

b) If you mix 81.43 g of C_2H_6 with 194.60 g of O_2 , how many grams of each substance will you end up with, assuming the reaction goes to completion? Include an ICE table in your answer. (*Note: your ICE table should be in terms of moles.*)

c) A chemist mixes 3.414 moles of O_2 with an unknown number of moles of C_2H_6 . The chemist obtains 1.657 moles of O_2 . How many moles of C_2H_6 must have been present originally, assuming the reaction went to completion? Include an ICE table in your answer.

19) Ammonia reacts with oxygen according to the following chemical equation:



Suppose you mix x moles of NH_3 with y moles of O_2 .

a) If NH_3 is the limiting reactant, how many moles of each substance will you end up with, assuming the reaction goes to completion? Include an ICE table in your answer.

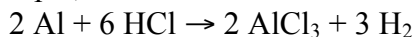
b) If O_2 is the limiting reactant, how many moles of each substance will you end up with, assuming the reaction goes to completion? Include an ICE table in your answer.

c) If you end up with $0.4y$ moles of O_2 , what must the relationship be between x and y , assuming the reaction goes to completion?

20) You have x grams of $\text{Na}_2\text{Cr}_2\text{O}_7$. How many grams of CrCl_3 will be formed if the $\text{Na}_2\text{Cr}_2\text{O}_7$ undergoes the reaction below? Express your answer in terms of x .



21) A metal sample weighing 1.410 g contains a mixture of copper and aluminum. When excess HCl is added to this sample, the aluminum reacts as follows:



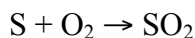
849 mL of H_2 (density 0.08264 g/L) is produced. Calculate the mass percentage of each element in the original sample. Note that copper does not react with HCl .

22) A chemist has a mixture of AgNO_3 and KNO_3 that weighs a total of 4.177 g. The chemist dissolves the mixture in water and then adds a solution of NaOH . The AgNO_3 reacts with the NaOH as follows:

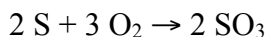


The chemist finds that 1.080 grams of Ag_2O were formed. Calculate the mass percentages of AgNO_3 and KNO_3 in the original mixture. (Note that KNO_3 does not react with NaOH .)

23) A 25.000 g sample of sulfur is burned. Some of the sulfur reacts to form SO_2 :



The rest of the sulfur reacts to form SO_3 :



The total mass of products (SO_2 and SO_3) is 58.723 g. Calculate the masses of SO_2 and SO_3 in this mixture.