

Name: Key  
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Chemistry 12  
 Electrochemistry Lesson #4  
 Balancing Half-Reactions

A half reaction must be balanced for mass and charge.

Memory-Aid for balancing Half reactions:

His name was: **MAJOR HYDROXIDE** or Major OH<sup>-</sup>.

1. Balance the MAJOR species first by adding co-efficients  
 ↳ other than oxygen + hydrogen
2. Balance the oxygen atoms second by adding H<sub>2</sub>O molecules
3. Balance the hydrogen atoms third by adding H<sup>+</sup>
4. Balance the charge last by adding electrons.  
 ↳ lowest possible charge on both sides!

Example 1.

Balance the half reaction  $\text{RuO}_2 \leftrightarrow \text{Ru}$ . The reaction occurs in **ACIDIC** solution

- Major "O" "H" " - "
- Step 1.  $\text{RuO}_2 \Rightarrow \text{Ru}$  (balanced) *major* always check to see if the "other" atoms are balanced.
  - Step 2.  $\text{RuO}_2 \Rightarrow \text{Ru} + 2\text{H}_2\text{O}$
  - Step 3.  $4\text{H}^+ + \text{RuO}_2 \Rightarrow \text{Ru} + 2\text{H}_2\text{O}$
  - Step 4.  $4\text{H}^+ + 4\text{e}^- + \text{RuO}_2 \Rightarrow \text{Ru} + 2\text{H}_2\text{O}$

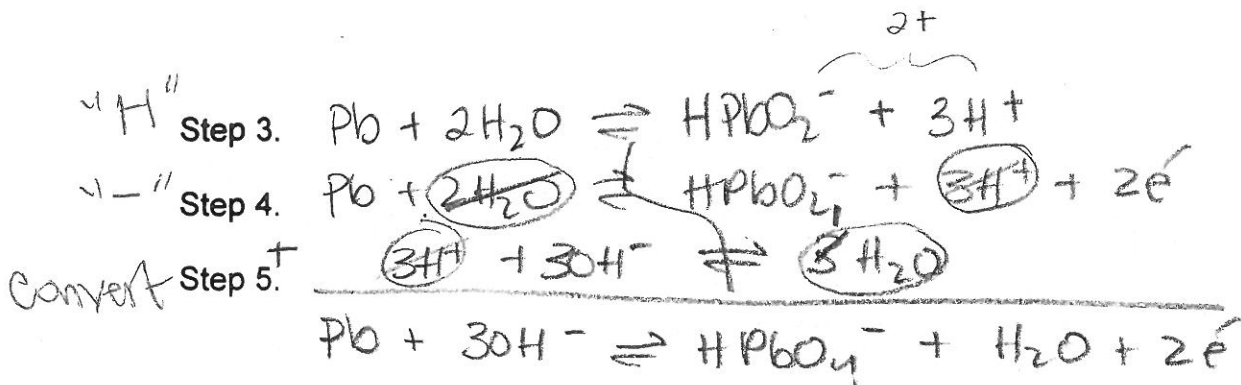
TO BALANCE HALF REACTIONS IN BASIC SOLUTION FOLLOW THE FOUR STEPS OF MAJOR HYDROXIDE AND THEN ADD THE DISSOCIATION OF

**WATER** ( $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$ ) SO THAT you convert  
H<sup>+</sup> to OH<sup>-</sup> (from ACID to base)

Example 2.

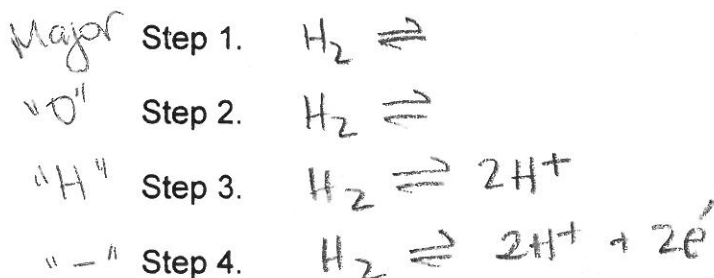
Balance the half reaction:  $\text{Pb} \leftrightarrow \text{HPbO}_2^-$  which occurs in **BASIC** solution.

- Major "O"
- Step 1.  $\text{Pb} \Rightarrow \text{HPbO}_2^-$  (balanced)
  - Step 2.  $\text{Pb} + 2\text{H}_2\text{O} \Rightarrow \text{HPbO}_2^-$



Example 3:

Balance the half reaction which occurs in **ACIDIC** solution



**CHANGES IN OXIDATION NUMBERS DURING HALF-REACTIONS**

In the half reaction:  $MnO_4^- \leftrightarrow MnO_2$

a. Calculate the Oxidation Numbers for Mn on both sides of the equation

$MnO_4^- = -1$	$MnO_2 = 0$
$(x) + 4(-2) = -1$	$(x) + 2(-2) = 0$
$x = 7$	$x = 4$

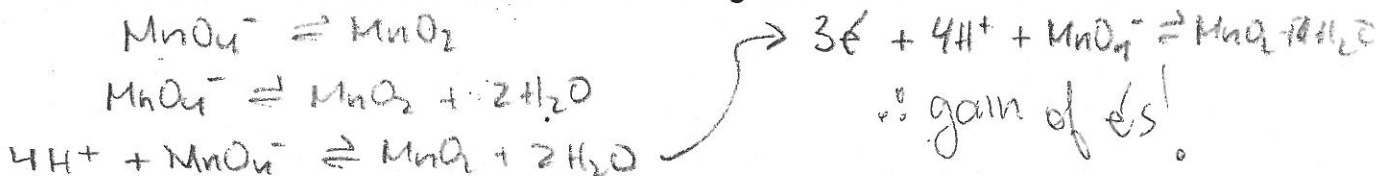
b. Calculate the change in oxidation number ( $\Delta ON$ ) and assign a value for the change

$\Delta ON = (4) - (7) = -3$

$\Delta ON = P - R$

$\Delta ON = -3$  ∴ reduction

c. Balance the half reaction in **ACIDIC** solution using **MAJOR HYDROXIDE**



d. Determine from your answer in "b" if this is a reduction or an oxidation half reaction.

B/C  $\Delta ON = -3$  ; reduction

Seatwork/homework: EXERCISES 19, 22-23 pg 203-204 and PLO's T1.