

V) Predicting Spontaneity

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How might you know whether a redox reaction is spontaneous (happens on its own) or not?

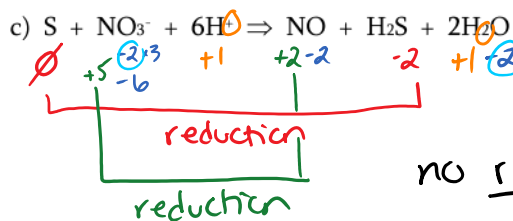
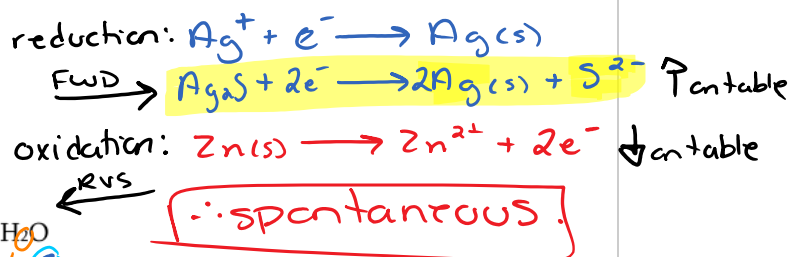
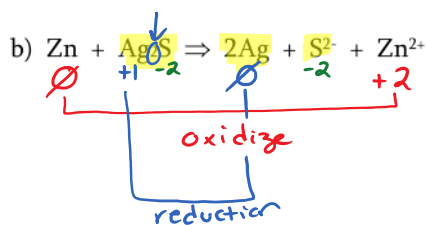
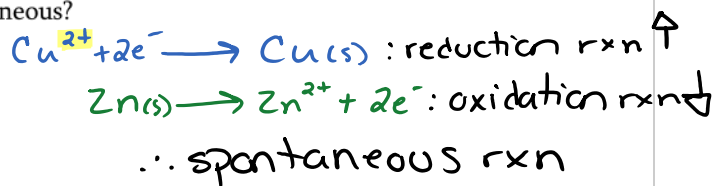
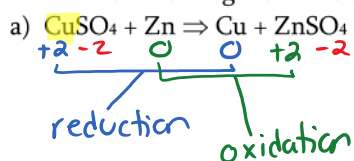
Remember, in order for a redox reaction to occur, there **must be an oxidation AND a reduction occurring simultaneously**.

* The first thing to do is figure out what substance is reducing and what substance is oxidizing. Then jot down the half-reactions for each.

- * 1. If the reduction half-reaction is higher on the table than the oxidation half-reaction, the reaction is SPONTANEOUS. *
2. If the reduction half-reaction is lower on the table than the oxidation half-reaction (or, if it's on the same line), the reaction is NOT spontaneous.
3. No redox reaction can occur if you have substances that only reduce or substances that only oxidize (both on the same side of the table).

Practice Questions:

1. Are the following reactions spontaneous?



no redox rxn possible
 ∴ no oxidation

$\text{metal cation} + e^- \leftarrow \text{metal(s)}$ Right side
 is reducing $\text{I}_2 + 2e^- \rightarrow 2\text{I}^-$
 Table: 2) Which metal can be oxidized by I_2 but not by an acidic solution of SO_4^{2-} ?
 $\text{I}_2 + 2e^- \rightarrow 2\text{I}^-$ (spontaneous reduction) reducing in acid.
 $\text{SO}_4^{2-} + 4\text{H}^+ + 2e^- \rightarrow \text{H}_2\text{SO}_3 + \text{H}_2\text{O}$
 metal(oxidized) \Rightarrow Cu(s) could be either oxidizing to Cu^+ or Cu^{2+}
 $\text{SO}_4^{2-} + 4\text{H}^+ \dots$

3) Which metal can act as a reducing agent for Sn^{2+} but not for Co^{2+} ?
 Right: oxidation run
 $\therefore \text{Ni(s)}$ is lower than Sn^{2+} , but \uparrow than Co^{2+}
 In order for Sn^{2+} to reduce (must be higher)
 if it is not reduced, Co^{2+} must be lower than the metal.

Assignment 3

- 1) Which of the following reactions occur spontaneously?
 - a) $\text{Cr}^{3+} + \text{Ba} \Rightarrow \text{Ba}^{2+} + \text{Cr}$
 - b) $\text{I}_2 + 2\text{Cl}^- \Rightarrow \text{Cl}_2 + 2\text{I}^-$
 - c) $2\text{NO}_3^- + 8\text{H}^+ + 3\text{Ni} \Rightarrow 2\text{NO} + 4\text{H}_2\text{O} + 3\text{Ni}^{2+}$
 - d) $2\text{Al}^{3+} + 3\text{Ca}^{2+} \Rightarrow 2\text{Al} + 3\text{Ca}$
- 2) What products are formed when NO_3^- in acidic solution is reduced by Fe(s) ?
- 3) Read Hebden p.195-199 and do p.199 #8ace, 9ac, 10ac, 11aeg, 12