

6.1: Balancing Chemical Equations

Why? Atoms are neither created nor destroyed in a chemical reaction, they are just rearranged. In other words, in a chemical reaction, what goes into the reaction must come out of the reaction. Using this knowledge and some bookkeeping skills, all unbalanced chemical equations can be balanced.

Model

1

The following figures show the combination of hydrogen and oxygen to produce water.

Illustrations from: http://wps.prenhall.com/wps/media/objects/439/449969/Media_Portfolio/ch10.html

Figure 1

1 molecule of hydrogen + 1 molecule of oxygen \rightarrow 1 molecule of water

Figure 2

2 molecules of reactants \rightarrow 2 molecules of product

Figure 3 4 H atoms in reactants \rightarrow 4 H atoms in

products

2 O atoms in reactants \rightarrow 2 O atoms in
products

Key Questions

1. In Figure 1 there is one molecule of H₂ and one molecule of O₂ on the left side

of the equation and one molecule of H₂O on the right. Even though there is 1 of everything, why is this reaction not balanced?

The number of atoms of each element are not balanced.

2. In Figure 2 there are two molecules on the left and two molecules on the right. Even though there are 2 on the left and 2 on the right, why is this reaction not balanced?

The number of atoms of each element are not balanced.

3. In Figure 3, how many reactant molecules and product molecules are shown in the model?

3 reactant molecules and 2 product molecules

4. Does Figure 3 represent a balanced equation? Explain your answer.

Yes, the number of oxygen and hydrogen atoms in the reactants is equal to the number of oxygen and hydrogen atoms in the products

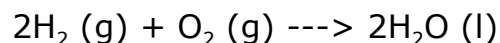
5. What condition must be met in order for there to be a balance between reactants and products?

The same number of atoms for each element in both the reactants and the products

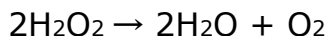
Exercises

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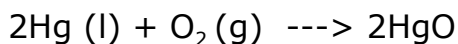
1. Write the balanced equation to show the reaction between hydrogen gas and oxygen gas to form water. (Hint: look at the model for guidance.)



2. Identify whether the following is a balanced chemical equation. Explain why or why not. If not, write the balanced equation.



3. If mercury (Hg) and oxygen (O₂) were reacted to form mercury (II) oxide (HgO), how many molecules of each reactant and product would be needed to balance the equation?



Model

2

Figure 4 shows the reaction between hydrogen and nitrogen to produce ammonia.

Fig.

4 Key Questions

1. Describe what is depicted in the first diagram shown at the top of Figure 4.

1 H₂ molecule reacts with 1 N₂ molecule to produce 1 NH₃ molecule

2. Does the first diagram at the top of Figure 4 represent a balanced chemical equation? Why or why not? Explain your reasoning in terms the type and number of each atom present.

No, the number of hydrogen and nitrogen atoms on the products and reactants side do not match

3. Describe what is depicted in the second diagram shown in the middle of Figure 4.

1 H₂ molecule reacts with 1 N₂ molecule to produce 2 NH₃ molecules

4. Does the second diagram in the middle of Figure 4 represent a balanced chemical equation? Why or why not? Explain your reasoning in terms the number and type of each atom present.

No, the number of hydrogen and nitrogen atoms on the products and reactants side do not match

5. Describe what is depicted in the third diagram shown at the bottom of Figure 4.

3 H₂ molecules react with 1 N₂ molecule to produce 2 NH₃ molecules

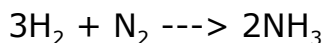
6. Does the third diagram at the bottom of Figure 4 represent a balanced chemical equation? Why or why not? Explain your reasoning in terms the number and type of each atom present.

Yes, the number of hydrogen and nitrogen atoms on the products and reactants side match

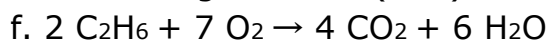
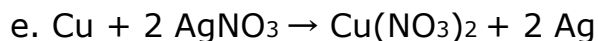
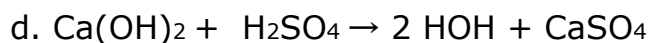
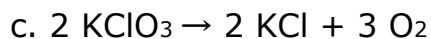
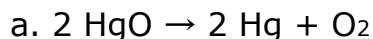
Exercises

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1. Write a balance reaction equation for hydrogen reacting with nitrogen to produce ammonia.

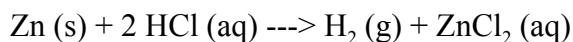


2. Using the smallest whole number coefficients, balance the following reactions. Draw diagrams like those in Figure 4 for Equations a, b, and f.

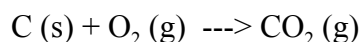


Problems Write the formulas for the components in each reaction and, using the smallest whole number coefficients, balance each equation.

1. Zinc metal reacts with hydrochloric acid to produce hydrogen gas and aqueous zinc chloride.



2. Solid carbon reacts with oxygen gas to produce carbon dioxide gas.



3. Solid sodium chloride is broken down into its elements.

