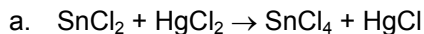


Unit 6: Redox Reactions and Electrochemistry

Practice Set 3: Balancing Redox Reactions

1. Balance the following redox reactions using the oxidation number method.

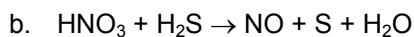


| | initial | | final | change | | Coefficient | | Total e ⁻ |
|----|---------|---|-------|--------|---|-------------|---|-------------------------|
| Sn | +2 | → | +4 | 2 | × | 1 | = | 2 |
| Hg | +2 | → | +1 | 1 | × | 2 | = | 2 |

Place a "1" in front of compounds containing Sn, and a "2" in front of compounds with Hg:

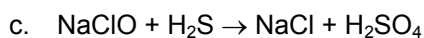
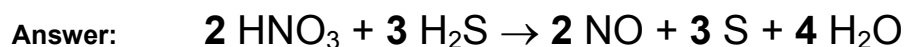


Double check to make sure all other atoms in the equation are balanced.



| | initial | | final | change | | Coefficient | | Total e ⁻ |
|---|---------|---|-------|--------|---|-------------|---|-------------------------|
| N | +5 | → | +2 | 3 | × | 2 | = | 6 |
| S | -2 | → | 0 | 2 | × | 3 | = | 6 |

Place a "2" in front of compounds containing N, and a "3" in front of compounds with S. Then balance for hydrogen and oxygen.



| | initial | | final | change | | Coefficient | | Total e ⁻ |
|----|---------|---|-------|--------|---|-------------|---|-------------------------|
| Cl | +1 | → | -1 | 2 | × | 4 | = | 8 |
| S | -2 | → | +6 | 8 | × | 1 | = | 8 |

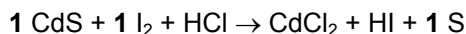




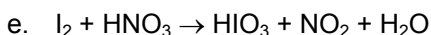
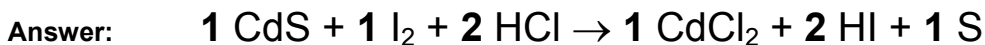
Because one of the atoms undergoing oxidation or reduction has a subscript (I_2) we will account for the number of atoms of each element when preparing our summary chart:

| | initial | | final | change | | no. atoms | | No. e^- | | Coefficient | | Total e^- |
|---|---------|---|-------|--------|---|----------------------|---|-----------|---|-------------|---|-------------|
| S | -2 | → | 0 | 2 | | | | 2 | × | 1 | = | 2 |
| I | 0 | → | -1 | 1 | × | 2 (in I_2) | = | 2 | × | 1 | = | 2 |

Place the balancing coefficients into the equation in front of the elements undergoing oxidation and reduction. For iodine, the 1 will go in front of the diatomic I_2 because these were the atoms being counted.



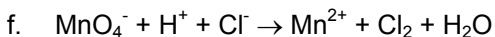
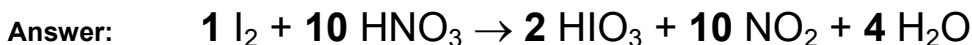
Then balance the rest of the equation. First balance for iodine atoms, then for Cd and H:



| | initial | | final | change | | no. atoms | | No. e^- | | Coefficient | | Total e^- |
|---|---------|---|-------|--------|---|----------------------|---|-----------|---|-------------|---|-------------|
| I | 0 | → | +5 | 5 | × | 2 (in I_2) | | 10 | × | 1 | = | 10 |
| N | +5 | → | +4 | 1 | | | = | 1 | × | 10 | = | 10 |

Because of the subscript with iodine (I_2), we multiply the change in oxidation number for iodine by 2 before we determine our coefficient multipliers.

