Twelve important thoughts that should be in your head.
Ask me about anything you don't "get".

1. Rust is Fe_2O_3 not FeO. You should know this because I said rust is IRON (III) OXIDE.
   That means that the iron cation is Fe^{+3} and oxygen is always just O^{-2} anion. Crisscross.
   FeO is iron (II) oxide.

2. Iron (III) oxide does not form FROM iron (III) (that is not real actually).
   It forms from just iron, or just $Fe_{(S)}$ NOT Fe_3

   The roman numeral applies to the particular cation that this metal is making at this time.
   Iron could be Fe^{+2} or Fe^{+3}, or the roman numeral II or roman numeral III ion.

   The metal iron is always not an ion, it's an atom of the element iron, no charge and always "monoatomic" which is different from the HONClBrIF twins, which are diatomic.

3. The HONClBrIF twins are always diatomic when pure, which means when they are hydrogen or are oxygen, etc. They can never be "just" F, or "just Cl. When pure they are diatomic.

   If these seven atoms are bonded to other atoms, they will be stable in different ways, depending upon the chemical formula of the compound.

   For example, H_2 is diatomic, pure hydrogen gas.
   HCl has only one H atom, H_2SO_4 has two H's, and H_3PO_4 has three H's.
   Octane C_8H_{18}, creates very stable bonded H atoms, but they're NOT twins inside compounds.

4. Electrolytes are hard, I am sorry. When I was a kid, electrolytes were solutions that had loose mobile ions, which means they HAD TO BE ionic compounds.

   NYS, because they hate you, adds this small but annoying "new detail", which is this:

   An electrolyte is an ionic compound that COULD be AQ, which means it would form loose mobile ions in water. Electrolytic solutions conduct electricity.

   These loose mobile ions conduct electricity, not the water.

   But (here it comes) solid ionic compounds THAT WOULD dissolve if placed in water are ALSO CALLED electrolytes, even though as a solid they could not conduct.

   Solid ionic compounds DO NOT have loose mobile ions, they are locked into a crystal formation and don't move much at all.

5. So, $NaCl_{(S)}$ does not conduct electricity, but
   it is called an electrolyte because $NaCl_{(AQ)}$ has loose mobile ions in solution that can conduct.

   $NaCl_{(AQ)}$ does conduct electricity, because the loose mobile ions in solution conduct electricity.

   $CaSO_4$ is an ionic compound. The solid does not conduct, just like $NaCl_{(S)}$

   $CaSO_4$ cannot dissolve in water, $CaSO_{4(AQ)}$ does not exist, table F shows it to be insoluble in water, so, it cannot form into loose mobile ions, it is NOT an electrolyte.

6. Finally, table sugar, sucrose, $C_{12}H_{22}O_{11}$ does dissolve into water.

   It's molecular, it does not have ANY IONS, so it can't conduct because it DOES NOT HAVE loose mobile ions, even though it does have LOOSE MOBILE MOLECULES.
   Loose mobile molecules, which are neutral, can't carry electricity.

7. Make sure you "get" that $NaCl_{(S)}$ $NaCl_{(AQ)}$ $CaSO_{4(S)}$ and $C_{12}H_{22}O_{11(S)}$
   These are electrolyte, electrolyte, not electrolyte, and not electrolyte, in order. Got that?

8. Aqueous means dissolve into water. Soluble means able to dissolve into solution. Many solutions are aqueous since in chemistry, most solutions are water based. Some things don't dissolve into water, they are not aqueous.
   Solutions DO NOT HAVE TO BE dissolved in water. Iodine is dissolved into rubbing alcohol, making it a tincture. That is not an aqueous solution. Oil based paints are not aqueous (latex paints are AQ).

9. Soluble means able to dissolve into solution, but AQ means able to dissolve ONLY into water solutions

10. In a single replacement reaction, there are 3 parts, the atoms, the cations and the anions.
Depending upon which atom is added to the solution, in the "fight" between itself and one of the ions already in—or making up the solution, it will "win" the fight on table J or it wont'.
Think now: if the atom wins the "fight", and it is a metal, it can only form cations.
It can ONLY replace the cation in solution, never the anion.

Think now: if the atom wins the "fight", and it is a NONMETAL, it can only form anions.
It can ONLY replace the ANION in solution, never the cation.

Single Replacement reactions can be cation replacement types like this…

$Mg_{(S)} + 2HCl_{(AQ)} \rightarrow MgCl_{2(AQ)} + H_{2(G)}$

The Mg atom can only form a cation. It's "higher" than the H on table J, so the Mg replaces the H in solution. The H is bumped out as a gas (and a HONClBrIF twin)

or, Single Replacement reactions can be anion replacement types like this…

$F_{2(G)} + 2NaBr_{(AQ)} \rightarrow 2NaF_{(AQ)} + Br_{2(L)}$

The F atom can only form an anion. It's "higher" than the Br on table J, so The F replaces the Br in solution. The Br is bumped out as a liquid (and a HONClBrIF twin).

11. Write out and balance ALL Double replacement reactions. If both products are AQ, it's a mixture.
You don't write out all the single replacement reactions, if table J says X no reaction, just write an X.
Do not write out the make believe products that do not and cannot form.

12. We add sulfuric acid to the water in the Hoffmann Apparatus because the pure water does not conduct electricity because it is literally DE-IONIZED, all the salts were removed. We could put a wide variety of salts into the water, like NaCl, or any on table F that are AQ in water, but the salts leave a slight residue when the water evaporates, and it's a good time to introduce to my students table K, the acids.

Acids are weird because they form from H atoms and strangely, when put into water they "unbond" into ions. Molecular compounds like HCl or H_2SO_4 bond together by sharing electrons, in covalent bonds. That's normal.
Put them into water, and the H all of a sudden starts acting like a group 1 metal, forming the H^{+1} cation. That is decidedly NOT normal!