

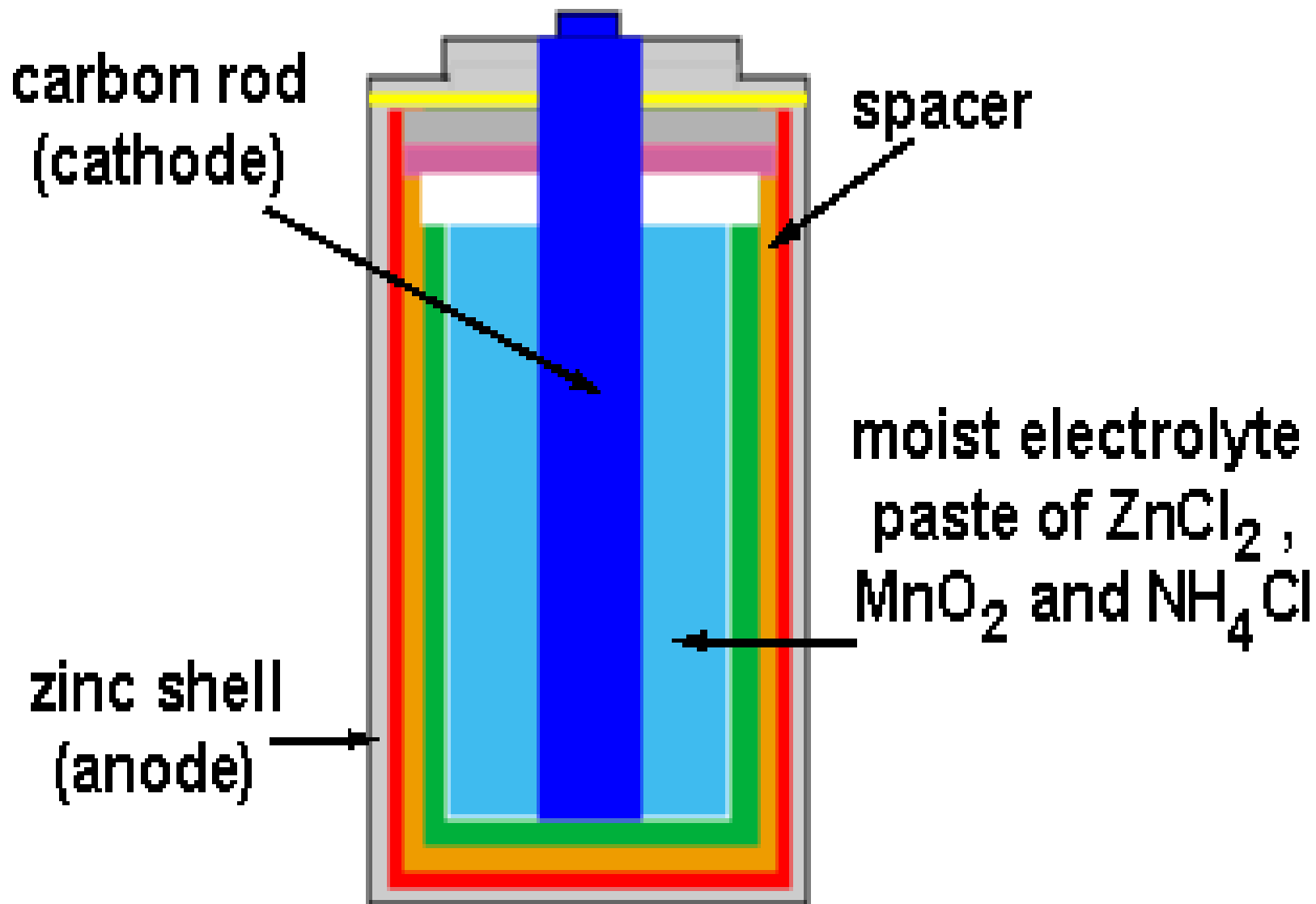
# **Electrochemistry Concepts**

**Target: I can assign oxidation numbers and balance redox reactions.**

# **N42 - Electrochemistry**

## **Concepts**

# Electrochemistry



# Mnemonics

**LEO** goes **GER**

**Loss of Electrons is Oxidation**

**Gain of Electrons is Reduction**

**OIL RIG**

**Oxidation is Loss of Electrons**

**Reduction is Gain of Electrons**



# Examples

## Oxidation



## Reduction



# Oxidation Numbers

The charge an atom in a compound would have if the compound was composed of ions.

