Finding Electrochemical Potential (Voltage)

Eo is the variable for “Electrochemical Potential”.

Technically “voltage” is the *unit*, not the variable. Annoying, right?

1. Break the overall reaction into half-reactions.
   1. A half-reaction will have the same element on both sides, but with different charges (oxidation numbers)
   2. To make it a completed half-reaction, you need to add electrons to the positive-er side (to balance the charge). (The electrons have already been added in the reactions on your table of Standard Reduction Potentials.)

Whole (complete) redox reaction:

Zn + Cu2+ 🡪 Zn2+ + Cu

Oxidation half-reaction:

Zn 🡪 Zn2+ + 2e-

Reduction half-reaction:

Cu2+ 2e- 🡪 Cu

1. Find the half-reactions on your table of Standard Reduction Potentials
   1. The reduction should look exactly the same on the chart. Write down its voltage.

Reduction half-reaction:

Cu2+ 2e- 🡪 Cu 0.34 V

* 1. The oxidation will have the same things in it, but will be facing the wrong direction. (Because the chart is REDUCTION potential, and the oxidation half-reaction is… oxidation.)

*My oxidation half-reaction:*

Zn 🡪 Zn2+ + 2e-

The zinc half-reaction I found on the chart:

Zn2+ + 2e- 🡪 Zn -0.76 V

* + 1. Since the half-reaction on the chart is the OPPOSITE of the one I want, it also has the OPPOSITE voltage of what I want.
    2. I change the sign. (Make it opposite of whatever sign is on the chart.)
    3. So if the *reduction half-reaction* was worth -0.76 V, the *oxidation half-reaction* is worth + 0.76 V.

*My oxidation half-reaction:*

Zn 🡪 Zn2+ + 2e- +0.76 V

* 1. Add the voltages together.

0.34 V + 0.76 V = 1.10 V

Eoreduction + Eooxidation = Eooverall

* + 1. Don’t do anything else. Just add.
    2. Need to multiply the reaction to fix coefficients? Okay. But don’t multiply the voltage. Just add.
    3. Want to find the LCM of the # of electrons in each half-reaction so they’ll cancel out? Okay. But still don’t multiply the voltage. Just add.
    4. Never multiply voltage, mmmkay?

1. What about the “spontaneous” thing?
   1. If the overall voltage is a positive number, it’s a spontaneous (galvanic cell) reaction.
   2. If the overall voltage is a negative number, it’s a non-spontaneous (electrolytic cell) reaction.