

Oxidation and Reduction

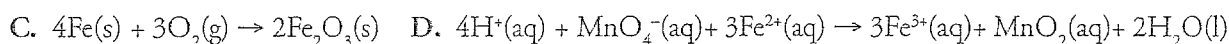
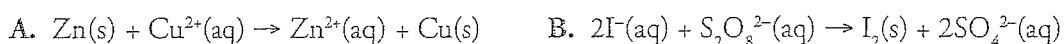
What happens when electrons are transferred in a chemical reaction?

Why?

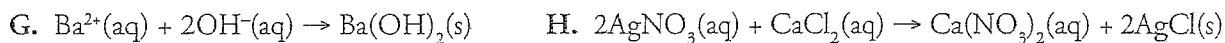
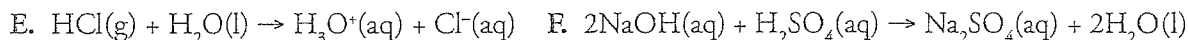
Silver tarnishes when it comes in contact with sulfur compounds in the air. Copper gets coated in beautiful green patina as it ages. Metals rust or corrode in the presence of air and water. Minerals (ionic compounds) found in ore can be decomposed with the use of electricity to produce pure metals and nonmetals. All of these reactions are examples of oxidation and reduction, otherwise known as **redox** reactions. In this activity you will explore what is happening at the atomic level in redox reactions.

Model 1 – Redox Reactions

Redox Reactions

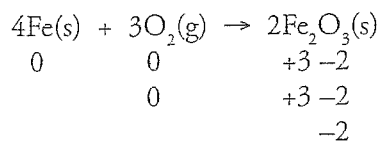


Nonredox Reactions

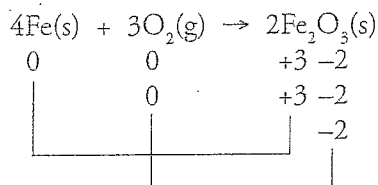


1. What two types of reactions are shown in Model 1?
2. Examine the redox and nonredox reactions in Model 1. Is/are there any feature(s) in the redox reactions that would allow you to identify them as redox reactions? If yes, use specific examples from Model 1 to support your answer.

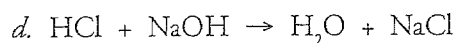
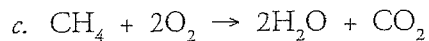
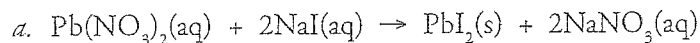
3. In the space under each reaction in Model 1, write the oxidation number for every atom. Divide the work among your group members. An example is shown here:



4. Identify any elements that changed oxidation number in the reactions in Model 1. Connect the starting and ending oxidation numbers with a line. An example is shown here:



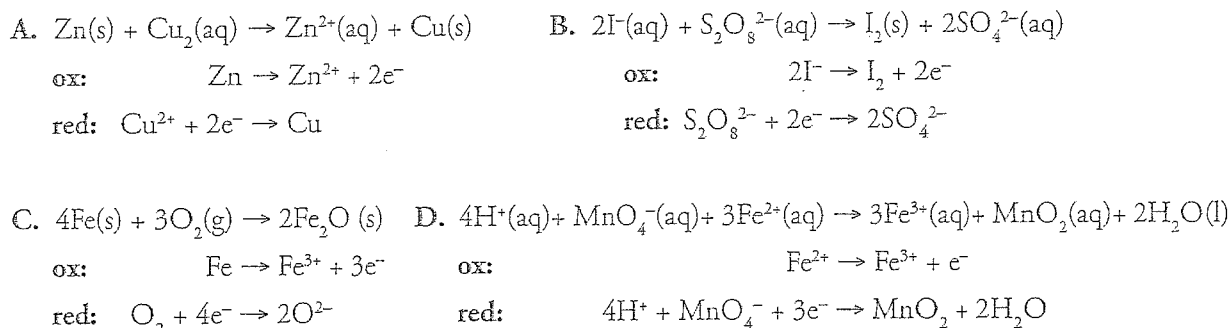
5. Based on the oxidation number analysis you just performed for the reactions in Model 1, are there any features of the redox reactions that would allow you to identify them as redox reactions? If yes, use specific examples from Model 1 to support your answer.
6. Identify the following reactions as either redox or nonredox using oxidation numbers as evidence.



Read This!

The process of oxidation and reduction can be thought of as a transfer of electrons from one atom to another. Thus, one atom gives up electrons and the other atom gains them. As a result of this process, the oxidation numbers of both atoms change. All redox reactions can be divided up into two reactions—an **oxidation half-reaction** and a **reduction half-reaction**. This allows for better understanding of the electron transfer process.

Model 2 – Half Reactions



7. What does the “e⁻” symbol represent in the oxidation and reduction half-reactions shown in Model 2?
8. Look at the oxidation half-reactions in Model 2.
- a. Which of the following types of particles may undergo oxidation? (Circle all that apply.)
Neutral atoms/molecules Cations Anions
- b. Are electrons lost or gained by an atom during the process of oxidation?
- c. Does the oxidation number of an atom involved in the process of oxidation increase or decrease?
9. Look at the examples of reduction in Model 2.
- a. Which of the following types of particles undergo reduction? (Circle all that apply.)
Neutral atoms/molecules Cations Anions
- b. Are electrons lost or gained by an atom during the process of reduction?
- c. Does the oxidation number of an atom involved in the process of reduction increase or decrease?

10. Consider the word “reduction” as it is used in the English language. In reduction half-reactions, what is “reduced”? Use the examples in Model 1 to verify your answer.

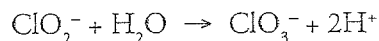
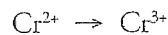
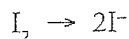
Read This!

Oxidation occurs when atoms lose electrons. **Reduction** occurs when atoms gain electrons. These two processes always occur together. In other words, you can't just let electrons loose into space—they must be grabbed by some other atom. Likewise, you can't just grab electrons from space—they must be taken from some other atom. An easy way to remember these processes is to remember the phrase “LEO the lion goes GER.”

LEO = Loss of Electrons is Oxidation GER = Gain of Electrons is Reduction

11. Consider the incomplete half-reactions below.

- Use oxidation numbers to identify the reactions below as oxidation or reduction.
- Place the correct number of electrons on the appropriate side of the reaction to complete the equation.



12. Consider Reaction A in Model 2. Show that the two half-reactions can be added together to give the overall redox reaction. *Hint:* Consider how you would add two equations together in algebra.

13. Show how the two half-reactions for Reaction B in Model 2 can be added together to give the overall redox reaction.

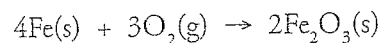
14. Recall that the same number of electrons that are lost by atoms during oxidation must be gained by atoms during reduction. Show how the half-reactions for Reactions C and D in Model 2 can be added together to give the overall redox reactions shown.



Extension Questions

15. Are electrons conserved in redox reactions? Explain.

16. When iron is exposed to oxygen, it forms rust as described by the following equation. In this reaction oxygen is acting as the **oxidizing agent**.



- What element was oxidized in the reaction above?
- Explain why oxygen is considered the oxidizing agent in this reaction? *Hint:* Consider the purpose of an “insurance agent” or a “real estate agent.”
- What is the **reducing agent** in the reaction above? Explain.