

Lesson 4: Equations and Stoichiometry

text: 49-61

what to know:

- what a chemical equation is and says and how to balance by trial and error, §2-3
- the following terms and symbols as they relate to chemical equations:
reactants, products, balanced, coefficient, (g), (l), (s), (aq), +, =>, §2-3
- weight relationships using equations, §2-4 (omit volume relationships of gases, 55-56)
- concepts of limiting reagents, theoretical yields and percent yields, §2-5

questions:

1. Does a chemical equation give a complete description of what happens during a chemical reaction?
Explain.
2. Why are reactants always shown on the left in chemical equations?
3. If we assume that 2 molecules of O₂ react with 1 molecule of N₂, a balanced equation can be written in two ways. Are both correct? How can one determine which is actually correct?
$$\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g}) \qquad \text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$$
4. Balance the following equations by trial and error.
 - a. $\text{C} + \text{O}_2 \rightleftharpoons \text{CO}_2$
 - b. $\text{Fe} + \text{O}_2 \rightleftharpoons \text{Fe}_2\text{O}_3$
 - c. $\text{K} + \text{H}_2\text{O} \rightleftharpoons \text{KOH} + \text{H}_2$
 - d. $\text{NaOH} + \text{H}_3\text{PO}_4 \rightleftharpoons \text{Na}_3\text{PO}_4 + \text{H}_2\text{O}$
 - e. $\text{Fe}_2\text{O}_3 + \text{CO} \rightleftharpoons \text{Fe} + \text{CO}_2$
 - f. $\text{KClO}_3 \rightleftharpoons \text{KCl} + \text{O}_2$
 - g. $\text{P}_4\text{O}_{10} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{PO}_4$
 - h. $\text{C}_6\text{H}_6 + \text{O}_2 \rightleftharpoons \text{CO}_2 + \text{H}_2\text{O}$
 - i. $\text{PH}_3 + \text{O}_2 \rightleftharpoons \text{P}_4\text{O}_{10} + \text{H}_2\text{O}$
5. Given the equation, $4\text{Al}(27) + 3\text{O}_2(32) \rightleftharpoons 2\text{Al}_2\text{O}_3(102)$
 - a. How many grams of Al would react with 3.20 g of oxygen?
 - b. How many g of aluminum oxide could be formed from 10.0 g of Al and 10.0 g of oxygen?
6. Given the balanced equation: $4\text{Ga}(70) + 3\text{O}_2(32) \rightleftharpoons 2\text{Ga}_2\text{O}_3(188)$
 - a. How many moles of O₂ are required to make 1.88 g of Ga₂O₃?
 - b. How many g of Ga are required to react with 1.60 g of O₂?
 - c. How many moles of Ga₂O₃ can be formed from 7.0 g of Ga and 3.2 g of O₂?
7. Given the equation, $4\text{NH}_3(17) + 5\text{O}_2(32) \rightleftharpoons 4\text{NO}(30) + 6\text{H}_2\text{O}(18)$. If 28.0 g of NH₃ react with excess O₂ to form 43.0 g of water, what is the percent yield?
8. Given the balanced equation, $3\text{H}_2(2) + \text{N}_2(28) \rightleftharpoons 2\text{NH}_3(17)$
 - a. How many moles of ammonia could be formed from 1.00 moles of hydrogen and excess nitrogen?
 - b. How many grams of N₂ would react with 1.00 moles of H₂?
 - c. How many grams of H₂ would be required to produce 0.85 g of ammonia?
 - d. How many moles of ammonia could be formed from 14.0 g of N₂ and 6.00 g of H₂?
9. Consider the reaction: $\text{MnO}_2(87) + 4\text{HCl}(36.5) \rightleftharpoons \text{MnCl}_2(126) + \text{Cl}_2(71) + 2\text{H}_2\text{O}(18)$
If 0.86 moles of MnO₂ and 48.2 g of HCl are allowed to react,
 - a. show which reagent would be used up first.
 - b. how many grams of H₂O would be formed.
10. Additional practice problems: #s 39,49,55,65,84 pages 67-70