**This is ACA # 30. 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 ACA30 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.**

**1. In Section 4.6 in Chapter 4 on page 200 are a set of rules for assigning oxidation states/numbers. An expanded set of rules are;**

**A. Any atom in a pure element or molecule such as $O_2$, $H_2$, $N_2$, $P_4$, or Zn has an oxidation number of zero.**

**B. For ions consisting of a single atom, the oxidation number is equal to the charge on the ion; $Cl^-$ has an oxidation number of -1 and $Zn^{2+}$ has an oxidation number of +2.**

**C. Fluorine is always -1.**

**D. Chlorine, bromine and iodine are -1 except in compounds with fluorine or oxygen (both of which have higher electronegativities).**

**E. The oxidation number of hydrogen is +1 except when bound to a metal (hydrogen is more electronegative).**

**F. The oxidation number of oxygen is usually -2 (except in $H_2O_2$ when oxygen has an oxidation number of -1)..**

**G. The sum of the oxidation numbers in a neutral compound must be zero.**

**H. The sum of the oxidation numbers for a polyatomic ion must equal the ion charge.**

**Assign the oxidation numbers to the following elements in the following compounds:**

**a) $Al_2O_3$**

| Element | Oxidation number |
|---|---|

| | | |
|---|---|---|
| Al | 3+ | 79% |
| | +3 | |
| O | 2- | 86% |
| | -2 | |

+6 14%
0 7%

-6 7%
4 7%

**b) $PO_4^{-3}$**

| Element | Oxidation number | |
|---|---|---|
| P | 5+ | 86% |
| | +5 | |
| O | 2- | 57% |
| | -2 | |

3 7%
0 7%

-8 21%
2 7%
4 7%

-1 7%

**c) $Mg(NO_3)_2$**

| Element | Oxidation number | |
|---|---|---|
| Mg | 2+ | 86% |
| | +2 | |
| N | 5+ | 79% |
| | +5 | |
| O | 2- | 57% |
| | -2 | |

**d) $NH_4^+$**

| Element | Oxidation number | |
|---|---|---|
| N | 3- | 79% |
| | -3 | |
| H | 1+ | 86% |
| | +1 | |

**e) $Na_2SO_4$**

| Element | Oxidation number | |
|---|---|---|
| Na | 1+ | 65% |
| | +1 | |
| O | 2- | 64% |
| | -2 | |
| S | 6+ | 57% |
| | +6 | |

**2. The overall reaction**

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

**can be broken into two half-reactions that reflect which element lost electrons and which element gained electrons. If we divide the overall reaction into two half-reactions based on the elements we would have**

**first half-reaction : $Zn(s) \rightarrow Zn^{2+}(aq)$**

**second half-reaction : $Cu^{2+}(aq)$ ----> Cu(s)**

**Notice that the number of elements is balanced for each of these half-reactions, but the charge is not. For the first half-reaction the charge is 0 (zero) on the reactants side and +2 on the products side. To balance the charge in the half-reaction we must add two electrons ($2e^-$ to the right side of the half-reaction). When we look at the second half-reaction it is clear two electrons must be added to the left side of the half-reaction.**

**first half-reaction : Zn(s) ---> $Zn^{2+}(aq) + 2e^-$**

**second half-reaction : $2e^- + Cu^{2+}(aq)$ ----> Cu(s)**

**Check out that when we add the first and second half-reactions together the electrons cancel and the overall reaction is the same as we had when we started. Being able to recognize the half-reactions given the overall reaction is important in Chapter 19. Lets try a few examples; NOTE: a is easy, b is a little more difficult, c is disgusting!**

**a) $Mg(s) + 2H^+(aq)$ ---> $Mg^{2+}(aq) + H_2(g)$**

**first half-reaction (magnesium) Mg(s) --> Mg^2+(aq) + 2e^-** 93%

**$Mg(s)$ ----> $Mg^{2+}(aq) + 2e^-$**

**second half-reaction 2e^- + 2H^+ --> H2(g)** 72 $2H^+ \rightarrow H_2$ 21%

**$2e^- + 2H^+(aq)$ ----> $H_2(g)$**

**b) $3H_2S + 2HNO_3$ ---> $3S + 2NO + 4H_2O$**

**first half-reaction (sulfur) 3H2S(g) --> 3S(s) + 6H^+(aq) + 6e^-** 36%

**$3H_2S$ ---->$3S + 6H^+ + 6e^-$**

**second half-reaction 6e^- + 6H^+(aq) + 2HNO3(aq) --> 2NO(g) + 4H2O(l)** 36%

21% $H_2$

**$6e^- + 2HNO_3 + 6H^+$ ----> $2NO + 4H_2O$**

**c) $K_2S_5(s) + 2HCl(g)$ ---> $H_2S(g) + 4S(s) + 2KCl(s)$**

**first half-reaction** 8e^- + 8H^+(aq) + K2S5(s) + 2HCl(g) --> 5H2S(g) + 2KCl(s) 21%

$K_2S_5(s) + 2HCl(g) \text{ ----> } 5S(s) + 2KCl(s) + 2H^+ + 2e^-$

**second half-reaction** K2S5(s) + 2HCl(g) --> 5S(s) + 2KCl(s) + 2H^+(aq) + 2e^-

$8e^- + 8H^+ + K_2S_5(s) + 2HCl(g) \text{ ----> } 5H_2S(g) + 2KCl(s)$

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

**nothing**

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

**nothing**