Net Ionic Equations and ReDox

Net ionic equations

- For equations where there are ions involved, the reactions can be simplified.
- Some ions react and are changed in charge or phase, and some ions remain the same throughout the reaction.
- The ions that remain unchanged are called “spectator” ions since they only “watch” the reaction occur around them.
- The spectator ions are removed from the equation so the equation only shows what changed.

Examples of net ionic equations

- Only two reactions will have net ionic equations, single replacement (later called redox) and double replacement.
- Single replacement:
  - $Cu_{(s)} + 2AgCl_{(aq)} \rightarrow CuCl_{2\,(aq)} + 2Ag_{(s)}$

  Written as ions it becomes:
  - $Cu_{(s)} + 2Ag^{+}_{(aq)} + 2\,Cl^{-}_{(aq)} \rightarrow Cu^{+2}_{(aq)} + 2Cl^{-}_{(aq)} + 2Ag_{(s)}$

  The chloride ions never changed from reactants to products so they are the spectator and can be removed leaving:
  - $Cu_{(s)} + 2Ag^{+}_{(aq)} + \rightarrow Cu^{+2}_{(aq)} + + 2Ag_{(s)}$
  - This is the net ionic equation.

Other example

- Double Replacement:
  - $2AgNO_{3\,(aq)} + CuCl_{2\,(aq)} \rightarrow 2AgCl_{(s)} + Cu(NO_3)_{2\,(aq)}$

  As ions it looks like this:

$2Ag^{+}_{(aq)} + 2NO_3^{-}{}_{(aq)} + Cu^{+2}_{(aq)} + 2Cl^{-}_{(aq)} \rightarrow 2AgCl_{(s)} + Cu^{+2}_{(aq)} + 2NO_3^{-}{}_{(aq)}$

The nitrate and copper ions are unchanged on both sides of the equation so they are spectators and can be removed leaving:

- $2Ag^{+}_{(aq)} + 2Cl^{-}_{(aq)} \rightarrow 2AgCl_{(s)}$
- This is the net ionic equation for the reaction.
- This is why if both products are soluble no reaction would occur because all ions would be spectators.

Redox reactions

- Redox stands for oxidation-reduction reactions.
- One substance is being reduced, which means it is gaining electrons, and therefore its charge is being reduced.
- The other substance is being oxidized, which means it is losing electrons and therefore its charge is being increased.
- Both of these have to happen at the same time, and the number of electrons lost or gained must be equal.
- This happens in single replacement reactions in this class.

Half reactions

- Using the earlier example of:
- $Cu_{(s)} + 2AgCl_{(aq)} \rightarrow CuCl_{2\,(aq)} + 2Ag_{(s)}$
- And the net ionic equation that was:
- $Cu_{(s)} + 2Ag^{+}_{(aq)} + \rightarrow Cu^{+2}_{(aq)} + + 2Ag_{(s)}$
- We can write our oxidation and reduction half-reactions as follows:
  - Oxidation: $Cu^{o} \rightarrow Cu^{+2} + 2e^{-}$
  - Reduction: $2Ag^{+} + 2e^{-} \rightarrow 2Ag^{o}$
  - Notice that the number of electrons released by the copper and the number of electrons gained by the 2 silver atoms are equal.

Electrochemical cells

- Each half-reaction has a certain electric potential value.
- By separating the two components of the reaction, and providing a path for the electrons to travel, you can create a current.
- This is how a battery works.
- The portion where reduction takes place is called the anode.
- The portion where oxidation takes place is called the cathode.