The "1" for iodine is placed in front of the diatomic iodine; the "10" goes in front of both nitrogens. Then balance for iodine on both sides of the equation, then for all other atoms.



| | initial | | final | change | | no. atoms | | No. e^- | | Coefficient | | Total e^- |
|----|---------|---|-------|--------|---|-----------------------|---|-----------|---|-------------|---|-------------|
| Mn | +7 | → | +2 | 5 | | | | 5 | × | 2 | = | 10 |
| Cl | -1 | → | 0 | 1 | × | 2 (in Cl_2) | = | 2 | × | 5 | = | 10 |

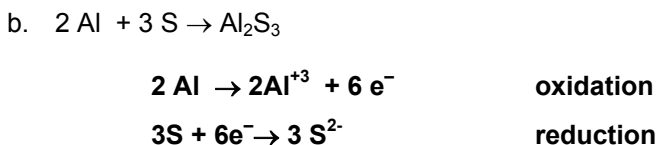
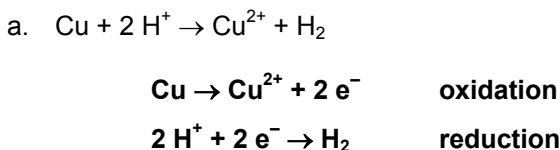
Because of the diatomic chlorine (Cl_2) we multiply the change in oxidation number for chlorine by 2. We then determine what coefficients are needed to balance for electrons. The "5" for chlorine will be placed in front of the diatomic chlorine. Then balance both sides of the equation for chlorine, then for all other atoms.



2. Balance the following half-reactions for both atoms and electrons by adding the appropriate number of electrons to the correct side of the equation. Also identify each as either an oxidation or reduction.



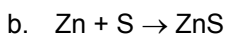
3. Break each equation into two half-reactions. Identify each half-reaction as oxidation or reduction.



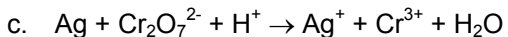
4. Balance the following equations using the half-reaction method.



| Step 1 | Step 2 | Step 3 |
|--|------------------------------|--|
| Write the two balanced half-reactions, removing any spectator ions: | Balance for electrons | Add the half-reactions, replacing any spectator ions that were removed and/or recombining compounds |
| $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$ | multiply by 2 | $2\text{Na} \rightarrow 2\text{Na}^+ + 2\text{e}^-$ |
| $\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$ | | $\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$ |
| | added together: | $2\text{Na} + \text{Br}_2 \rightarrow 2\text{Na}^+ + 2\text{Br}^-$ |
| | reform compound: | $2\text{Na} + \text{Br}_2 \rightarrow 2\text{NaBr}$ |



| Step 1 | Step 2 | Step 3 |
|--|------------------------------|--|
| Write the two balanced half-reactions, removing any spectator ions: | Balance for electrons | Add the half-reactions, replacing any spectator ions that were removed and/or recombining compounds |
| $\text{Zn} \rightarrow \text{Zn}^{2+} + 2 \text{e}^{-}$ | | $\text{Zn} \rightarrow \text{Zn}^{2+} + 2 \text{e}^{-}$ |
| $\text{S} + 2 \text{e}^{-} \rightarrow \text{S}^{2-}$ | | $\text{S} + 2 \text{e}^{-} \rightarrow \text{S}^{2-}$ |
| | added together: | $\text{Zn} + \text{S} \rightarrow \text{Zn}^{2+} + \text{S}^{2-}$ |
| | reform compound: | $\text{Zn} + \text{S} \rightarrow \text{ZnS}$ |



For each half-reaction, remember to balance for atoms first, then add electrons to balance for charge.

| Step 1 | Step 2 | Step 3 |
|---|--------------------------|---|
| Write the two balanced half-reactions, removing any spectator ions: | Balance electrons | Add the half-reactions, replacing any spectator ions that were removed and/or recombining compounds |
| $\text{Ag} \rightarrow \text{Ag}^{+} + \text{e}^{-}$ | $\times 6$ | $6 \text{Ag} \rightarrow 6 \text{Ag}^{+} + 6 \text{e}^{-}$ |
| $\text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^{+} + 6 \text{e}^{-} \rightarrow 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}$ | | $\text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^{+} + 6 \text{e}^{-} \rightarrow 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}$ |
| | added together: | $6\text{Ag} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} \rightarrow 6\text{Ag}^{+} + 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$ |