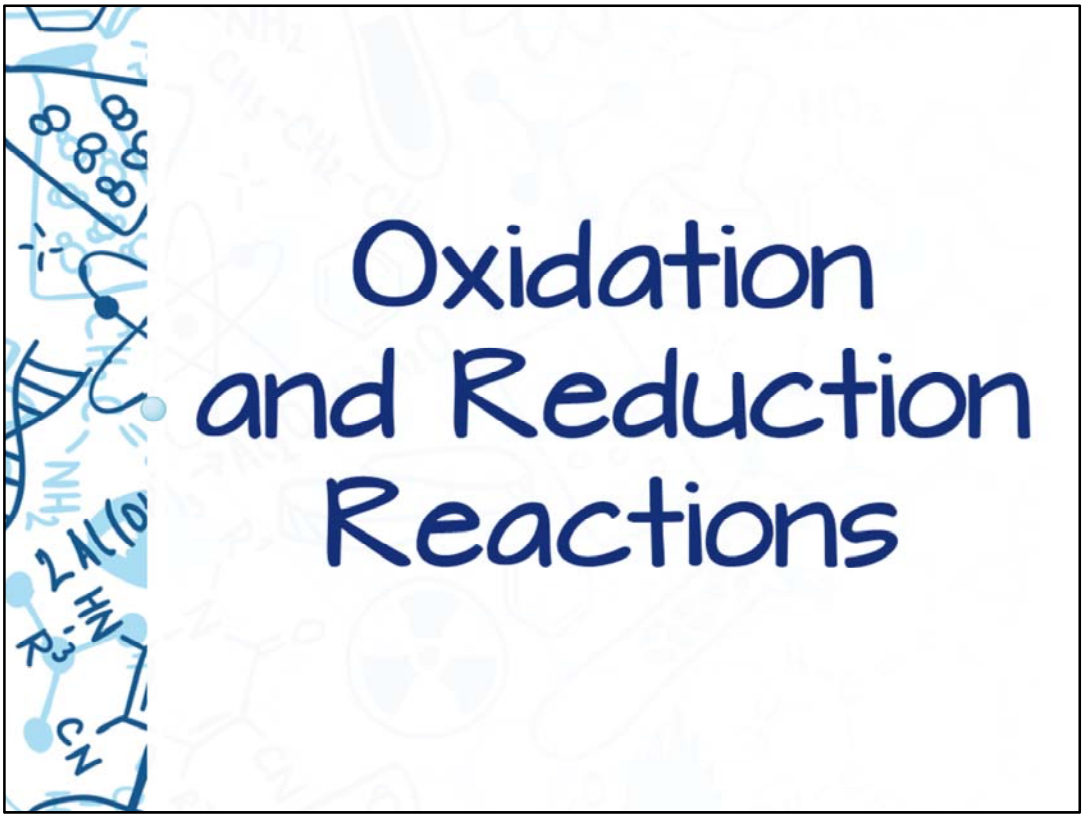
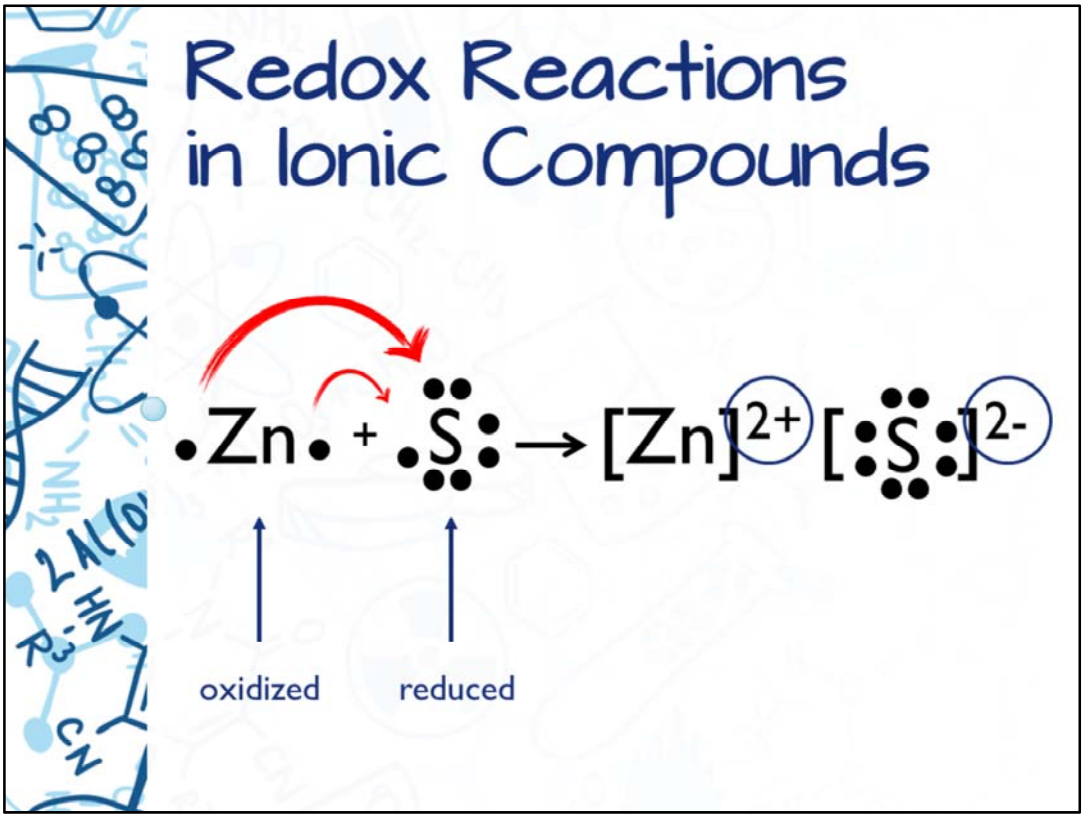
Module 11: Acid/Bases, Neutralization, and Redox Reactions

