

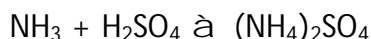
Stoichiometry Practice Problems

Directions: Before you start solving any of these problems, you must:

- Write out the equation and balance it
- Map out your plan of attack
- Write out all of your conversion factors in advance
- Using dimensional analysis only, solve the problem.

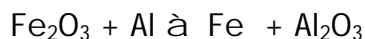
Remember, you will only receive credit if you follow these steps and show all your work.

- How many moles of ammonium sulfate can be made from the reaction of 30.0 mol of NH_3 with H_2SO_4 according to the following equation:



(15 mol $(\text{NH}_4)_2\text{SO}_4$)

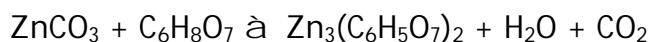
- In a very violent reaction called a thermite reaction, aluminum metal reacts with iron (III) oxide to form iron metal and aluminum oxide according to the following equation:



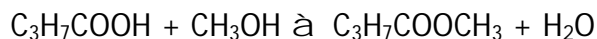
- What mass of Al will react with 150. g of Fe_2O_3 ? (51 g Al)
- If 0.905 mol Al_2O_3 is produced in the reaction, what mass of Fe is produced? (101 g Fe)
- How many moles of Fe_2O_3 will react with 99.0 g of Al? (1.83 mol Fe_2O_3)

- The reaction $\text{N}_2 + 2 \text{H}_2 \rightarrow 2 \text{NH}_3$ is used to produce ammonia commercially. If 1.40 g of N_2 are used in the reaction, how many grams of H_2 will be needed? (0.303 g H_2)
- What mass of sulfuric acid is required to react with 1.27 g of potassium hydroxide? (1.11 g sulfuric acid)
- Ammonium hydrogen phosphate, a common fertilizer, is made from reacting phosphoric acid with ammonia, NH_3 .
 - Write the equation for this reaction.

- b. If 10.00 g of ammonia react, how many moles of fertilizer will be produced? (0.293 mol ammonium hydrogen phosphate)
- c. What mass of ammonia will react with 2800 kg of H₃PO₄? (970 kg ammonia)
6. The following reaction shows the synthesis of zinc citrate, a ingredient in toothpaste, from zinc carbonate and citric acid.



- a. How many moles of ZnCO₃ and C₆H₈O₇ are required to produce 30.0 mol of Zn₃(C₆H₅O₇)₂? (90.0 mol ZnCO₃; 60.0 mol C₆H₈O₇)
- b. What quantities, in kilograms, of H₂O and CO₂ are produced by the reaction of 500. mol of citric acid? (13.5 kg H₂O; 33.0 kg CO₂)
7. Methyl butanoate, an oily substance with a strong fruity fragrance can be made by reacting butanoic acid with methanol according to the following equation:



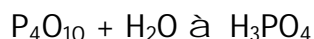
- a. What mass of methyl butanoate is produced from the reaction of 52.5 g of butanoic acid? (60.9 methyl butanoate)
- b. In order to purify methyl butanoate, water must be removed. What mass of water is produced from the reaction of 5800. g of methanol? (3261 g water)
8. Ammonium nitrate decomposes to yield, nitrogen gas, water and oxygen gas.
- a. How many moles of nitrogen gas are produced when 36.0 g of ammonium nitrate reacts? (0.450 mol N₂)
- b. If 7.35 mol of water are produced in the reaction, what mass of ammonium nitrate reacted? (294 g ammonium nitrate)
9. Lead (II) nitrate reacts with potassium iodide to produce lead (II) iodide and potassium nitrate. If 1.23 mg of lead nitrate are consumed, what is the mass of the potassium nitrate produced? (0.751 mg potassium nitrate)
10. A car battery produces electrical energy with the following chemical reaction:



If the battery loses 0.34 kg of lead in this reaction, how many moles of lead (II) sulfate are produced? (3.3 mol lead (II) sulfate)