Helps track how the electrons are moving around during a reaction.

Sometimes easy to determine, sometimes complex.



# Rules for Assigning Oxidation Numbers

1. Any uncombined element is 0.
2. Monatomic ion equals the charge on the ion.
3. The more-electronegative element in a binary compound is assigned the number equal to the charge it would have if it were an ion.
4. Fluorine in a compound is always -1
5. Oxygen is -2 unless it is combined with F, when it is +2, or it is in a peroxide, such as  $\text{H}_2\text{O}_2$ , when it is -1

6. Hydrogen in most of its compounds is +1 unless it is combined with a metal, in which case it is -1
7. In compounds, the elements of groups 1 and 2 as well as aluminum have oxidation numbers +1, +2 and +3 respectively.
8. The sum of the oxidation numbers of all atoms in a neutral compound is 0.
9. The sum of the oxidation numbers of all atoms in a polyatomic ion equals charge of the ion.



# Balancing Redox Equations

More complicated than balancing normal reactions.

You have to balance the electrons, not just the atoms!

## Steps

1. Assign oxidation numbers to determine which things are oxidized and which are reduced.
2. Split the rxn into two halves – oxidation half and reduction half. Include electrons.
3. Balance the atoms.
4. Balance the charge by balancing the number of electrons.
5. Add half reactions back together, simplify, and CHECK.

# Best Advice...

**USE PENCIL!**

**DON'T CRAM YOUR WORK! USE LOTS OF SPACE!**

**DON'T PANIC!**

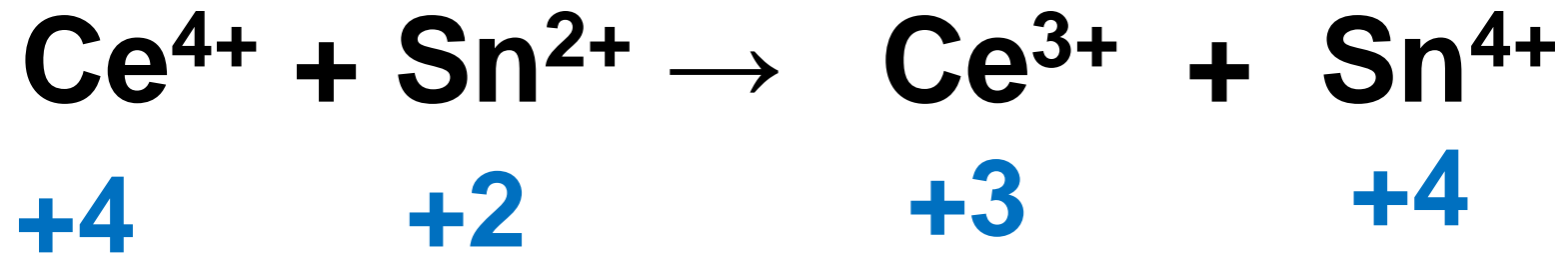
**STUCK???** ERASE AND START OVER.

# Balancing Redox Reactions

1

## Assign oxidation states

Determine the element oxidized and the element reduced.



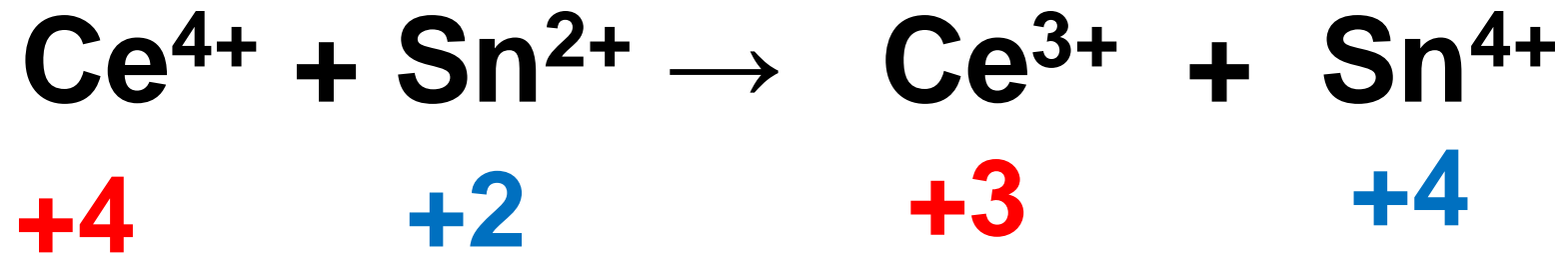
monoatomic  
ions match  
their charge

# Balancing Redox Reactions

1

## Assign oxidation states

Determine the element oxidized and the element reduced.



