The Half Reaction Method for Balancing Redox Reactions

This method assumes the reaction occurs in aqueous, acidic solution where H₂O and H⁺ are plentiful. If instead the reaction occurs in a basic solution, this method allows you to correct for this at the end (see step 8).

1. Assign oxidation numbers to all atoms in the reactants and products.
2. Remove spectator ions from the equation (if any occur), except for those containing only H and/or O.
3. Write two half-reactions, one for oxidation and one for reduction. If you have multiple oxidations, put them all together in one half reaction. Do the same if you have multiple reductions.
4. Balance each half-reaction as follows:
   a. Balance all elements other than oxygen and hydrogen.
   b. Balance oxygen by adding the appropriate number of water molecules (H₂O).
   c. Balance hydrogen by adding the appropriate number of hydrogen ions (H⁺).
   d. Balance the charge by adding the appropriate number of electrons (e⁻).
5. Multiply each half-reaction by a whole number so that the number of electrons lost in the oxidation half-reaction equals the number of electrons gained in the reduction half-reaction.
6. Add the two half reactions together, keeping all of the reactants together left of the yield arrow and all of the products together right of the yield arrow. The electrons will cancel out, so they are not shown in the final equation.
7. Cancel any species that appear on both sides of the equation. Check to make sure that the equation is balanced. If you removed spectator ions before you wrote the half-reactions, put them back in and balance by inspection.
8. If your reaction occurs in a basic solution, you must make the following correction: Remove any H⁺ from the equation by adding an equal number of OH⁻ ions to both sides of the equation. Remember that H⁺ and OH⁻ combine to form H₂O so replace the H⁺ and OH⁻ that occur on the same side with an equal number of H₂O. Now cancel any water molecules that appear on both sides of the equation.