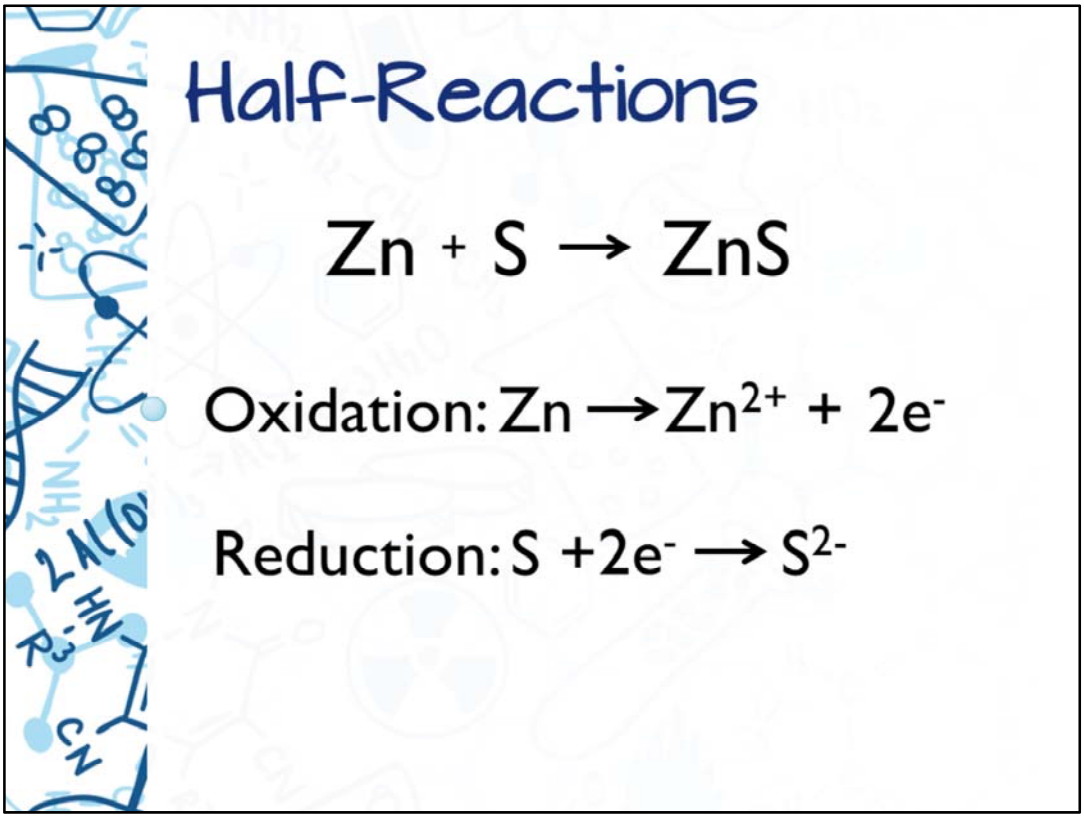
Topic 6 Content: Oxidation and Reduction Reactions Presentation Notes



