

This is ACA # 31. It is OK to use your textbook, but if you can answers the questions without it that is OK too.

I recommend you print out this page and bring it to class. [Click here](#) to show a set of five ACA31 student responses, randomly selected from all of the student responses thus far, in a new window.

John , here are [your responses](#) to the ACA and the [Expert's response](#).

For this ACA we will use this short version of the [Standard Reduction Potential Table](#). You might want to print the table out before beginning the ACA.

Answer the following questions using the SRP Table.

1. Identify the species (name and/or formula) from the table above that is the most likely to be oxidized.

Li(s) 67%

27% Li<sup>+</sup>  
6% F<sub>2</sub>

Lithium, Li is the most likely species to be oxidized in this table.

2. Identify the species (name and/or formula) from the table above that is the most likely to be reduced.

F<sub>2</sub>(g) 73%

6% F<sup>-</sup>  
6% F

Fluorine, F<sub>2</sub> is the most likely species to be reduced in this table.

We can use the Standard Reduction Potential Table to calculate the E° for a reaction. For example, we measured E° for a reaction  $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+}(\text{aq})$  in a BCE this week. We can calculate the E° the following way;

i) separate the reaction into its corresponding half-reactions;

ii) The oxidation half-reaction occurs at the anode and the reduction half-reaction occurs at the cathode:

iii) look up the E° for the half-reaction in the Standard Reduction Potential Table;

iv) calculate  $E^\circ$  using the relationship  $E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$

So for the reaction  $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+}(\text{aq})$

the half-reactions are

$\text{Zn(s)} \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{e}^-$  (oxidation at the anode)

$2\text{e}^- + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)}$  (reduction at the cathode)

From the SRP Table the  $E^\circ$  for the half-reactions are

Half-reaction	$E^\circ$ (volts)
$2\text{e}^- + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)}$	+0.34
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn(s)}$	-0.76

We determine  $E^\circ$  for the reaction by using the equation  $E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = +0.34 \text{ v} - (-0.76 \text{ v}) = +1.10 \text{ v}$

So  $E^\circ = +1.10 \text{ v}$

3. Using the Table of Standard Reduction Potentials determine whether each of the following reactions has a positive  $E^\circ$  (standard cell potential) or a negative  $E^\circ$ .

a)  $2\text{Cl}^-(\text{aq}) + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + \text{Cu(s)}$  :  $E^\circ = -1.05 \text{ volts}$

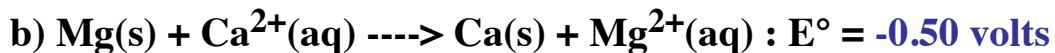
Half-reaction	$E^\circ$ (volts)
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^-(\text{aq})$	+1.36
$2\text{e}^- + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)}$	+0.34

48%  
6% 1.36v  $\text{Cl}_2$  only  
18% 1.70v adding both.  
12% ?  
12% 1.02v

$\text{Cl}^-(\text{aq})$  is being oxidized and  $\text{Cu}^{2+}(\text{aq})$  is being reduced, then

$$E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = +0.34 \text{ v} - (+1.36 \text{ v}) = -1.02 \text{ v}$$

A negative ( $E^\circ = -1.02 \text{ V}$ ) cell potential for this reaction means it is not thermodynamically favored, it will not occur. So chlorine ion with an  $E^\circ = -1.36 \text{ volts}$  is NOT very reactive.



53%

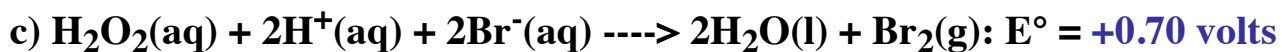
Half-reaction	$E^\circ$ (volts)
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg(s)}$	-2.37
$2\text{e}^- + \text{Ca}^{2+}(\text{aq}) \rightarrow \text{Ca(s)}$	-2.87

18% +0.50v  
60% -5.13v  
18% ?

$\text{Mg(s)}$  is being oxidized and  $\text{Ca}^{2+}(\text{aq})$  is being reduced, then

$$E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = -2.87 \text{ v} - (-2.37 \text{ v}) = -0.50 \text{ v}$$

negative ( $E^\circ = -0.50 \text{ V}$ ) this reaction is not thermodynamically favored, it will not occur.



