Balancing Half-Reactions : Notes/W.S. 24

Some simpler half-reactions may be balanced by inspection.

For half-reactions taking place in an **acidic** solution, follow the four steps given below.

1) Balance main atoms (other than O and H).

2) Balance O atoms by adding H_2O molecules to one side.

3) Balance H atoms by adding H^+ ions to one side.

4) Balance charges by adding electrons to one side.

For **basic** solutions, carry out the first three steps, then eliminate the H^+ ions by adding OH^- ions to **both** sides. Then balance charges.

Examples:

Balance $Br_2 \rightarrow BrO_3^-$ in acid solution

$Br_2 \rightarrow 2BrO_3^-$

$Br_2 + 6H_2O \rightarrow 2BrO_3^-$

$Br_2 + 6H_2O \rightarrow 2BrO_3^- + 12H^+$

$Br_2 + 6H_2O \rightarrow 2BrO_3^- + 12H^+ + 10e^-$

Br is oxidized

Balance $HgO \rightarrow Hg$ in basic solution

$HgO \rightarrow Hg + H_2O$

$HgO + 2H^+ \rightarrow Hg + H_2O$

$HgO + 2H^+ + 2OH^- \rightarrow Hg + H_2O + 2OH^-$

$HgO + 2H_2O \rightarrow Hg + H_2O + 2OH^-$

$HgO + H_2O \rightarrow Hg + 2OH^-$

$HgO + H_2O + 2e^- \rightarrow Hg + 2OH^-$

Hg is reduced

Questions:

1) Balance the following half-reactions. State whether each is an oxidation or a reduction half-reaction.

a)	Ag^+	->	Ag	
b)	Pb	->	Pb^{2+}	
c)	I_2	->	I^-	
d)	SO_4^{2-}	->	$S_2O_8^{2-}$	
e)	S	->	H_2S	acidic
f)	$HClO_2$	->	Cl^-	acidic
g)	N_2O_4	->	NO_3^-	basic
h)	S	->	H_2SO_3	acidic
i)	MnO_4^-	->	Mn^{2+}	acidic
j)	AgO	->	Ag_2O	basic

Answers: 1)a) $Ag^+ + e^-$ -> Ag, reduction, b) Pb -> $Pb^{2+} + 2e^-$, oxidation, c) $I_2 + 2e^-$ -> $2I^-$, reduction, d) $2SO_4^{2-}$ -> $S_2O_8^{2-} + 2e^-$, oxidation, e) S +

$2H^+ + 2e^- \rightarrow H_2S$, reduction, f) $HClO_2 + 3H^+ + 4e^- \rightarrow Cl^- + 2H_2O$, reduction, g) $N_2O_4 + 4OH^- \rightarrow 2NO_3^- + 2H_2O + 2e^-$, oxidation, h) $S + 3H_2O \rightarrow H_2SO_3 + 4H^+ + 4e^-$, oxidation, i) $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$, reduction, j) $2AgO + H_2O + 2e^- \rightarrow Ag_2O + 2OH^-$, reduction.