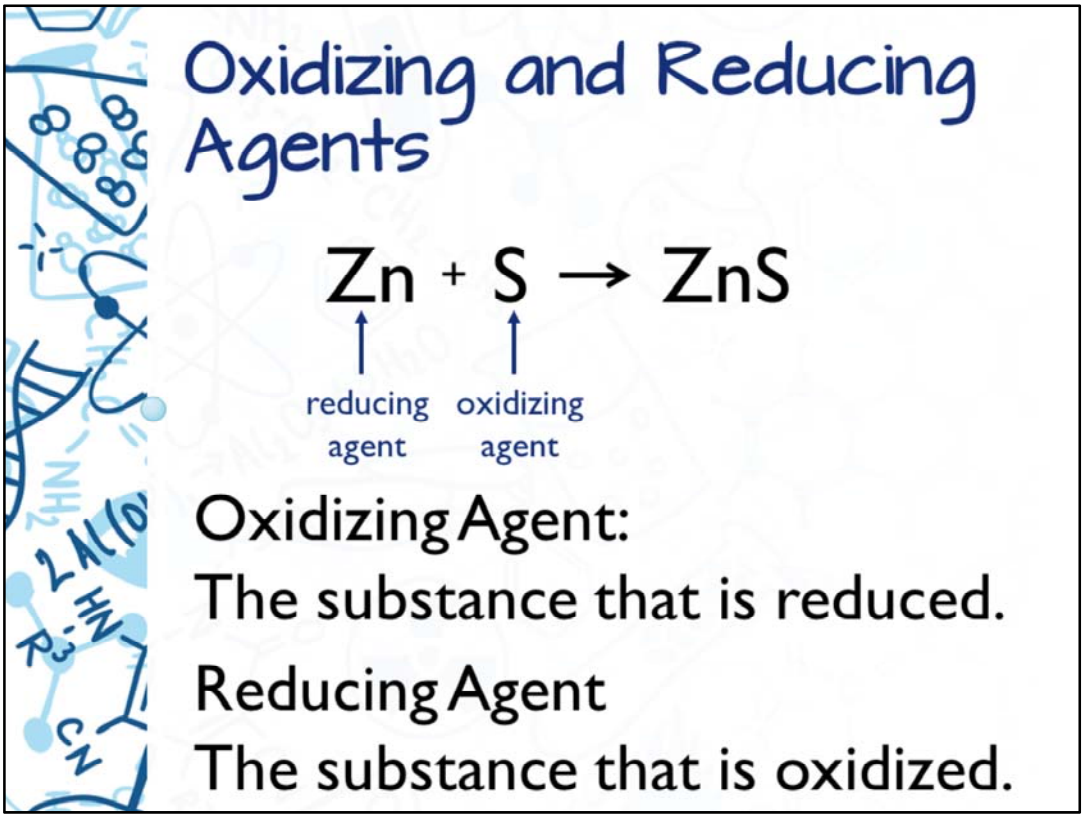
Oxidation and Reduction Reactions



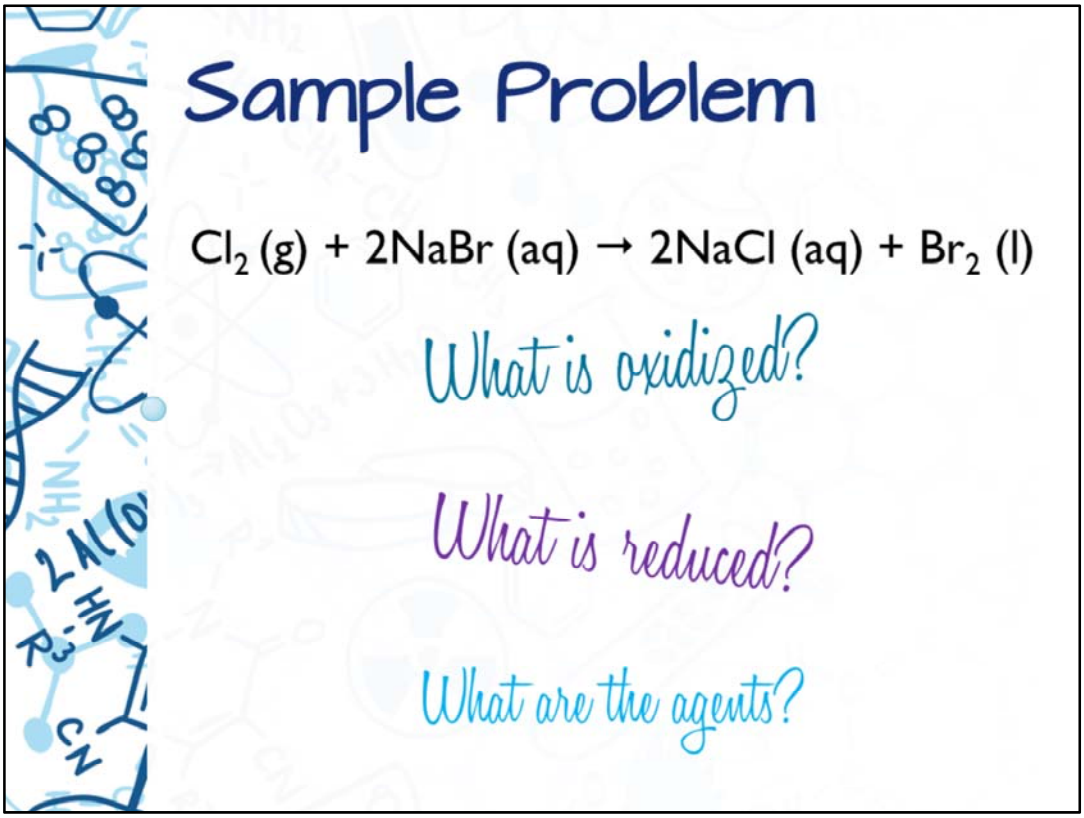
When a nonmetal and metal react, the electrons transfer from the metal to the nonmetal. For example, if the metal zinc is heated while in the presence of sulfur, then zinc sulfide is produced. How is this new compound created? Two electrons are transferred from the zinc to the sulfur. Oxidation occurs when a substance loses electrons. In this example, zinc is being oxidized. That means that sulfur is being reduced, as it is gaining electrons. Notice how the oxidation numbers are written for this reaction. Since zinc has a plus two charge and sulfur has a minus two charge, the overall oxidation number for zinc sulfide is zero.



Both processes of oxidation and reduction are occurring simultaneously during this reaction. In order to show both reactions, a half-reaction is used. A half-reaction is an equation that shows either the oxidation or reduction that occurs during a redox reaction. Remember, in the oxidation half-reaction, zinc loses two electrons. These electrons are given to sulfur. Those two electrons are highlighted in the oxidation half-reaction. In the reduction half-reaction, two electrons are gained by sulfur. These two reactions are highlighted in the reduction half-reaction. Notice how the half-reactions include the oxidation numbers for each atom. The resulting zinc and sulfide ions that are formed during these processes are attracted to one another, forming an ionic bond.

