

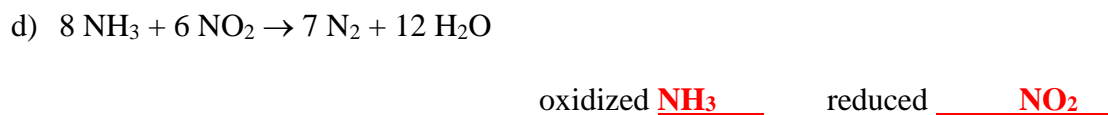
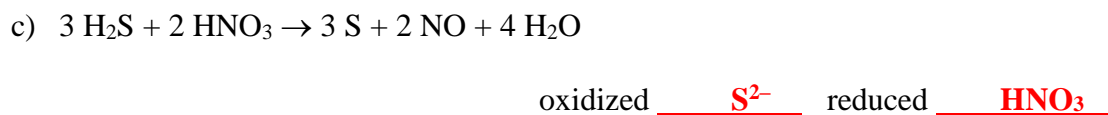
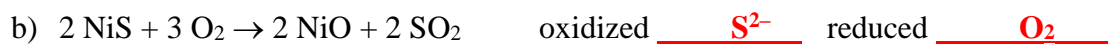
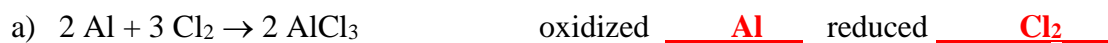
**REDOX REACTIONS**

Chapters 4 &amp; 20

1. In the compounds below, assign oxidation numbers to each element:



2. Identify which substance is oxidized and which substance is reduced in each of the following redox reactions.



## BALANCING REDOX REACTIONS

### Half-Reaction Method

1. Assign oxidation number to each element and identify the substance being oxidized and the substance being reduced.
2. Write oxidation and reduction half-reactions. In oxidation half-reaction electrons should appear on the product side, and in the reduction half-reaction they should appear on the reactant side.
3. Balance each half-reaction with respect to all elements, except H and O.

#### For Acid Solutions:

4. Add the appropriate number of H<sub>2</sub>O molecules to the deficient side to balance O.
5. Add H<sup>+</sup> to the deficient side to balance H.

#### For Basic Solutions:

4. For each deficient O:  
Add two (2) hydroxides, OH<sup>-</sup>, to the deficient side.  
Add one (1) water, H<sub>2</sub>O, to the other side.
5. For each deficient H:  
Add one (1) water, H<sub>2</sub>O, to the deficient side.  
Add one (1) hydroxide, OH<sup>-</sup>, to the other side.

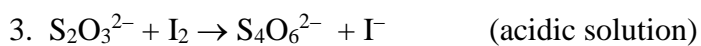
Balance each of the following redox reactions using the half-reaction method:



Oxidation  <u>    </u> <b>Cu</b> <u>    </u> <u>    </u> <b>2</b> <u>    </u> element      # of e <sup>-</sup>	HALF-REACTION  <b>3 x [Cu → Cu<sup>2+</sup> + 2 e<sup>-</sup>]</b> <b>3 Cu → 3 Cu<sup>2+</sup> + 6 e<sup>-</sup></b>
Reduction  <u>    </u> <b>N</b> <u>    </u> <u>    </u> <b>3</b> <u>    </u> element      # of e <sup>-</sup>	HALF-REACTION  <b>HNO<sub>3</sub> + 3 e<sup>-</sup> → NO</b> <b>2 x [3 H<sup>+</sup> + HNO<sub>3</sub> + 3 e<sup>-</sup> → NO + 2 H<sub>2</sub>O]</b> <b>6 H<sup>+</sup> + 2 HNO<sub>3</sub> + 6 e<sup>-</sup> → 2 NO + 4 H<sub>2</sub>O</b>
Balanced total reaction	<b>6 H<sup>+</sup> + 3 Cu + 2 HNO<sub>3</sub> → 3 Cu<sup>2+</sup> + 2 NO + 4 H<sub>2</sub>O</b>



