AP CHEMISTRY

TOPIC 2: STOICHIOMETRY, PART II (MORE PRACTICE)

Day 29: (2)

Oxidation / Reduction Equations:

- Oxidation Numbers
- Acid Redox

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1) Determine the **oxidation number** for each ELEMENT in the chemical formula

a) $Ir_2(SO_3)_3$

Ir: (2) +3 = +6
S: (3) +4 = +12
O: (9) -2 = -18
0

b) $Ca(HCO_3)_2$ ALWAYS +2!

Ca (1) +2 = +2
H (2) +1 = +2
C (2) +4 = +8
O (6) -2 = -12
0

H (1) +1 = +1
C (1) +4 = +4
O (3) -2 = -6
-1

c) $Al_2(SnO_3)_3$ ALWAYS +3!

Al (2) +3 = +6
Sn (3) +4 = +12
O (9) -2 = -18
0

d) Rb_2SeO_4 ALWAYS +1

Rb (2) +1 = +2
Se (1) +6 = +6
O (4) -2 = -8

2) Determine the species that ~~are~~ oxidized, reduced, the oxidizing agent, and reducing agent.

a) $\overset{+2\ -2}{OsO} + \overset{0}{Br_2} \rightarrow \overset{+2\ -1(2)}{OsBr_2} + \overset{+6\ -2(3)}{OsO_3}$

$Os^{+2} \rightarrow Os^{+6} + 4e^-$

$e^- + Br^0 \rightarrow Br^{-1}$

OX: Os^{+2}
RED: Br^0
OX AG: Br_2
RED AG: OsO

b) $\overset{+3\ -2}{Cr_2O_3} + \overset{+1\ +5\ -2}{HNO_3} \rightarrow \overset{+4\ -2}{NO_2} + \overset{+6\ -2}{CrO_3}$

OX: Cr^{+3}
RED: N^{+5}
OX AG: HNO_3
RED AG: Cr_2O_3

$Cr^{+3} \rightarrow Cr^{+6} + 3e^-$
$e^- + N^{+5} \rightarrow N^{+4}$

c) $\overset{+1\ +5\ -2}{H_3PO_4} + \overset{0}{Hg} \rightarrow \overset{+1\ +5\ -2}{Hg_3PO_4} + \overset{0}{H_2}$

OX: Hg^0
RED: H^{+0}
OX AG: H_3PO_4
RED AG: Hg

d) $\overset{0}{C} + \overset{+1\ +5\ -2}{HNO_3} \rightarrow \overset{+4\ -2}{CO_2} + \overset{+4\ -2}{NO_2}$

$C^0 \rightarrow C^{+4} + 4e^-$
$e^- + N^{+5} \rightarrow N^{+4}$

OX: C^0, RED: N^{+5}, OX AG. HNO_3, RED AG. C

3) Balance the following REDOX equation that occur in an **Acidic** solution:

a) $I^{-1} + NO_2^{-1} \rightarrow I_2 + NO$

$2I^{-1} \rightarrow I_2 + 2e^-$

$2(e^- + 2H^+ + NO_2^{-1} \rightarrow NO + H_2O)$

$4H^+ + 2NO_2^{-1} + 2I^{-1} \rightarrow I_2 + 2NO + 2H_2O$

b) $Bi + SO_4^{-2} \rightarrow Bi^{+3} + SO_2$

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

$(2e^- + 4H^+ + SO_4^{-2} \rightarrow SO_2 + 2H_2O)\,3$

$12H^+ + 3SO_4^{-2} + 2Bi \rightarrow 2Bi^{+3} + 3SO_2 + 6H_2O$

c) $HNO_3 + HI \rightarrow NO_2 + I_2$

$2HI \rightarrow I_2 + 2H^+ + 2e^-$

$2(e^- + H^+ + HNO_3 \rightarrow NO_2 + H_2O)$

$2HI + 2HNO_3 \rightarrow I_2 + 2NO_2 + 2H_2O$

11) Balance the following REDOX equation that occur in a **Basic** solution:

a) $V \rightarrow HV_6O_{17}^{-3} + H_2$

$17H_2O + 6V \rightarrow HV_6O_{17}^{-3} + 33H^+ + 30e^-$

$15(2e^- + 2H^+ \rightarrow H_2)$ $\quad 30H^- \rightarrow 30H_2O$

$30H^- + 17H_2O + 6V \rightarrow 3H^+ + 15H_2 + HV_6O_{17}^{-3}$

$3OH^- + 14H_2O + 6V \rightarrow 15H_2 + HV_6O_{17}^{-3}$

b) $MnO_4^{-1} \rightarrow MnO_4^{-2} + O_2$

$4(e^- + MnO_4^{-1} \rightarrow MnO_4^{-2})$

$+4OH^- + 2H_2O \rightarrow O_2 + 4H^+ + 4e^- \quad (4H^+ + 4OH^- \rightarrow 4H_2O)$

$2H_2O + 4MnO_4^{-1} \rightarrow O_2 + 4MnO_4^{-2} + 4H^+ + 4OH^-$

$4OH^- + 4MnO_4^{-1} \rightarrow O_2 + 4MnO_4^{-2} + 2H_2O$

c) $P_4 \rightarrow PH_3 + H_2PO_2^{-1}$

$12e^- + 12H^+ + P_4 \rightarrow 4PH_3$

$3(8H_2O + P_4 \rightarrow 4H_2PO_2^{-1} + 8H^+ + 4e^-)$

$24H_2O + 4P_4 \rightarrow 12H^+ + 12H_2PO_2^{-1} + 4PH_3$

$+12OH^- \quad 12OH^- \rightarrow 12H_2O$

$12OH^- + 12H_2O + 4P_4 \rightarrow 12H_2PO_2^{-1} + 4PH_3$