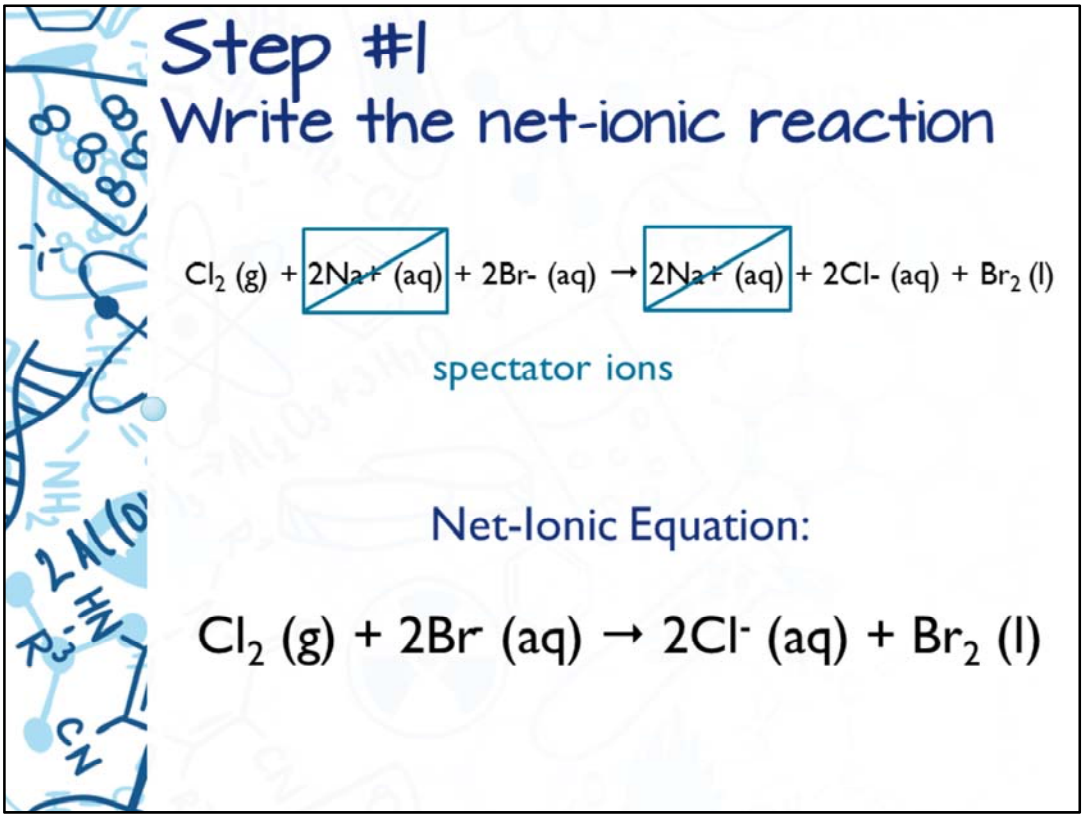


In a redox reaction, there must be at least one oxidizing agent and one reducing agent. In the example of the redox of zinc sulfide, zinc is the reducing agent and sulfur is the oxidizing agent. Why? Zinc causes sulfur to gain electrons. The sulfur causes zinc to be oxidized. Think about it this way; the oxidizing agent is the substance that is reduced. The reducing agent is the substance that is oxidized.

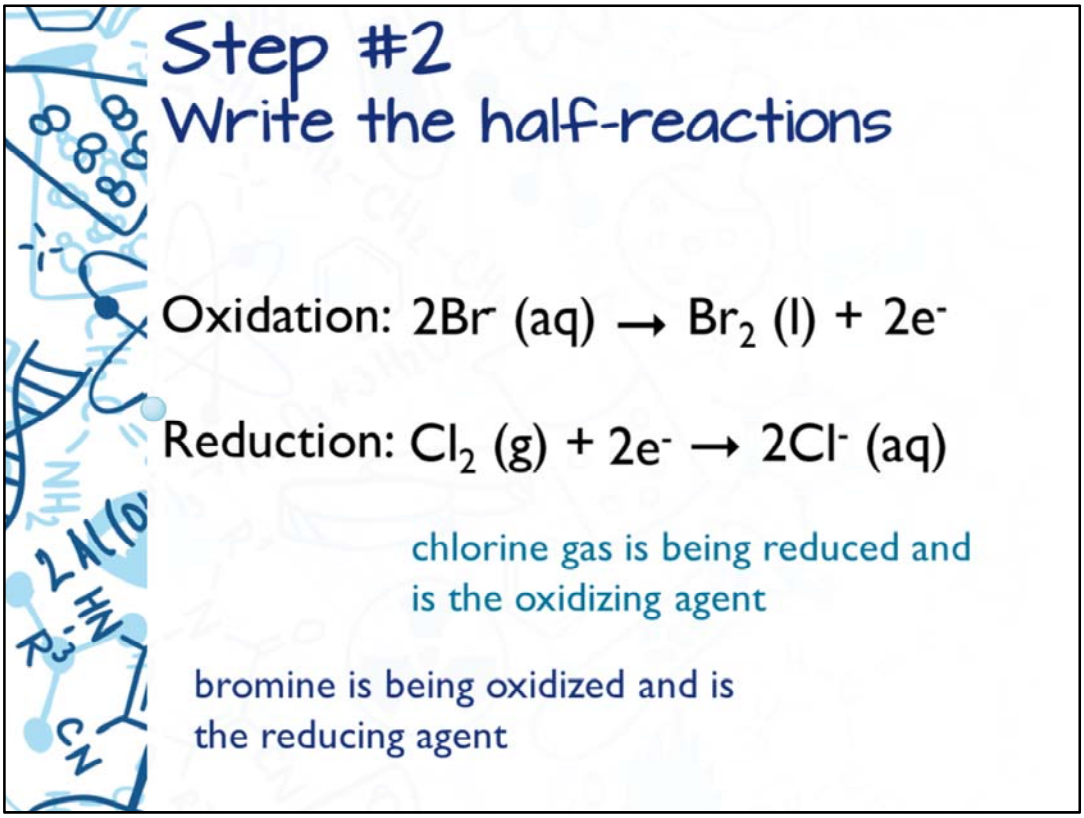


Review the equation shown here. In this reaction, chlorine gas is added to an aqueous solution of sodium bromide. The reaction produces sodium chloride and bromine. Attempt to answer the following questions on your own. Then, click ***NEXT*** to see the correct responses.