<p>Oxidation</p> <p><u>Sn</u>      <u>2</u> element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><math>\text{SnO}_2^{2-} \rightarrow \text{SnO}_3^{2-} + 2 e^-</math>  <math>3 \times [2 \text{OH}^- + \text{SnO}_2^{2-} \rightarrow \text{SnO}_3^{2-} + 2 e^- + \text{H}_2\text{O}]</math>  <math>6 \text{OH}^- + 3 \text{SnO}_2^{2-} \rightarrow 3 \text{SnO}_3^{2-} + 6 e^- + 3 \text{H}_2\text{O}</math></p>
<p>Reduction</p> <p><u>Bi</u>      <u>3</u> element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><math>\text{Bi}(\text{OH})_3 + 3 e^- \rightarrow \text{Bi}</math>  <math>2 \times [\text{Bi}(\text{OH})_3 + 3 e^- \rightarrow \text{Bi} + 3 \text{OH}^-]</math>  <math>2 \text{Bi}(\text{OH})_3 + 6 e^- \rightarrow 2 \text{Bi} + 6 \text{OH}^-</math></p>
<p>Balanced total reaction</p>	<p><math>2 \text{Bi}(\text{OH})_3 + 3 \text{SnO}_2^{2-} \rightarrow 2 \text{Bi} + 3 \text{SnO}_3^{2-} + 3 \text{H}_2\text{O}</math></p>



<p>Oxidation</p> <p><u>S</u>      <u>0.5</u> element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><math>2 \text{S}_2\text{O}_3^{2-} \rightarrow \text{S}_4\text{O}_6^{2-} + 2 e^-</math></p>
<p>Reduction</p> <p><u>I</u>      <u>1</u> element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><math>\text{I}_2 + 2 e^- \rightarrow 2 \text{I}^-</math></p>
<p>Balanced total reaction</p>	<p><math>2 \text{S}_2\text{O}_3^{2-} + \text{I}_2 \rightarrow \text{S}_4\text{O}_6^{2-} + 2 \text{I}^-</math></p>



<p>Oxidation</p> <p><u>  <b>I</b>  </u>    <u>  <b>6</b>  </u>            element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><b><math>\text{I}^- \rightarrow \text{IO}_3^- + 6 e^-</math></b></p> <p><b><math>6 \text{OH}^- + \text{I}^- \rightarrow \text{IO}_3^- + 6 e^- + 3 \text{H}_2\text{O}</math></b></p>
<p>Reduction</p> <p><u>  <b>Mn</b>  </u>    <u>  <b>1</b>  </u>            element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><b><math>\text{MnO}_4^- + 1 e^- \rightarrow \text{MnO}_4^{2-}</math></b></p> <p><b><math>6 \times [\text{MnO}_4^- + 1 e^- \rightarrow \text{MnO}_4^{2-}]</math></b></p> <p><b><math>6 \text{MnO}_4^- + 6 e^- \rightarrow 6 \text{MnO}_4^{2-}</math></b></p>
<p>Balanced total reaction</p>	<p><b><math>6 \text{OH}^- + 6 \text{MnO}_4^- + \text{I}^- \rightarrow 6 \text{MnO}_4^{2-} + \text{IO}_3^- + 3 \text{H}_2\text{O}</math></b></p>



<p>Oxidation</p> <p><u>  <b>Br</b>  </u>    <u>  <b>5</b>  </u>            element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><b><math>\text{Br}_2 \rightarrow 2 \text{BrO}_3^- + 10 e^-</math></b></p> <p><b><math>12 \text{OH}^- + \text{Br}_2 \rightarrow 2 \text{BrO}_3^- + 10 e^- + 6 \text{H}_2\text{O}</math></b></p>
<p>Reduction</p> <p><u>  <b>Br</b>  </u>    <u>  <b>1</b>  </u>            element    # of <math>e^-</math></p>	<p>HALF-REACTION</p> <p><b><math>5 \times [\text{Br}_2 + 2 e^- \rightarrow 2 \text{Br}^-]</math></b></p> <p><b><math>5 \text{Br}_2 + 10 e^- \rightarrow 10 \text{Br}^-</math></b></p>
<p>Balanced total reaction</p>	<p><b><math>12 \text{OH}^- + 6 \text{Br}_2 \rightarrow 2 \text{BrO}_3^- + 10 \text{Br}^- + 6 \text{H}_2\text{O}</math></b></p> <p><b><math>6 \text{OH}^- + 3 \text{Br}_2 \rightarrow \text{BrO}_3^- + 5 \text{Br}^- + 3 \text{H}_2\text{O}</math></b></p>