

Writing and Balancing Half Reactions

Identifying if a reaction is a redox reaction

Are electrons transferred? To answer this question you'll have to write down the chemical equation for the process and assign oxidation numbers to the atoms in all of the reactants and products. If the oxidation numbers for any of the atoms in the reactants are different from the oxidation number for the same atoms on the product side, electron transfer must have occurred, and you have a redox reaction. Based on the reading passage above, write how you can tell if a reaction is a redox reaction.

You know it's redox when...	You know it's NOT redox when...
<ul style="list-style-type: none"> - Ox # change - a single replacement reaction occurs 	<ul style="list-style-type: none"> - Ox #s don't change - double replacement reactions,

Half Reaction

- Half reaction shows the exchange of electrons in a redox reaction
- One half reaction shows oxidation; the other shows reduction

Example of a Reduction Half Reaction

- $Fe^{3+} + 3e^- \rightarrow Fe^0$ (electrons gained - are reactant)
- Electrons on the left side, gained in the reaction

Remember!
 Lose Electrons Oxidation
 Gain Electrons Reduction

Example of an Oxidation Half Reaction

- $Fe^0 \rightarrow Fe^{3+} + 3e^-$ (electrons lost - are product)
- Electrons are the right hand side, loss of electrons in the reaction
- Always add electrons to the side the reaction that has the more positive charge

Complete the Incomplete Half-Reactions - rewrite the equation and place the correct number of electrons on the appropriate side

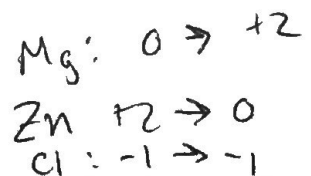
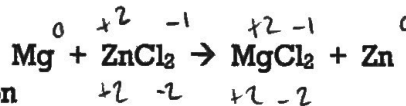
- $I_2 \rightarrow 2I^-$ $I_2^0 + 2e^- \rightarrow 2I^-$
- $Cr^{2+} \rightarrow Cr^{3+}$ $Cr^{+2} \rightarrow Cr^{+3} + e^-$
- $Sr \rightarrow Sr^{2+}$ $Sr^0 \rightarrow Sr^{2+} + 2e^-$

Following the law of conservation

- Half reactions follow:
 - Law of conservation of mass: same number of atoms on both sides of the reaction
 - Conservation of charge: net charge must be the same on both sides of the equation (# of electrons lost = # electrons gained)

Rules for setting up half reactions

- Assign oxidation numbers

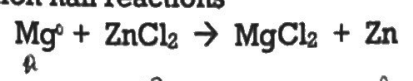


- Identify oxidation and reduction

○ Mg is oxidized because electrons were lost and the oxidation number increased

Name: KEY Official Class: _____ Date: _____
 Teacher: _____ Period: _____ Class: _____

- o Zn is reduced because electrons were gained and the oxidation number decreased
- Write the oxidation and reduction half reactions



Mg: 0 → +2 (ox)
 Zn: +2 → 0 (red)
 Cl: -1 → -1

- o Reduction Half Reaction: $\text{Zn}^{+2} + 2e^- \rightarrow \text{Zn}^0$
- o Oxidation Half Reactions: $\text{Mg}^0 \rightarrow \text{Mg}^{+2} + 2e^-$

- Balance masses (change coefficients) and balance charge – multiply each half reaction to have the same number of electrons



- o Reduction: $\text{Zn}^{+2} + 2e^- \rightarrow \text{Zn}^0$
- o Oxidation: $\text{Mg}^0 \rightarrow \text{Mg}^{+2} + 2e^-$

Everything is already balanced.

Practice: For each reaction, write the oxidation and reduction half reactions. Then balance out the equations.

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<p>$\text{Li} + \text{Ca}^{+2} \rightarrow \text{Li}^{+1} + \text{Ca}$ Li: 0 → +1 Ca: +2 → 0</p> <p>Red: <u>$\text{Ca}^{+2} + 2e^- \rightarrow \text{Ca}^0$</u></p> <p>Ox: <u>$\text{Li}^0 \rightarrow \text{Li}^{+1} + e^-$</u></p> <p>Balance of rxn $(\text{Li}^0 \rightarrow \text{Li}^{+1} + e^-) \times 2$</p> <p><u>$2\text{Li}^0 \rightarrow 2\text{Li}^{+1} + 2e^-$</u></p> <p>Combined: <u>$2\text{Li} + \text{Ca}^{+2} \rightarrow 2\text{Li}^{+1} + \text{Ca}$</u></p>	<p>$\text{Mn} + \text{Cu}^{+2} \rightarrow \text{Mn}^{+4} + \text{Cu}$ Mn: 0 → +4 Cu: +2 → 0</p> <p>Red: <u>$\text{Cu}^{+2} + 2e^- \rightarrow \text{Cu}^0$</u></p> <p>Ox: <u>$\text{Mn}^0 \rightarrow \text{Mn}^{+4} + 4e^-$</u></p> <p>Balance $(\text{Cu}^{+2} + 2e^- \rightarrow \text{Cu}^0) \times 2$</p> <p>$\hookrightarrow 2\text{Cu}^{+2} + 4e^- \rightarrow 2\text{Cu}^0$</p> <p>Combined: <u>$\text{Mn}^0 + 2\text{Cu}^{+2} \rightarrow \text{Mn}^{+4} + 2\text{Cu}$</u></p>
<p>$\text{Ni} + \text{Fe}^{+3} \rightarrow \text{Ni}^{+3} + \text{Fe}$ Ni: 0 → +3 Fe: +3 → 0</p> <p>Red: <u>$\text{Fe}^{+3} + 3e^- \rightarrow \text{Fe}^0$</u></p> <p>Ox: <u>$\text{Ni}^0 \rightarrow \text{Ni}^{+3} + 3e^-$</u></p> <p>Balance? - Not needed</p> <p>Combined: <u>$\text{Fe}^{+3} + \text{Ni}^0 \rightarrow \text{Ni}^{+3} + \text{Fe}$</u></p>	<p>$\text{Zn} + \text{Cr}^{+3} \rightarrow \text{Zn}^{+2} + \text{Cr}$ Zn: 0 → +2 Cr: +3 → 0</p> <p>Red: <u>$\text{Cr}^{+3} + 3e^- \rightarrow \text{Cr}^0$</u></p> <p>Ox: <u>$\text{Zn}^0 \rightarrow \text{Zn}^{+2} + 2e^-$</u></p> <p>Balance: $2(\text{Cr}^{+3} + 3e^- \rightarrow \text{Cr}^0) = 2\text{Cr}^{+3} + 6e^- \rightarrow 2\text{Cr}^0$ $3(\text{Zn}^0 \rightarrow \text{Zn}^{+2} + 2e^-) = 3\text{Zn}^0 \rightarrow 3\text{Zn}^{+2} + 6e^-$</p> <p>Combine: <u>$3\text{Zn}^0 + 2\text{Cr}^{+3} \rightarrow 3\text{Zn}^{+2} + 2\text{Cr}^0$</u></p>