**LEO** goes **GER**

$\text{Sn}^{2+}$  lost electrons = oxidized,  $+2 \rightarrow +4$

$\text{Ce}^{4+}$  gained electrons = reduced,  $+4 \rightarrow +3$

# Balancing Redox Reactions

2

Write oxidation and reduction half-reactions, including electrons

**Oxidation** electrons being lost, products

**Reduction** electrons being gained, reactants

Sn went from +2  $\rightarrow$  +4, that's a loss of...



Ce went from +4  $\rightarrow$  +3, that's a gain of...

# Balancing Redox Reactions

3

**Balance Atoms – already done this time!**

**Oxidation** electrons being lost, products

**Reduction** electrons being gained, reactants

Sn went from +2  $\rightarrow$  +4, that's a loss of...



Ce went from +4  $\rightarrow$  +3, that's a gain of...

# Balancing Redox Reactions

4

**Balance the charge by balancing the # of e<sup>-</sup>**

- Balance electrons between half-reactions.  
*Least Common Multiple*

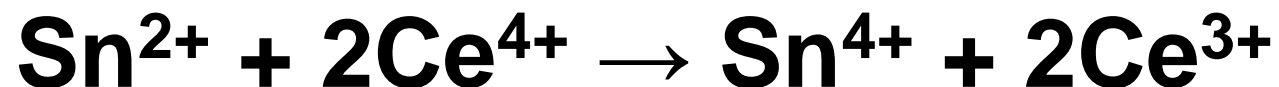
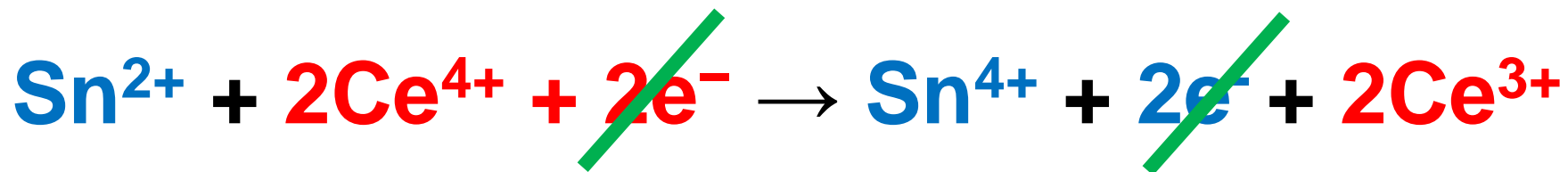


