7.2 Balancing Redox Reactions with Half Reactions Assignment

1. For each of these reactions, determine whether or not it is a redox reaction. If any are, identify oxidizing and reducing agents in those reactions.

a. $CaBr_2 + Pb(NO_3)_2 \rightarrow PbBr_2 + Ca(NO_3)_2$

2+ 1- 2+ 1- 2+ 1- 2+ 1-

NOT REDOX.

element	Initial Ox. No		Final Ox. No.	e⁻ gained or lost	Oxidized or reduced	Agent
		→				
		→				

b. $P_4 + 5O_2 \rightarrow P_4O_{10}$

0 0 4(P)+2(0) = 0

4P - 20 = 0

P = 5

element	Initial Ox. No		Final Ox. No.	e⁻ gained or lost	Oxidized or reduced	Agent
P	0	→	5	5 lost	OX	reducing
O	0	→	-2	2 gained	RED	oxidizing

c. $SnCl_2 + 2\,FeCl_3 \rightarrow 2\,FeCl_2 + SnCl_4$

+2 -1 +3 -1 +2 -1 +4 -1

element	Initial Ox. No		Final Ox. No.	e⁻ gained or lost	Oxidized or reduced	Agent
Sn	+2	→	+4	2 lost	OX	Reducing
Fe	+3	→	+2	1 gained	RED	Oxidizing

2. Break each equation into two half-reactions. Identify each half-reaction as oxidation or reduction.

a. $Cu + 2H^+ \rightarrow Cu^{2+} + H_2$

$Cu \rightarrow Cu^{2+} + 2e^-$ oxidation

$2e^- + 2H^+ \rightarrow H_2$ reduction

b. $2Al + 3S \rightarrow Al_2S_3$

$2Al \rightarrow 2Al^{3+} + 6e^-$ oxidation

$6e^- + 3S \rightarrow 3S^{2-}$ reduction

3. Balance the following equations using the half-reaction method. Identify what is reduced and what is the reducing agent.

a. $\overset{0}{Na} + \overset{0}{Br_2} \rightarrow \overset{+1\ -1}{NaBr}$

$2Na \rightarrow 2Na^+ + 2e^-$ red agent reduced

$2e^- + Br_2 \rightarrow 2Br^-$

$2Na + Br_2 \rightarrow 2NaBr$

b. $Zn + S \rightarrow \overset{2+\ 2-}{ZnS}$

$Zn \rightarrow Zn^{2+} + 2e^-$ red agent

$2e^- + S \rightarrow S^{2-}$ red

$Zn + S \rightarrow ZnS$

c. $Au^{3+}_{(aq)} + Cd_{(s)} \rightarrow Au_{(s)} + Cd^{2+}_{(aq)}$

$2(Au^{3+} + 3e^- \rightarrow Au)$

$3(Cd \rightarrow Cd^{2+} + 2e^-)$

$2Au^{3+} + 6e^- \rightarrow 2Au$ red

$3Cd \rightarrow 3Cd^{2+} + 6e^-$ reducing agent

$2Au^{3+}_{(aq)} + 3Cd_{(s)} \rightarrow 2Au_{(s)} + 3Cd^{2+}_{(aq)}$

4. Write a balanced equation for each of the following half-reactions, and state whether it represents oxidation or reduction.

a. $HClO_2 \rightarrow Cl^-$ (acidic)

$4e^- + 3H^+ + HClO_2 \rightarrow Cl^- + 2H_2O$

Being that electrons are being gained, this is a reduction half reaction.

b. $Cr(OH)_3 \rightarrow CrO_4^{2-}$ (basic)

$5OH^- + H_2O + Cr(OH)_3 \rightarrow CrO_4^{2-} + 5H^+ + 5OH^-$

$5OH^- + H_2O + Cr(OH)_3 \rightarrow CrO_4^{2-} + 4H_2O$

$5OH^- + Cr(OH)_3 \rightarrow CrO_4^{2-} + 4H_2O + 3e^-$

Being that electrons are being lost, this is an oxidation half reaction.

c. $H_2GeO_3 \rightarrow Ge$ (acidic)

$4e^- + 4H^+ + H_2GeO_3 \rightarrow Ge + 3H_2O$

Being that electrons are being gained, this is a reduction half reaction.

d. $SbO_2^- \rightarrow Sb$ (basic)

$4OH^- + 4H^+ + SbO_2^- \rightarrow Sb + 2H_2O + 4OH^-$

$4H_2O + SbO_2^- \rightarrow Sb + 2H_2O + 4OH^-$

$2H_2O + SbO_2^- + 3e^- \rightarrow Sb + 4OH^-$

Being that electrons are being gained, this is a reduction half reaction.

5. $Cu + NO_3^- \rightarrow Cu^{2+} + NO$

$(Cu \rightarrow Cu^{2+} + 2e^-)3$

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

$3Cu + 8H^+ + 2NO_3^- \rightarrow 3Cu^{2+} + 2NO + 4H_2O$