This is ACA # 33. 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 ACA33 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.

Answer the following questions using the SRP Table.

1a. Calculate the standard cell potential for the reaction

$$3Mg(s) + 2Al^{3+}(aq) \text{ ----> } 3Mg^{2+}(aq) + 2Al(s)$$

E^o = +0.701 volts 94%

From the SRP Table

Reduction half-reaction	E^o (volts)
$Al^{3+}(aq) + 3e^-$ ----> $Al(s)$	-1.66
$Mg^{2+}(aq) + 2e^-$ ----> $Mg(aq)$	-2.36

$E^o_{cell} = E^o_{cathode} - E^o_{anode} = -1.66 - (-2.36) = +0.70$ volts

b) What is the value of K for the reaction in Question 1a.

($\Delta G^o = -nFE^o$ where F = 96,500 J volt^{-1}

and $\Delta G^o = -RT \ln K$ where R = 8.314 J mol^{-1} K^{-1}

so $E^o = RT/nF \ln K$ or $E^o = 0.0257/n \ln K$

n is the number of electrons transferred in the balanced chemical equation)

K = 1.19e71 81%

$E^o = 0.0257/n \ln K$

+0.70 volts = (0.0257/6) ln K

ln K = +0.70 volts (6/0.0257) = 163.42

$e^{\ln K} = e^{163.42}$

$K = 9.42 \times 10^{70}$

c) For the E° calculated in 1a what are the standard concentrations for $[Al^{3+}]$ and $[Mg^{2+}]$?

$[Al^{3+}] = [Mg^{2+}] =$ 1 **M** 88%

$[Al^{3+}] = [Mg^{2+}] = 1.0$ M

2. Given that $E_{cell} = E^o_{cell} - (0.0257/n) \ln Q$
complete the missing cells in the table below

Experiment	$[Al^{3+}]$	$[Mg^{2+}]$	E^o_{cell} (volts)	E_{cell} (volts)	Q ($[Mg^{2+}]^3/([Al^{3+}]^2)$)
1	1.0 M	1.0 M	+0.70	+0.70	1 Q = 1 94%
2	0.5 M	1.75 M	+0.70	0.69 E_{cell}= +0.69 volts 81%	21.4
3	0.050	3.04 M	+0.70	+0.66	1.13e4

	M	$[Mg^{2+}]$ = 2.425 M			Q = 5.70×10^3
4	0.0010 M	2.499 M	+0.70	+0.63	1.56×10^7
5	1.0×10^{-10}	2.500 M	+0.70	+0.50	1.56×10^{21}

Experiment #1: $Q = [Mg^{2+}]^3/([Al^{3+}]^2 = [1]^3/([1]^2 = 1$

Experiment #2:

$E_{cell} = E^o{}_{cell} - 0.0257/n \ln Q$

$E_{cell} = E^o{}_{cell} - 0.0257/n \ln [Mg^{2+}]^3/([Al^{3+}]^2$

$E_{cell} = +0.70 \text{ volts} - 0.0257/6 \ln [0.50]^3/([1.75]^2$

$E_{cell} = +0.70 \text{ volts} - 0.0257/6 \ln [0.50]^3/([1.75]^2$

$E_{cell} = +0.70 \text{ volts} - 0.0257/6 \ln 21.4 = +0.70 \text{ volts} - 0.013 \text{ volts} = +0.69 \text{ volts}$

Experiment #3:

	3Mg(s)	+ $2Al^{3+}$(aq)	---->	$3Mg^{2+}$(aq)	+ 2Al(s)
Initial		1.0 M		1.0 M	
Change		-0.95 = -2(0.475)		+1.425 = 3(0.475)	
Final		0.05		2.425	

NOTE: We must set up an ICE table to determine the final $[Mg^{2+}]$ when the final $[Al^{3+}]$ is 0.050 M. The final $[Mg^{2+}]$ = 2.425 M

$Q = [Mg^{2+}]^3/([Al^{3+}]^2 = [2.425]^3/([0.05]^2 = 5.70 \times 10^3$

3a. What happens to the value of Q as the reaction proceeds from left to right?

Q increases 94%

Looking at the table for the set of five experiments, as we proceed from Exp #1 to Exp #5 the reaction is proceeding from left to right. As the reaction proceeds from left to right Q is getting larger.

b. What happens to the cell potential as the reaction proceeds from left to right?

E° decreases 69% E_{cell} & $E°_{cell}$

Looking at the table for the set of five experiments, as we proceed from Exp #1 to Exp #5 the reaction is proceeding from left to right. As the reaction proceeds from left to right E_{cell} is getting smaller

c. What value is E_{cell} approaching as the reaction proceeds from left to right?

0 volts 75%

E_{cell} is getting smaller and smaller as the reaction proceeds from left to right, so E_{cell} is approaching 0.

d. What value is Q approaching as the reaction proceeds from left to right?

K (1.19 e71

Q is getting larger and larger as the reaction proceeds from left to right, so Q is approaching K, the equilibrium constant for the reaction.

4a. When Q is greater than 1 what is the sign of ln Q?

positive (positive or negative) 75%

If Q is greater than 1 than the natural log of a number greater than 1 is positive.

b. When Q is less than 1 what is the sign of ln Q?

negative **(positive or negative)** 75%

If Q is less than 1 than the natural log of a number less than 1 is negative.

c. When Q is greater than 1 is E_{cell} greater than, less than or equal to $E^o{}_{cell}$?

less than 94%

If Q is greater than 1 than the natural log of a number greater than 1 is positive and as show in the equation,

$$E_{cell} = E^o{}_{cell} - 0.0257/n \ln Q$$

E_{cell} will be smaller compared to $E^o{}_{cell}$.

d. When Q is less than 1 is E_{cell} greater than, less than or equal to $E^o{}_{cell}$?

greater than 100%

If Q is less than 1 than the natural log of a number less than 1 is negative and as show in the equation,

$$E_{cell} = E^o{}_{cell} - 0.0257/n \ln Q$$

E_{cell} will be larger compared to $E^o{}_{cell}$.

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

nothing

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

nothing