# Balancing Redox Reactions

5

**Add half reactions together, simplify, check**

- Make sure the atoms balance AND the charges



**CHECK:** Atoms balanced – yes!    Charges balanced – yes!



# Balancing Redox Reactions

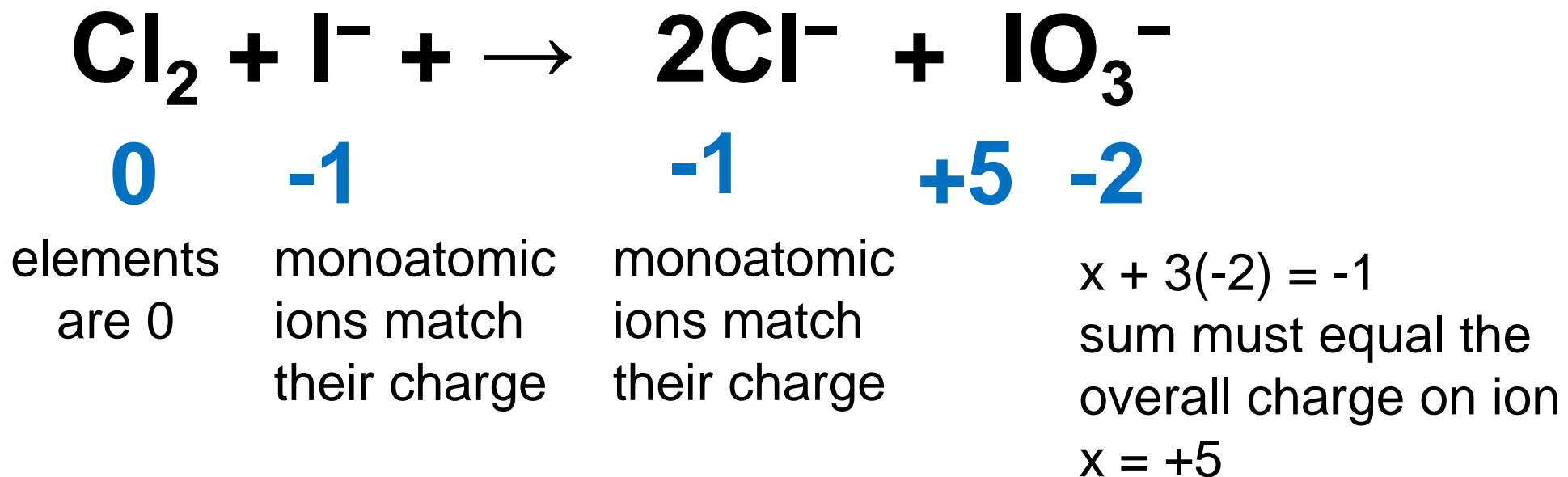
Yes, I know this isn't balanced!  
That is what we are working on!

1

## Assign oxidation states

Determine the element oxidized and the element reduced.

oxygen -2, not in one of the exceptions.

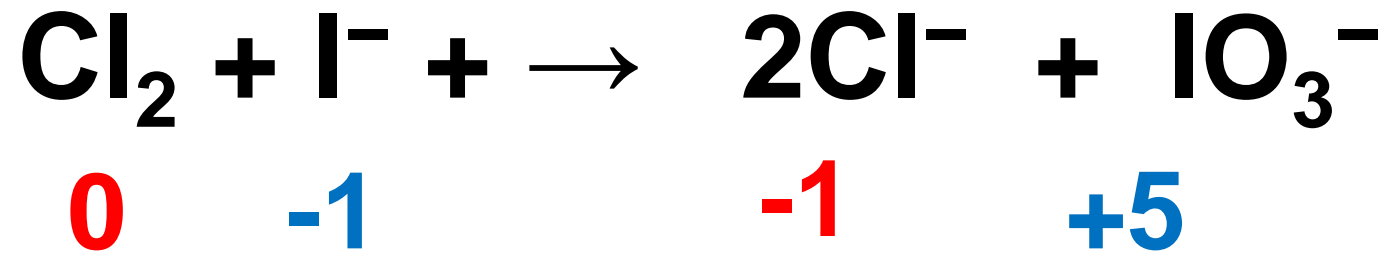


# Balancing Redox Reactions

1

## Assign oxidation states

Determine the element oxidized and the element reduced.



LEO goes GER

I<sup>-</sup> lost electrons = oxidized, -1 → +5

Cl gained electrons = reduced, 0 → -1

# Balancing Redox Reactions

2

Write oxidation and reduction half-reactions, including electrons

**Oxidation** electrons being lost, products

**Reduction** electrons being gained, reactants

Yes, I know these are not balanced! That is what we are still working on! It takes a while!

I went from -1  $\rightarrow$  +5, that's a loss of...



Each Cl went from 0  $\rightarrow$  -1, that's a gain of...

# Balancing Redox Reactions

3

## Balance the atoms in the half reactions

- First balance elements other than H and O.
- Add H<sub>2</sub>O where O is needed.
- Add H<sup>+</sup> where H is needed



# Balancing Redox Reactions

4

**Balance the charge by balancing the # of e<sup>-</sup>**

- Balance electrons between half-reactions.