66%

Half-reaction	$E^\circ$ (volts)
$\text{Br}_2(\text{l}) + 2\text{e}^- \rightarrow 2\text{Br}^-(\text{aq})$	+1.07
$2\text{e}^- + \text{H}_2\text{O}_2(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow 2\text{H}_2\text{O(l)}$	+1.77

12% +2.84v  
18% ?

$\text{Br}^-(\text{aq})$  is being oxidized and  $\text{H}_2\text{O}_2(\text{aq})$  in  $\text{H}^+(\text{aq})$  is being reduced, then

$$E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = +1.77 \text{ v} - (+1.07 \text{ v}) = +0.70 \text{ v}$$

positive ( $E^\circ = +0.70 \text{ V}$ ) this reaction is thermodynamically favored, it will occur.

4. Will Pb(s) reduce Ag<sup>+</sup>(aq)? Explain.

Yes

60%

Calc. E°

Yes.

The E° for the reaction is +0.93 volts

Half-reaction	E° (volts)
Pb <sup>2+</sup> (aq) + 2e <sup>-</sup> ----> Pb(s)	-0.13
2e <sup>-</sup> + 2Ag <sup>+</sup> (aq) ----> 2Ag(s)	+0.80

2Ag<sup>+</sup> is +1.60V

Pb is lower on the SRP  
Ag is higher " " "

For lead to reduce silver(I) ion, then lead must be oxidized. Lead metal will reduce silver(I) ion, the reaction Pb(s) + 2Ag<sup>+</sup>(aq) ----> Pb<sup>2+</sup>(aq) + 2Ag(s) has a positive E°.

$$E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = +0.80 \text{ v} - (-0.13 \text{ v}) = +0.93 \text{ v}$$

5. Will 1 M HNO<sub>3</sub> oxidized Cu(s)? Explain.

Y

67%

Calculate E°

It is oxidized  
E° for H is 0

Yes.

The E° for the reaction is +0.62 volts

Half-reaction	E° (volts)
Cu <sup>2+</sup> (aq) + 2e <sup>-</sup> ----> Cu(s)	+0.34
3e <sup>-</sup> + NO <sub>3</sub> <sup>-</sup> (aq) + 4H <sup>+</sup> (aq) ----> NO(g) + 2H <sub>2</sub> O(l)	+0.96

For HNO<sub>3</sub> to oxidized Cu(s) the HNO<sub>3</sub> must be reduced. The reaction 3Cu(s) + 2NO<sub>3</sub><sup>-</sup>(aq) + 8H<sup>+</sup>(aq) ----> 3Cu<sup>2+</sup>(aq) + 2NO(g) + 4H<sub>2</sub>O(l) has a positive E° = +0.62 volts.

$$E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = +0.96 \text{ v} - (+0.34 \text{ v}) = +0.62 \text{ v}$$

6. Will 1 M HCl oxidized Cu(s)? Explain.

No

No

The cell potential is -0.34 v

The  $E^\circ$  for  $\text{Cu(s)} + 2\text{H}^+(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{H}_2(\text{g})$  is negative, so the reaction will not occur.

7. Identify a reagent that will oxidize Zn(s) but will not oxidize Pb(s).

$\text{Sn}^{2+}$  or  $\text{Ni}^{2+}$

Either  $\text{Sn}^{2+}(\text{aq})$ ,  $\text{Ni}^{2+}(\text{aq})$ ,  $\text{Co}^{2+}(\text{aq})$  or  $\text{Fe}^{2+}(\text{aq})$ , because the  $E^\circ$  for the reaction of any of these ions will produce a positive  $E^\circ$  for Zn(s) and a negative  $E^\circ$  for Pb(s).

8. Predict the products of the following reaction;  $\text{Pb(s)} + \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow$



$\text{Pb}^{2+}(\text{aq})$ ,  $\text{Cr}^{3+}(\text{aq})$  and  $\text{H}_2\text{O(l)}$

9. Is there anything about the questions that you feel you do not understand? List your concerns/questions.

nothing

10. If there is one question you would like to have answered in lecture, what would that question be?

nothing

Does a greater SRP mean  
it can or cannot oxidize  
a substance?

Do mol or molarity dictate  
how well it oxidizes/reduce

I feel like there is a lot  
we haven't covered!!

recognize ox/red Balancing redox rxn

half-rxn has a  
metal / does not  
have a metal

many, many  
different  
ways to ask  
this!!

[ Describing/explaining an  
electrochemical cell

[ Calc.  $E^\circ = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$