ConcepTest On Simple Redox Reactions

ConcepTest designed to test oxidation numbers and their use:

The chemical reaction which occurs when sucrose \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \) ferments to ethanol \( \text{C}_2\text{H}_6\text{O} \) is

\[
\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{O} \rightarrow 4 \text{C}_2\text{H}_6\text{O} + 4 \text{CO}_2
\]

In this reaction, the oxidation number of the carbon

1. changes from 0 in \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \) to \(-2\) in \( \text{C}_2\text{H}_6\text{O} \), so the carbon is oxidized.
2. changes from 0 in \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \) to \(+2\) in \( \text{C}_2\text{H}_6\text{O} \), so the carbon is reduced.
3. changes from 0 in \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \) to \(-2\) in \( \text{C}_2\text{H}_6\text{O} \), so the carbon is reduced.
4. is unchanged, so this is not a redox reaction.

Correct Answer is #3.
Comment to Instructor: Students need to be able to correctly assign oxidation numbers, and to apply the results to the interpretation of what’s going on.

ConcepTest on oxidation numbers

\[ \text{Zn} (s) + 2 \text{HCl} (aq) \rightarrow \text{ZnCl}_2 (aq) + \text{H}_2 (g) \]

In the reaction shown above, what is the oxidation number of \( \text{H}_2 \)?

1. +1
2. \(-1\)
3. 0
4. +2

Comment to Instructor: Correct answer is #3. 0. Student selecting #1 mistakenly thinks all hydrogen exist as \( \text{H}^+ \). Student selecting #4 probably thinks the subscript 2 in \( \text{H}_2 \) is the oxidation number.

ConcepTest on Oxidation Numbers

\[ 2 \text{FeCl}_3 (aq) + \text{Na}_2\text{SO}_3 (aq) + \text{H}_2\text{O} \rightarrow 2 \text{FeCl}_2 (aq) + \text{Na}_2\text{SO}_4 + 2 \text{HCl} (aq) \]

In the reaction shown above, which element is undergoing oxidation?

1. Fe
2. Cl
3. S
4. O

Comment to Instructor: Correct answer is #3. S. It has an oxidation number of +4 in \( \text{Na}_2\text{SO}_3 \) and an oxidation number of +6 in \( \text{Na}_2\text{SO}_4 \).
ConcepTest on Oxidation vs. Reduction

\[ \text{Zn} (s) + 2 \text{HCl} (aq) \rightarrow \text{ZnCl}_2 (aq) + \text{H}_2 (g) \]

In the reaction shown above, is Zn being oxidized or reduced?

1. oxidized
2. reduced
3. neither

Comment to Instructor: Correct answer is 1. oxidized. The oxidation number of Zn is changing from 0 to +2.

ConcepTest on Oxidation vs. Reduction

\[ \text{Zn} (s) + 2 \text{HCl} (aq) \rightarrow \text{ZnCl}_2 (aq) + \text{H}_2 (g) \]

In the reaction shown above, is Cl being oxidized or reduced?

1. oxidized
2. reduced
3. neither

Comment to Instructor: Correct answer is 3. neither. The oxidation number of Cl is \(-1\) in HCl as well as in ZnCl₂. Some students make think the Cl is changing from +1 to +2 or \(-1\) to \(-2\) because the subscript of Cl changed.

ConcepTest on Identifying Which is the Oxidizing Agent

\[ \text{Zn} (s) + 2 \text{HCl} (aq) \rightarrow \text{ZnCl}_2 (aq) + \text{H}_2 (g) \]

In the reaction shown above, which is the oxidizing agent?

1. Zn
2. H
3. HCl
4. \(\text{Zn}^{+2}\)

Comment to Instructor: Correct answer is 3. HCl. Since the oxidation number of H is decreasing from \(+1\) to 0, it is undergoing reduction. Zn is being oxidized, and HCl is the “agent” that is causing the Zn to be oxidized. #4 indicates that the student is thinking that the \(\text{Zn}^{+2}\) in ZnCl₂ is undergoing reduction and is therefore the oxidizing agent. It is common for students to look at the products to find the oxidizing agent.