11. In a space shuttle, the CO₂ that the crew exhales is removed from the air by a reaction within canisters of lithium hydroxide. On average, each astronaut exhales about 20.0 mol of CO₂ daily. What mass of water will be produced when this amount reacts with lithium hydroxide? The other product of this reaction is lithium carbonate. (360 g water)

12. Water is sometimes removed from the products of a reaction by placing them in a closed container with excess P₄O₁₀. Water is absorbed by the following reaction:



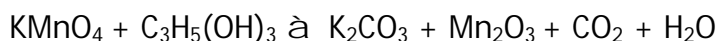
- What mass of water can be absorbed by 1.00 x 10² g of P₄O₁₀? (38.1 g water)
- If the P₄O₁₀ in the container absorbs 0.614 mol of water, what mass of H₃PO₄ is produced? (40.1 g phosphoric acid)
- If the mass of the container of P₄O₁₀ increases from 56.64 g to 63.70 g, how many moles of water are absorbed? (0.392 mol water)

13. Ethanol, C₂H₅OH, is considered a clean fuel because it burns in oxygen to produce carbon dioxide and water with few trace pollutants. If 95.0 g of H₂O are produced during the combustion of ethanol, how many grams of ethanol were present at the beginning of the reaction? (81.0 g ethanol)

14. Sulfur dioxide is one of the major contributors to acid rain. Sulfur dioxide can react with oxygen and water in the atmosphere to form sulfuric acid. If 50.0 g of sulfur dioxide from pollutants reacts with water and oxygen found in the air, how many grams of sulfuric acid can be produced? How many grams of oxygen are used in the process. (76.5 g sulfuric acid; 12.5 g oxygen)

15. When heated, sodium bicarbonate decomposes into sodium carbonate, water and carbon dioxide. If 5.00 g of sodium bicarbonate decomposes, what is the mass of the carbon dioxide produced? (1.31 g carbon dioxide)

16. A reaction between hydrazine, N_2H_4 , and dinitrogen tetroxide has been used to launch rockets into space. The reaction produces nitrogen gas and water vapor.
- Write a balanced chemical equation for this reaction.
 - What is the mole ratio of dinitrogen tetroxide to nitrogen gas?
 - How many moles of nitrogen gas will be produced if 20,000 mol of hydrazine are used by a rocket? (30000 mol nitrogen)
 - How many grams of water are made when 450. kg of dinitrogen tetroxide are consumed? (3.52×10^5 g water)
17. Joseph Priestley is credited with the discovery of oxygen. He produced O_2 by heating mercury (II) oxide to decompose it into its elements. How many moles of oxygen could Priestley have produced if he had decomposed 517.84 g of mercury (II) oxide? (1.1954 mol oxygen)
18. Iron (III) chloride can be made by the reaction of iron with chlorine gas. How much iron, in grams, will be needed to completely react with 58.0 g of Cl_2 ? (30.5 g Fe)
19. Sodium sulfide and cadmium (II) nitrate undergo a double-replacement reaction. What is the mass, in milligrams, of cadmium sulfide that can be made from 5.00 mg of sodium sulfide? (9.26 mg cadmium (II) nitrate)
20. Potassium permanganate and glycerin react explosively according to the following equation:



- How many moles of carbon dioxide can be produced from 4.44 mol of KMnO_4 ? (1.59 mol of carbon dioxide)
- If 5.21 g of H_2O are produced? How many moles of glycerine, $\text{C}_3\text{H}_5(\text{OH})_3$, were used? (0.0723 mol glycerine)
- If 3.39 mol of potassium carbonate are made, how many grams of manganese (III) oxide are also made? (535 g manganese (III) oxide)
- How many grams of glycerin will be needed to react with 50.0 g of KMnO_4 ? How many grams of CO_2 will be produced in the same reaction? (8.33 g glycerine; 4.97 g carbon dioxide)