AP CHEMISTRY

TOPIC 2: STOICHIOMETRY, PART G

Day 28:

Oxidation / Reduction Equations:

- Oxidation Numbers
- Acid Redox

---

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

a) NiO_2 — Ni: (1)[+4] = +4; O: (2)[-2] = -4; 0

b) P_4O_6 — P: (4)[+3] = +12; O: (6)[-2] = -12; 0

c) CO — C: (1)[+2] = +2; O: (1)[-2] = -2; 0

d) $Mg_2P_2O_7$ — Mg: (2)[+2] = +4; P: (2)[+5] = +10; O: (7)[-2] = -14; 0

e) $NaBiO_3$ — Na: (1)[+1] = +1; Bi: (1)[+5] = +5; O: (3)[-2] = -6; 0

f) $Ca(NO_3)_2$ — Ca: (1)[+2] = +2; N: (2)[+2] = +4; O: (3)[-2] = -6; 0

g) $Na_2S_2O_3$ — Na: (2)[+1] = +2; S: (2)[+2] = +4; O: (3)[-2] = -6; 0

h) $(NH_4)_2HPO_4$ — N: (2)[+3] = +6; H: (6)[-1] = -6; H: (3)[+1] = +3; P: (1)[+5] = +5; O: (4)[-2] = -8; 0

2) Specify which of the following are oxidation-reduction reactions and identify the oxidizing agent, the reducing agent, the substance being reduced, and the substance being oxidized.

a) $\overset{+4\ -1(4)}{CH_4\,(g)} + 2\ \overset{0}{O_2\,(g)} \rightarrow \overset{+4\ -2(2)}{CO_2\,(g)} + 2\ \overset{+1(2)\ -2}{H_2O\,(g)}$

OX: H^{-1} OX Ag: O_2
RED: O^0 RED Ag: CH_4

b) $\overset{0}{Zn\,(s)} + 2\ \overset{+1\ -1}{HCl\,(aq)} \rightarrow \overset{+2\ -1}{ZnCl_2\,(aq)} + \overset{0}{H_2\,(g)}$

OX: Zn^0 OX Ag: HCl
RED: H^+ RED Ag: Zn^0

c) $\overset{+6\ -2}{Cr_2O_7^{-2}\,(aq)} + 2\ \overset{-2\ +1}{OH^{-1}\,(aq)} \rightarrow 2\ \overset{+6\ -2}{CrO_4^{-2}\,(aq)} + 2\ \overset{+1\ -2}{H_2O\,(l)}$

NOT REDOX!

d) $\overset{0}{O_3\,(g)} + \overset{+2\ -2}{NO\,(g)} \rightarrow \overset{0}{O_2\,(g)} + \overset{+4\ -2(2)}{NO_2\,(g)}$

OX: N^{+2} OX Ag: O_3
RED: O^0 RED Ag: NO

e) $Cu\,(s) + 2\ Ag^{+1}\,(aq) \rightarrow 2\ Ag\,(s) + Cu^{+2}\,(aq)$

OX: Cu^0 OX Ag: Ag^+
RED: Ag^{+1} RED Ag: Cu^0

f) $\overset{+3\ -2\ +1}{Al(OH)_4^{-1}\,(aq)} \rightarrow \overset{+3\ -2}{AlO_2^{-1}\,(aq)} + 2\ \overset{+1\ -2}{H_2O\,(l)}$

NOT REDOX

3) Balance the following REDOX equations that occur in an acidic solution:

a) $Zn_{(s)} + HCl_{(aq)} \rightarrow Zn^{+2}_{(aq)} + H_{2(g)} + Cl^{-1}_{(aq)}$

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

$2e^- + H^+ + HCl \rightarrow H_2 + Cl^{-1}$

$H^+ + HCl + Zn \rightarrow Zn^{+2} + H_2 + Cl^{-1}$ ✓

(+1) (+1)

b) $I^{-1}_{(aq)} + ClO^{-1}_{(aq)} \rightarrow I_3^{-1}_{(aq)} + Cl^{-1}_{(aq)}$

$3\,I^{-1} \rightarrow I_3^{-1} + 2e^-$

$2e^- + 2H^+ + ClO^{-1} \rightarrow Cl^{-1} + H_2O$

$3\,I^{-1} + 2H^+ + ClO^{-1} \rightarrow I_3^{-1} + Cl^{-1} + H_2O$ ✓

(-2) (-2)

c) $As_2O_{3\,(s)} + NO_3^{-1}{}_{(aq)} \rightarrow H_3AsO_{4\,(aq)} + NO_{(g)}$

$4(3e^- + 4H^+ + NO_3^{-1} \rightarrow NO + 2H_2O)$ ✓

$3(5H_2O + As_2O_3 \rightarrow 2H_3AsO_4 + 4H^+ + 4e^-)$ ✓

$4H^+ + 4NO_3^{-1} + 7H_2O + 3As_2O_3 \rightarrow 4NO + 6H_3AsO_4$

d) $Br^{-1}_{(aq)} + MnO_4^{-1}{}_{(aq)} \rightarrow Br_{2\,(l)} + Mn^{+2}_{(aq)}$

$5(2Br^{-1} \rightarrow Br_2 + 2e^-)$

$2(5e^- + 8H^+ + MnO_4^{-1} \rightarrow Mn^{+2} + 4H_2O)$

$16H^+ + 10Br^{-1} + 2MnO_4^{-1} \rightarrow 5Br_2 + 2Mn^{+2} + 8H_2O$ ✓

e) $IO_3^{-1}{}_{(aq)} + Cr_2O_7^{-2}{}_{(aq)} \rightarrow IO_4^{-1}{}_{(aq)} + Cr^{+3}_{(aq)}$

$3(H_2O + IO_3^{-1} \rightarrow IO_4^{-1} + 2H^+ + 2e^-)$

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

$3H_2O + 14H^+ + 3IO_3^{-1} + Cr_2O_7^{-2} \rightarrow 3IO_4^{-1} + 2Cr^{+3} + 7H_2O + 8H^+$

$8H^+$ $4H_2O$

(+3) (+3) ✓