OXIDATION NUMBERS

Section Review

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The oxidation number of an element in an uncombined state is 1. The oxidation number of a monatomic ion is the same in magnitude and 2. as its ionic 3. The sum of the oxidation numbers of the elements in a neutral compound is 4. In a polyatomic ion, however, the sum is equal to the 5. Oxidation numbers help you keep track of 6. transfer in redox reactions. An oxidation number increase is 7. while a 8. is reduction.

Match the oxidation number of nitrogen in each formula in Column B to the correct oxidation number in Column A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. -3</td>
<td>a. N₂</td>
</tr>
<tr>
<td>18. -2</td>
<td>b. HNO₃</td>
</tr>
<tr>
<td>19. -1</td>
<td>c. NO</td>
</tr>
<tr>
<td>20. 0</td>
<td>d. NH₂OH</td>
</tr>
<tr>
<td>21. +1</td>
<td>e. NH₃</td>
</tr>
<tr>
<td>22. +2</td>
<td>f. N₂O₃</td>
</tr>
<tr>
<td>23. +3</td>
<td>g. N₂O</td>
</tr>
<tr>
<td>24. +4</td>
<td>h. N₂H₄</td>
</tr>
<tr>
<td>25. +5</td>
<td>i. NO₂</td>
</tr>
</tbody>
</table>

The purpose of this exercise is to show that an element can have several oxidation numbers!
Practice Problems

In your notebook, solve the following problems.

**SECTION 20.1 THE MEANING OF OXIDATION AND REDUCTION**

Determine what is oxidized and what is reduced in each reaction. Identify the oxidizing agent and the reducing agent.

<table>
<thead>
<tr>
<th></th>
<th>Oxidized</th>
<th>Reduced</th>
<th>Oxidizing Agent</th>
<th>Reducing Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2Sr + O₂ → 2SrO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>2Li + S → 2Li₂S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2Cs + Br₂ → 2CsBr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>3Mg + N₂ → Mg₃N₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>4Fe + 3O₂ → 2Fe₂O₃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Cl₂ + 2NaBr → 2NaCl + Br₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Si + 2F₂ → SiF₄</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>2Ca + O₂ → 2CaO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Mg + 2HCl → MgCl₂ + H₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>2Na + 2H₂O → 2NaOH + H₂</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SECTION 20.2 OXIDATION NUMBERS**

1. Give the oxidation number of each kind of atom or ion.
   - a. Sn
   - b. K⁺
   - c. S²⁻
   - d. Fe³⁺
   - e. Se
   - f. Mg²⁺
   - g. Sn⁴⁺
   - h. Br⁻

2. Calculate the oxidation number of chromium in each of the following formulas.
   - a. Cr₂O₃
   - b. H₂CrO₇
   - c. CrSO₄
   - d. CrO₄²⁻

3. Use the changes in oxidation number to determine which elements are oxidized and which are reduced in these reactions. (Note: It is not necessary to use balanced reactions.)
   - a. C + H₂SO₄ → CO₂ + SO₂ + H₂O
   - b. HNO₃ + HI → NO + I₂ + H₂O
   - c. KMnO₄ + HCl → MnCl₂ + Cl₂ + H₂O + KCl
   - d. Sb + HNO₃ → Sb₂O₅ + NO + H₂O

4. For each reaction in problem 3 above, identify the oxidizing agent and reducing agent.
The oxidation number of an element in an uncombined state is ___1___. The oxidation number of a monatomic ion is the same in magnitude and __2__ as its ionic __3___. The sum of the oxidation numbers of the elements in a neutral compound is __4__. In a polyatomic ion, however, the sum is equal to the __5___. Oxidation numbers help you keep track of __6__ transfer in redox reactions. An oxidation number increase is __7__, while a __8__ is reduction.

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</tr>
<tr>
<td>h</td>
<td>18. -2</td>
</tr>
<tr>
<td>d</td>
<td>19. -1</td>
</tr>
<tr>
<td>a</td>
<td>20. 0</td>
</tr>
<tr>
<td>g</td>
<td>21. +1</td>
</tr>
<tr>
<td>c</td>
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</tr>
<tr>
<td>f</td>
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</tr>
<tr>
<td>i</td>
<td>24. +4</td>
</tr>
<tr>
<td>b</td>
<td>25. +5</td>
</tr>
</tbody>
</table>

a. N₂  

b. HNO₃

c. NO

d. NH₂OH

e. NH₃

f. N₂O₃

g. N₂O

h. N₂H₄

i. NO₂

Match the oxidation number of nitrogen in each formula in Column B to the correct oxidation number in Column A.

The purpose of this exercise is to show that an element can have several oxidation numbers!
OXIDATION-REDUCTION REACTIONS

Practice Problems
In your notebook, solve the following problems.

SECTION 20.1 THE MEANING OF OXIDATION AND REDUCTION

Determine what is oxidized and what is reduced in each reaction. Identify the oxidizing agent and the reducing agent.

1. \(2\text{Sr} + \text{O}_2 \rightarrow 2\text{SrO}\)
2. \(2\text{Li} + \text{S} \rightarrow 2\text{Li}_2\text{S}\)
3. \(2\text{Cs} + \text{Br}_2 \rightarrow 2\text{CsBr}\)
4. \(3\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2\)
5. \(4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3\)
6. \(\text{Cl}_2 + 2\text{NaBr} \rightarrow 2\text{NaCl} + \text{Br}_2\)
7. \(\text{Si} + 2\text{F}_2 \rightarrow \text{SiF}_4\)
8. \(2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}\)
9. \(\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\)
10. \(2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2\)

SECTION 20.2 OXIDATION NUMBERS

1. Give the oxidation number of each kind of atom or ion.
   a. \(\text{Sn} \) 0
   b. \(\text{K}^+\) +1
   c. \(\text{S}^{2-}\) -2
   d. \(\text{Fe}^{3+}\) +3
   e. \(\text{Se} \) 0
   f. \(\text{Mg}^{2+}\) +2
   g. \(\text{Sn}^{4+}\) +4
   h. \(\text{Br}^-\) -1

2. Calculate the oxidation number of chromium in each of the following formulas.
   a. \(\text{Cr}_2\text{O}_3\)
   b. \(\text{H}_2\text{Cr}_2\text{O}_7\)
   c. \(\text{CrSO}_4\)
   d. \(\text{CrO}_4^{2-}\)

3. Use the changes in oxidation number to determine which elements are oxidized and which are reduced in these reactions. (Note: It is not necessary to use balanced reactions.)
   a. \(\text{C} + \text{H}_2\text{SO}_4 \rightarrow \text{CO}_2 + \text{SO}_2 + \text{H}_2\text{O}\)
   b. \(\text{HNO}_3 + \text{HI} \rightarrow \text{NO} + \text{I}_2 + \text{H}_2\text{O}\)
   c. \(\text{KMnO}_4 + \text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + \text{H}_2\text{O} + \text{KCl}\)
   d. \(\text{Sb} + \text{HNO}_3 \rightarrow \text{Sb}_2\text{O}_3 + \text{NO} + \text{H}_2\text{O}\)

4. For each reaction in problem 3 above, identify the oxidizing agent and reducing agent.
   → whatever was oxidized, is called the reducing agent.
   → whatever was reduced, is called the oxidizing agent.