*Least Common Multiple*

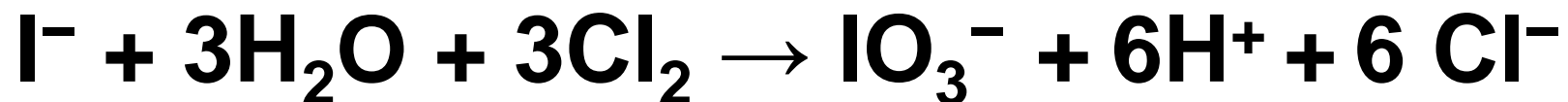
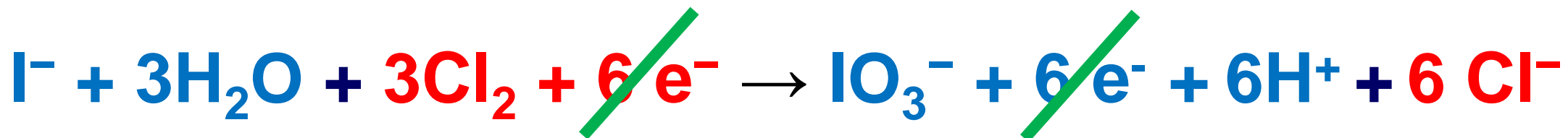


# Balancing Redox Reactions

5

**Add half reactions together, simplify, check**

- Make sure the atoms balance AND the charges



**CHECK:** Atoms balanced – yes!      Charges balanced – yes!

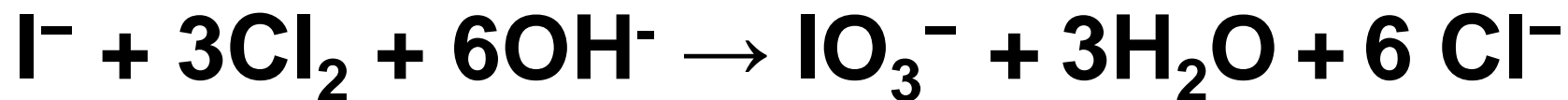
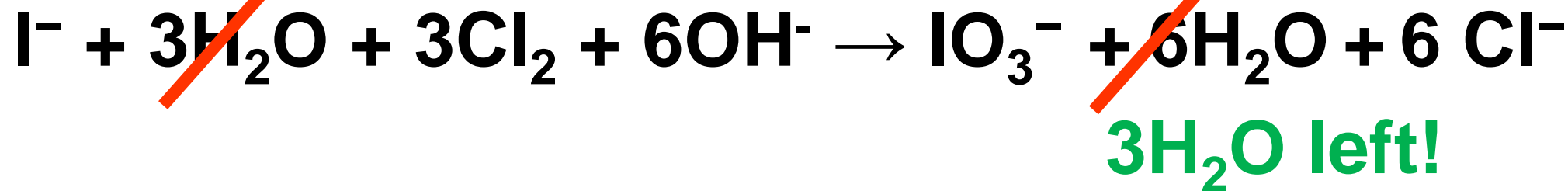
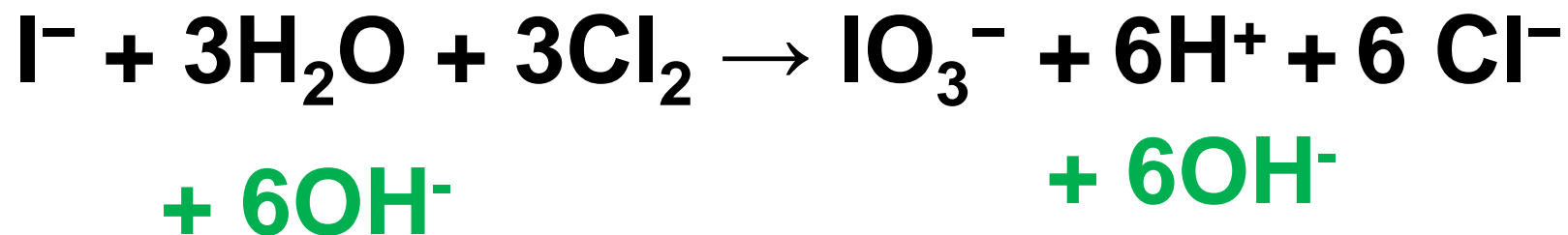


# Balancing Redox Reactions

6

WHAT IF IT IS IN BASIC SOLUTION!?!?!

- Then cancel out any waters that you can



**CHECK:** Atoms balanced – yes!    Charges balanced – yes!



# A Few More Electrochemistry Terms

## **Oxidizing agent**

The substance that is doing the oxidizing of the other substance. Whichever substance is reduced is the oxidizing agent.

## **Reducing agent**

The substance that is doing the reducing of the other substance. Whichever substance is oxidized is the reducing agent.

# YouTube Link to Presentation

[https://youtu.be/-y2xTX\\_BVsA](https://youtu.be/-y2xTX_BVsA)