Worksheet No. 2B

Name Key

Class _____ Date _____

1. Balance the following equations by adding half-equations provided in Appendix D of the *Heath Chemistry* text. Then decide on the basis of the positions of the half-equations in the table whether or not the reaction may be expected to proceed.
   a. $ClO_4^- + Mn^{2+} \rightarrow Cl^- + MnO_2$
   b. $IO_3^- + H_2O_2 \rightarrow I_2 + O_2$
   c. $MnO_2 + Sn^{4+} \rightarrow MnO_4^- + Sn^{2+}$
   d. $NO_3^- + Br_2 \rightarrow NO + BrO_3^-$

a) $ClO_4^- + 4Mn^{2+} + 4H_2O \rightarrow Cl^- + 4MnO_2 + 8H^+$

yes, proceeds

b) $2IO_3^- + 2H^+ + 5H_2O_2 \rightarrow I_2 + 6H_2O + 5O_2$

yes. proceeds

c) $2MnO_2 + 8OH^- + 3Sn^{4+} \rightarrow 2MnO_4^- + 4H_2O + 3Sn^{2+}$

no. doesn't proceed

d) $5NO_3^- + 2H^+ + 1\frac{1}{2}Br_2 \rightarrow 5NO + 3BrO_3^- + H_2O$

no. doesn't proceed.

2. Balance each of the following half-reactions, in either acidic or basic solution, as requested. Then state whether the process is oxidation or reduction.
   a. $BrO_3^- \rightarrow Br^-$ (basic)
   b. $HClO_2 \rightarrow ClO_3^-$ (acidic)
   c. $Ga \rightarrow H_2GaO_3^-$ (basic)
   d. $ReO_4^- \rightarrow ReO_2$ (acidic)

$6e^- + 3H_2O + BrO_3^- \rightarrow Br^- + 6OH^-$ reduction

$H_2O + HClO_2 \rightarrow ClO_3^- + 3H^+ + 2e^-$ oxidation

$4OH^- + Ga \rightarrow H_2GaO_3^- + H_2O + 3e^-$ oxidation

$3e^- + 4H^+ + ReO_4^- \rightarrow ReO_2 + 2H_2O$ reduction

3. Balance each of the following redox equations. Use either the half-reaction equation method or the oxidation number method.

a. $Cr_2O_7^{2-} + HNO_2 \rightarrow Cr^{3+} + NO_3^-$ (acidic)

b. $IO_3^- + N_2O \rightarrow I_2 + NO$ (acidic)

c. $MnO_4^- + Te \rightarrow MnO_2 + TeO_3^{2-}$ (basic)

d. $P_4 + NO_2^- \rightarrow H_2PO_2^- + N_2O$ (basic)

e. $ClO_4^- + I^- \rightarrow Cl^- + IO_3^-$ (acidic)

f. $IO_4^- + PH_3 \rightarrow I^- + P_4$ (basic)

g. $C_2H_5OH + Cr_2O_7^{2-} \rightarrow CH_3COOH + Cr^{3+}$ (acidic)

h. $MnO_4^- + CH_3CH(OH)CH_3 \rightarrow Mn^{2+} + CH_3COCH_3$ (acidic)

i. $HPO_2^- \rightarrow PO_4^{3-} + P_4$ (basic)

j. $N_2O \rightarrow N_2H_4 + NO_3^-$ (basic)

a. $Cr_2O_7^{2-} + 5H^+ + 3HNO_2 \rightarrow 2Cr^{3+} + 4H_2O + 3NO_3^-$

b. $2IO_3^- + 2H^+ + 5N_2O \rightarrow I_2 + H_2O + 10NO$

c. $4MnO_4^- + 3Te + 2OH^- \rightarrow 4MnO_2 + H_2O + 3TeO_3^{2-}$

d. $2NO_2^- + P_4 + 3H_2O + 2OH^- \rightarrow N_2O + 4H_2PO_2^-$

e. $3ClO_4^- + 4I^- \rightarrow 3Cl^- + 4IO_3^-$

f. $3IO_4^- + 8PH_3 \rightarrow 3I^- + 2P_4 + 12H_2O$

g. $3C_2H_5OH + 2Cr_2O_7^{2-} + 16H^+ \rightarrow 3CH_3COOH + 4Cr^{3+} + 11H_2O$

h. $2MnO_4^- + 5CH_3CH(OH)CH_3 + 6H^+ \rightarrow 2Mn^{2+} + 5CH_3COCH_3 + 8H_2O$

i. $20HPO_2^- + 4OH^- \rightarrow 8PO_4^{3-} + 3P_4 + 12H_2O$

j. $7N_2O + 5H_2O + 6OH^- \rightarrow 4N_2H_4 + 6NO_3^-$