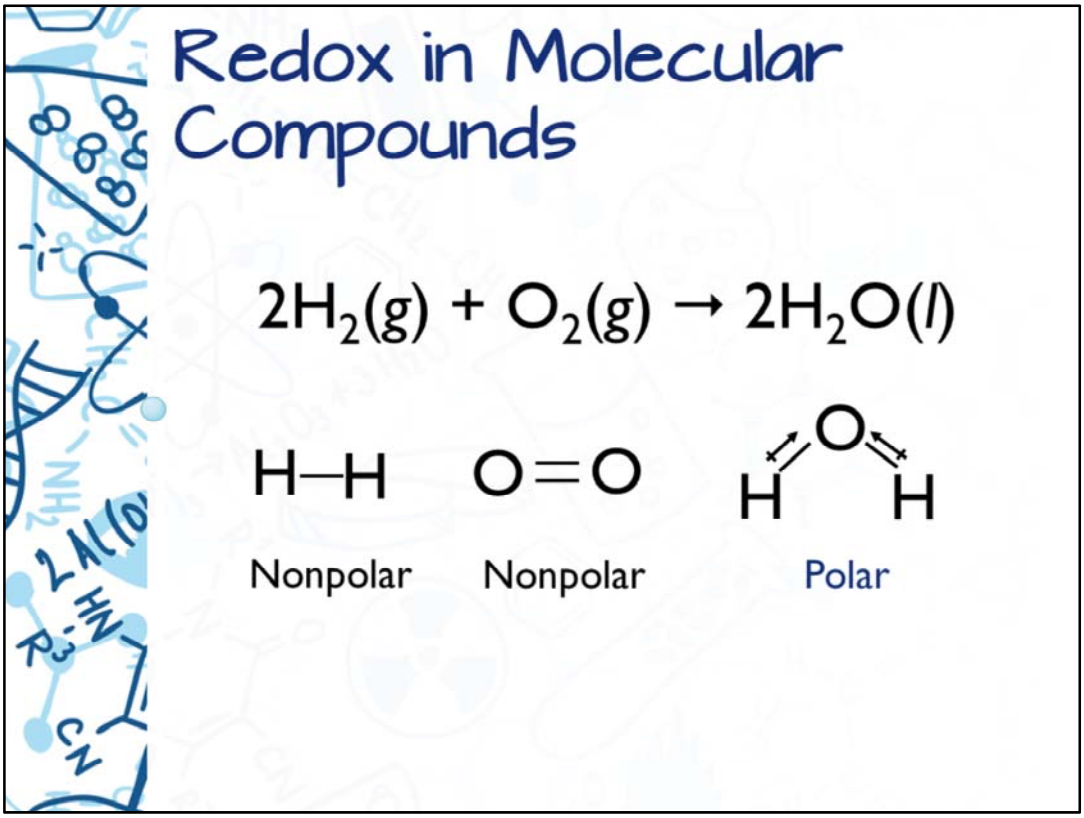
- What is being oxidized?
- What is being reduced?
- What are the oxidizing and reducing agents?



The first step in this problem is to write the net-ionic equation. As you write the net-ionic equation, you will notice that sodium serves as a spectator in this reaction. Once you remove the spectator ions, you have the net-ionic equation.



The second step in this problem is to write the half-reactions. From the net ionic equation, you can derive the two half-reactions. In the oxidation half-reaction, you can observe that bromine is gaining electrons. In the reduction half-reaction, you can see that chlorine gas is losing a total two electrons. What does this mean? This means that chlorine gas is being reduced and is the oxidizing agent. The bromine is gaining electrons. This means the bromine is being oxidized and is the reducing agent.



Observing the loss of gain of electrons in ions is very easy to see in a reaction in which ions are formed. However, in many reactions, ions are not formed. In molecular compounds, the electrons are shared in a covalent bond. Although the electrons in molecular compounds are not shared completely, they are still considered redox reactions. An example of this occurs when hydrogen gas reacts with oxygen gas. In this reaction, water is formed as the product. Both of the individual hydrogen and oxygen atoms are nonpolar. When the atoms form the water molecule, the sharing of electrons is no longer equal. The bonding electrons become more attracted to the oxygen atom because oxygen is more electronegative. Technically, the atoms are not transferred, but you can say that the hydrogen atoms are oxidized due to the partial loss. The oxygen is reduced because it partially gains electrons.