

Oxidation-Number Changes in Reactions

Ck12 Science

To access the online version of this FlexBook
click the link below:

https://www.ck12.org/c/chemistry/oxidation-number-changes-in-reactions/lesson/Changes-in-Oxidation-Number-in-Redox-Reactions-CHEM/?referrer=concept_details

To access a customizable version of this book, as well as other interactive content, visit www.ck12.org

CK-12 Foundation is a non-profit organization with a mission to reduce the cost of textbook materials for the K-12 market both in the U.S. and worldwide. Using an open-source, collaborative, and web-based compilation model, CK-12 pioneers and promotes the creation and distribution of high-quality, adaptive online textbooks that can be mixed, modified and printed (i.e., the FlexBook® textbooks).

Copyright © 2024 CK-12 Foundation, www.ck12.org

The names “CK-12” and “CK12” and associated logos and the terms “**FlexBook®**” and “**FlexBook Platform®**” (collectively “CK-12 Marks”) are trademarks and service marks of CK-12 Foundation and are protected by federal, state, and international laws.

Any form of reproduction of this book in any format or medium, in whole or in sections, must be attributed according to our attribution guidelines.

<https://www.ck12info.org/about/attribution-guidelines>

Except as otherwise noted, all CK-12 Content (including CK-12 Curriculum Material) is made available to Users in accordance with the CK-12 Curriculum Materials License

<https://www.ck12info.org/curriculum-materials-license>



Complete terms for use for the CK-12 website can be found at:

<http://www.ck12info.org/terms-of-use/>

Printed: February 26, 2024 (PST)



AUTHORS

Ck12 Science



Oxidation-Number Changes in Reactions

Discusses how to identify reduced and oxidized molecules in chemical equations.

Oxidation-Number Changes in Reactions

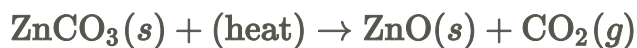


[Figure1]

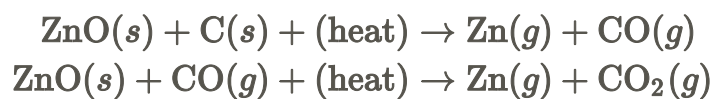
Where does the zinc in batteries come from?

Zinc is an important component of many kinds of batteries. This metal is mined as zinc compounds, one of which is zinc carbonate. To obtain the pure metal, the ore must go through the following chemical processes:

1. High temperatures and hot air blasts are used to roast the ore:



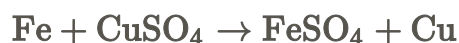
2. Then the ZnO is treated with carbon:



The result is the pure metal which can then be fabricated into a variety of products.

Changes in Oxidation-Number in Redox Reactions

Consider the reaction below between elemental iron and copper sulfate:



In the course of the reaction, the oxidation number of Fe increases from zero to +2. The oxidation number of copper decreases from +2 to 0. This result is in accordance with the activity series. Iron is above copper in the series, so will be more likely to form Fe^{2+} while converting the Cu^{2+} to metallic copper (Cu^0).

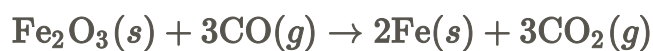
A loss of negatively-charged electrons corresponds to an increase in oxidation number, while a gain of electrons corresponds to a decrease in oxidation number. Therefore, the element or ion that is oxidized undergoes an increase in oxidation number. The element or ion that is reduced undergoes a decrease in oxidation number. **Table below** summarizes the processes of oxidation and reduction.

Processes of Oxidation and Reduction

Oxidation	Reduction
Complete loss of electrons (ionic reaction)	Complete gain of electrons (ionic reaction)
Gain of oxygen	Loss of oxygen
Loss of hydrogen in a molecular compound	Gain of hydrogen in a molecular compound
Increase in oxidation number	Decrease in oxidation number

Sample Problem: Identifying Oxidation and Reduction

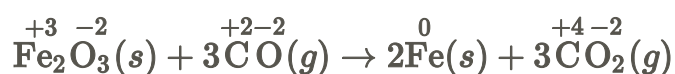
Use changes in oxidation number to determine which atoms are oxidized and which atoms are reduced in the following reaction. Identify the oxidizing and reducing agent.



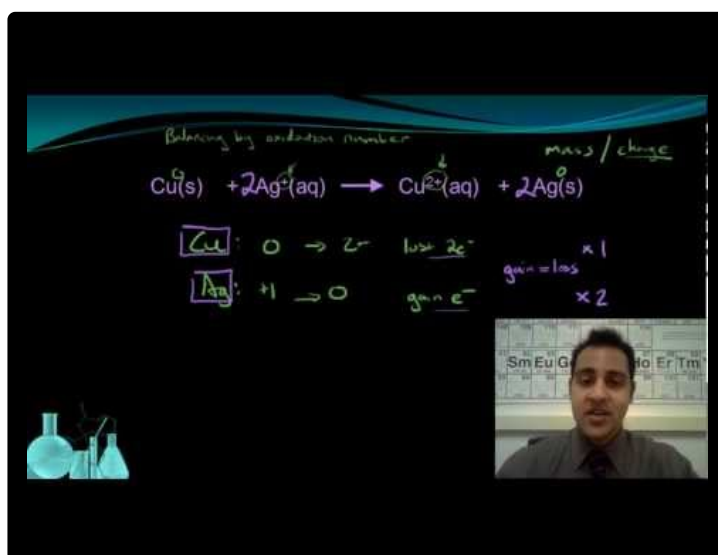
Step 1: Plan the problem.

Use the oxidation number rules to assign oxidation numbers to each atom in the balanced equation. Coefficients do not affect oxidation numbers. The oxidized atom increases in oxidation number and the reduced atom decreases in oxidation number.

Step 2: Solve.



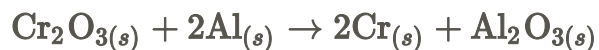
The element carbon is oxidized because its oxidation number increases from +2 to +4. The iron(III) ion within the Fe_2O_3 is reduced because its oxidation number decreases from +3 to 0. The carbon monoxide (CO) is the reducing agent since it contains the element that is oxidized. The Fe^{3+} ion is the oxidizing agent since it is reduced in the reaction.



<https://www.ck12.org/flx/render/embeddedobject/185711>

Review

1. In the example reaction above, list the ways the reduction of ferric oxide fits the definitions of oxidation and reduction.
2. In the reaction below, what is oxidized and what is reduced?



3. List the ways that the conversion of aluminum in the reaction above fits the definitions in the table.
-



1.0 REFERENCES

Image	Attributions
	Credit: Dave Dyet Source: http://commons.wikimedia.org/wiki/File:Smithsonite_3_w-high_limonite_content_Zinc_carbonate_Sunbeam_Mine_near_Ruth_Nevada_1807.jpg License: Public Domain