

Name: _____

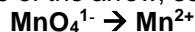
Period: _____

Seat#: _____

For Half-Reactions in Acidic Solution

Step One: Balance the atom being reduced/oxidized.

In our example, there is already one Mn on each side of the arrow, so this step is already done.



Step Two: Balance the oxygen's.

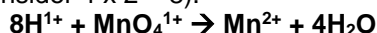
Do this by adding water molecules (as many as are needed) to the side needing oxygen. In our case, the left side has 4 oxygen's, while the right side has none, so:



Notice that, when the water is added, hydrogen's also come along. There is nothing that can be done about this; we'll take care of it in the next step. A common question is: "Why can't I just add 4 oxygen atoms to the right side?" Quick answer: don't do it, it's wrong. There are not free oxygen atoms floating around in our reaction vessel. So you can't add them!

Step Three: Balance the hydrogen's.

Do this by adding hydrogen ions (as many as are needed) to the side needing hydrogen. In our example, we need 8 (notice the water molecule's formula, then consider $4 \times 2 = 8$).

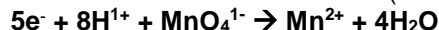


Step Four: Balance the total charge.

This will be done using electrons. It is ALWAYS the last step. First, a comment. You do not need to look at the oxidation number for each atom. You only need to look at the charge on the ion or molecule, then sum those up.

Left side of the reaction, total charge is +7. There are 8 H⁺, giving $8 \times +1 = +8$ and a minus one from the permanganate. (A very typical wrong answer for the left side is zero. Someone only counted the +1 and the -1, they forget the 8.)

Right side of the reaction, total charge is +2. The water molecule is neutral (zero charge) and the single Mn is +2.



Five electrons reduces the +7 to a +2 and the two sides are EQUAL in total charge.

The half-reaction is now correctly balanced!

For Half-Reactions in Basic Solution

Step One to Four: Balance the half-reaction AS IF it were in acid solution.

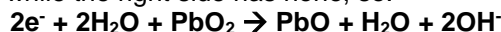
Just go about steps 1-4 business as usual! The half-reaction is actually in basic solution, but we are going to start out as if it were in acid solution and then fix it later to account for it being in a basic solution. Here are the 4 acid steps:

- 1) Balance the atom being reduced/oxidized.
- 2) Balance the oxygens.
- 3) Balance the hydrogens.
- 4) Balance the charge.

Let's use this half reaction for our example. Pretend we just finished steps 1-4: $2e^- + 2\text{H}^{1+} + \text{PbO}_2 \rightarrow \text{PbO} + \text{H}_2\text{O}$

Step Five: Convert all H⁺ to H₂O.

If you are in a basic solution you will not have H⁺ floating around. It is combined with the hydroxides that are present from the base! To convert the H⁺ into water add the same number of OH⁻ ions as you have H⁺ ions, BUT you have to add them to both sides to preserve the balancing! The side with the H⁺ will determine how many hydroxide to add. In our case, the left side has 2 hydrogen ions, while the right side has none, so:



Notice that, when the two hydroxide ions on the left were added, they immediately reacted with the hydrogen ion present. The reaction is: $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

Step Six: Remove any duplicate molecules or ions.

In our example, there are two water molecules on the left and one on the right. This means one water molecule may be removed from each side, giving:



The half-reaction is now correctly balanced!

By the way, notice the 2OH⁻. Be careful to read that as two hydroxide ions (2 OH⁻) and NOT twenty hydride ions (20 H⁻). People have been known to do that.

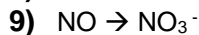
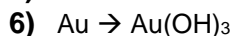
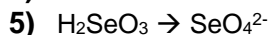
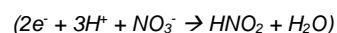
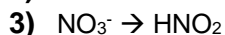
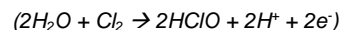
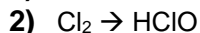
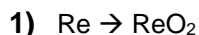
Dougherty Valley HS Chemistry

Redox – Balancing Redox Rxns in Acidic and Basic Solutions

Directions: In each of the following equations do the following on binder paper:

- Balance the reaction in the type of solution indicated.
- If you need/want some extra practice:
 - Indicate the element that has been oxidized and the one that has been reduced.
 - Label the oxidation state of each before and after the process.
 - Some answers have been provided in italics to the side.

Reaction done in Acidic Solution



Reaction done in Basic Solution

