CH1020 Exercises (Worksheet 11)

1. What is the oxidation number of nitrogen in each of the following species:
   a. N_2 0
   b. N_2H_4 -2
   c. NH_4^+ -3
   d. NO_2 +4
2. Determine the oxidation numbers for each element in the following substances:

   $a).\ \overset{+4\ -2}{S\,O_2}$

   $b).\ \overset{+1\ +1\ -2}{H\,Br\,O}$

   $c).\ \overset{+3\ -1}{P\,F_3}$

   $d).\ \overset{+1\ \ -1}{K_2\,O_2}$

   $e).\ \overset{+1\ +3\ -2}{Li\,Co\,O_2}$

   $f).\ \overset{+1\ \ +3\ \ -1}{Na\,Al\,H_4}$

   $g).\ \overset{+1\ +3\ -2}{H\,Cl\,O_2}$

   $h).\ \overset{+2\ \ +6\ \ -2}{Ba\,Cr\,O_4}$

   $i).\ \overset{+1\ +6\ -2\ \ -}{H\,S\,O_4}$

3. Which element is oxidized and which is reduced in the following reactions:

   a. $N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$ H_2 is oxidized, N_2 is reduced

   b. $3Fe(NO_3)_2(aq)+2Al(s)\rightarrow 3Fe(s)+2Al(NO_3)_3(aq)$ Al oxidized, Fe reduced

   c. $PbS(s)+4H_2O_2(aq)\rightarrow PbSO_4(s)+4H_2O(g)$ S oxidized, O reduced

   d. $Cl_2(aq)+2NaI(aq)\rightarrow I_2(aq)+2NaCl(aq)$ I oxidized, Cl reduced

4. Which of the following reactions are redox reactions? For those that are, indicate which element is the <u>oxidizing agent</u> and which is the <u>reducing agent</u>. For those that are not redox reactions, indicate whether they are precipitation or neutralization reactions.

   a. $P_4(s)+10HClO(aq)+6H_2O(l)\rightarrow 4H_3PO_4(aq)+10HCl(aq)$ redox reaction; P is the reducing agent and Cl is the oxidizing agent.

b. $Br_2(l) + 2K(s) \rightarrow KBr(s)$ redox reaction; K is the reducing agent and Br is the oxidizing agent.

c. $ZnCl_2(aq) + 2NaOH(aq) \rightarrow Zn(OH)_2(s) + 2NaCl(aq)$ precipitation

d. $Ba(s) + Cl_2(g) \rightarrow BaCl_2(s)$ redox reaction; Ba is the reducing agent and Cl is the oxidizing agent.

e. $HBr(aq) + KOH(aq) \rightarrow H_2O(l) + KBr(aq)$ acid/base reaction

f. $2MnCO_3(s) + O_2(g) \rightarrow 2MnO_2(s) + 2CO_2(g)$ redox reaction; Mn is the reducing agent and O is the oxidizing agent

g. $Pb(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow PbSO_4(s) + NaNO_3(aq)$ precipitation reaction

5. Using the activity series, write balanced chemical equations for the following reactions. If no reaction occurs, write NR.

a. Nickel metal is added to a solution of copper(II)nitrate
$Ni(s) + Cu(NO_3)_2 \rightarrow Cu(s) + Ni(NO_3)_2(aq)$

b. Zinc metal is added to a solution of magnesium sulfate
no reaction

c. Hydrobromic acid solution is added to tin metal
$2HBr(aq) + Sn(s) \rightarrow SnBr_2(aq) + H_2(g)$

d. Hydrogen gas is bubbled through an aqueous solution of nickel(II)chloride
no reaction

e. Aluminum metal is added to a solution of cobalt(II)sulfate
$2Al(s) + 3CoSO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3Co$

f. Hydrogen gas is bubbled through a solution of silver nitrate
$H_2(g) + 2AgNO_3(aq) \rightarrow 2Ag(s) + 2HNO_3(aq)$

g. Hydrochloric acid is added to gold metal
no reaction