CHM 1046 - JOENS WORKSHEET #11 Due date: M,W,F Wednesday, November 9
T,R Thursday, November 10

* While I prefer you turn in a hard copy of the worksheet, I will accept scanned copies sent to my email address, joensj@fiu.edu

Section: (circle one) M,W,F Tu,Tr

For problems involving calculations you must show your work for credit. Unless otherwise stated, you may assume T = 25.0 °C.

1) For each of the following molecules or ions give the oxidation numbers for all elements that are present.

a) H_3PO_4 H ___+1_____ P ___+5_____ O ___-2_____

b) NH_4^+ N ___-3_____ H __+1_____

c) SF_6 S ___+6_____ F ___-1_____

d) $Pb(OH)_4$ Pb __+4_____ O ___-2_____ H ___+1_____

e) HCO_3^- H ___+1_____ C ___+4_____ O ___-2_____

f) Cu^+ Cu __+1_____

g) $Ag(NH_3)_2^+$ Ag __+1_____ N ___-3_____ H ___+1_____

2) Consider the following reaction

$$\overset{+1\ +4\ -2}{H_2SO_3}(aq) + \overset{0}{Br_2}(aq) + \overset{+1\ -2}{H_2O}(\ell) \rightarrow \overset{+1}{4\ H^+}(aq) + \overset{-1}{2\ Br^-}(aq) + \overset{+6\ -2}{SO_4^{2-}}(aq)$$

a) Give the element and the initial and final oxidation numbers for the oxidation process and the reduction process taking place in the above reaction.

oxidation S +4 to +6

reduction Br 0 to -1

b) Which species in the above reaction is the oxidizing agent, and which species is the reducing agent?

oxidizing agent ____Br_2_____ reducing agent ___H_2SO_3_____

3) Balance the following unbalanced oxidation-reduction reaction for acid conditions

$\overset{+2}{Fe^{2+}}(aq) + \overset{+5\ -2}{NO_3^-}(aq) \rightarrow \overset{+3}{Fe^{3+}}(aq) + \overset{+2\ -2}{NO}(g)$

oxidation $(Fe^{2+} \rightarrow Fe^{3+} + e^-) \times 3$

reduction $NO_3^- + 3\ e^- + 4\ H^+ \rightarrow NO + 2\ H_2O$

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net $3\ Fe^{2+}(aq) + NO_3^-(aq) + 4\ H^+(aq) \rightarrow 3\ Fe^{3+}(aq) + NO(g) + 2\ H_2O(\ell)$

4) Balance the following unbalanced oxidation-reduction reaction for acid conditions

$\overset{+5\ -2}{BiO_3^-}(aq) + \overset{+3}{Cr^{3+}}(aq) \rightarrow \overset{+3}{Bi^{3+}}(aq) + \overset{+6\ -2}{Cr_2O_7^{2-}}(aq)$

oxidation $2\ Cr^{3+} + 7\ H_2O \rightarrow Cr_2O_7^{2-} + 6\ e^- + 14\ H^+$

reduction $(BiO_3^- + 2\ e^- + 6\ H^+ \rightarrow Bi^{3+} + 3\ H_2O) \times 3$

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net $2\ Cr^{3+}(aq) + 3\ BiO_3^-(aq) + 4\ H^+(aq) \rightarrow Cr_2O_7^{2-}(aq) + 3\ Bi^{3+}(aq) + 2\ H_2O(\ell)$

5) Balance the following unbalanced oxidation-reduction reaction for base conditions

$\overset{+4\ -2}{SO_3^{2-}}(aq) + \overset{+6\ -2}{CrO_4^{2-}}(aq) \rightarrow \overset{+6\ -2}{SO_4^{2-}}(aq) + \overset{+3\ -2}{CrO_2^-}(aq)$

oxidation $(SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2\ e^- + 2\ H^+) \times 3$

reduction $(CrO_4^{2-} + 3\ e^- + 4\ H^+ \rightarrow CrO_2^- + 2\ H_2O) \times 2$

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net (acid) $3\ SO_3^{2-} + 2\ CrO_4^{2-} + 2\ H^+ \rightarrow 3\ SO_4^{2-} + 2\ CrO_2^- + H_2O$

add OH– $2\ OH^- \rightarrow 2\ OH^-$

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net (base) $3\ SO_3^{2-}(aq) + 2\ CrO_4^{2-}(aq) + H_2O(\ell) \rightarrow 3\ SO_4^{2-}(aq) + 2\ CrO_2^-(aq) + 2\ OH^-(aq)$

Note that I have indicated the oxidation numbers of all elements above where they appear in the original unbalanced net ionic reaction. I have not indicated the state of the reactants or product (s, ℓ, g, aq) until the final balanced equation is given. In problem 5, we first balanced the reaction for acid conditions, and then added OH^- to both sides to convert H^+ to H_2O ($H^+ + OH^- = H_2O$), and then rebalanced the equation to eliminate H_2O from one side of the equation.