Balancing Redox Reactions Worksheet

Acid Solutions

$$Mn^{2+} + BiO_3^- ===> MnO_4^- + Bi^{3+}$$

 $2 (4 H_2O + Mn^{2+} ===> MnO_4^- + 8 H^+ 5 e)$
 $5 (2 e + 6 H^+ + BiO_3^- ===> Bi^{3+} + 3 H_2O)$
 $14 H^+ + 2 Mn^{2+} + 5 BiO_3^- ===> 2 MnO_4^- + 5 Bi^{3+} + 7 H_2O$

$$MnO_4^- + S_2O_3^{2-} ===> S_4O_6^{2-} + Mn^{2+}$$

$$2 (5 e + 8 H^+ + MnO_4^- ===> Mn^{2+} + 4 H_2O)$$

$$5 (2 S_2O_3^{2-} ===> S_4O_6^{2-} + 2 e)$$

$$16 H^+ + 2 MnO_4^- + 10 S_2O_3^{2-} ===> 2 Mn^{2+} + 8 H_2O + 5 S_4O_6^{2-}$$

$$ClO_3^- + Cl^- ===> Cl_2 + ClO_2$$

 $2 (e + 2 H^+ + ClO_3^- ===> ClO_2 + H_2O)$
 $2 Cl^- ===> Cl_2 + 2 e)$
 $4 H^+ + 2 ClO_3^- + 2 Cl^- ===> 2 ClO_2 + 2 H_2O + Cl_2$

$$P + Cu^{2+} ===> Cu + H_2PO_4^{-}$$

$$2 (4 H_2O + P ===> H_2PO_4^{-} + 6 H^{+} + 5 e)$$

$$5 (2 e + Cu^{2+} ===> Cu)$$

$$8 H_2O + 2 P + 5 Cu^{2+} ===> 2 H_2PO_4^{-} + 12 H^{+} + 5 Cu)$$

$$PH_3 + I_2 ===> H_3PO_2^- + I^-$$

 $2 (2 H_2O + PH_3 ===> H_3PO_2^- + 4 H^+ + 3 e)$
 $3 (2 e + I_2 ===> 2 I^-)$
 $4 H_2O + 2 PH_3 + 3 I_2 ===> 2 H_3PO_2^- + 8 H^+ + 6 I^-$

$$NO_2 ===> NO_3^- + NO$$

 $2 H_2O + 2 NO_2 ===> 2 NO_3^- + 4 H^+ + 2 e$
 $2 e + 2 H^+ + NO_2 ===> NO + H_2O$
 $H_2O + 3 NO_2 ===> 2 NO_3^- + NO + 2 H^+$

Basic Solutions

$$MnO_4^- + C_2O_4^{2-} ===> MnO_2 + CO_2$$

 $2 (3 e + 4 H^+ + MnO_4^- ===> MnO_2 + 2 H_2O)$
 $3 (C_2O_4^{2-} ===> 2 CO_2 + 2 e)$
 $4 H_2O + 2 MnO_4^- + 3 C_2O_4^{2-} ===> 2 MnO_2 + 8 OH^- + 6 CO_2$

$$ClO_2 ===> ClO_2^- + ClO_3^-$$

 $e + ClO_2 ===> ClO_2^-$
 $H_2O + ClO_2 ===> ClO_3^- + 2 H^+ + e$
2 OH + 2 ClO₂ ===> ClO₂ + ClO₃ + H₂O

$$Cu(NH_3)_4^{2+} + S_2O_4^{2-} ===> SO_3^{2-} + Cu + NH_3$$

 $2 e + Cu(NH_3)_4^{2+} ===> Cu + 4 NH_3$
 $2 H_2O + S_2O_4^{2-} ===> 2 SO_3^{2-} + 4 H^+ + 2 e$
 $Cu(NH_3)_4^{2+} + S_2O_4^{2-} + 4 OH^- ===> Cu + 4 NH_3 + 2 SO_3^{2-} + 2 H_2O$

$$Zn + NO_3^- ===> Zn(OH)_4^{2-} + NH_3$$

 $8 e + 9 H^+ + NO_3^- ===> NH_3 + 3 H_2O$
 $4 (4 H_2O + Zn ===> Zn(OH)_4^{2-} + 4 H^+ + 2 e$
 $6 H_2O + NO_3^- + 7 OH^- + 4 Zn ===> NH_3 + 4 Zn(OH)_4^{2-}$

$$Zn ===> Zn(OH)_4^{2-} + H_2$$

 $4 H_2O + Zn ===> Zn(OH)_4^{2-} + 4 H^+ + 2 e$
 $2 e + 2 H_2O ===> H_2 + 2 OH^-$
 $2 OH^- + Zn + 2 H_2O ===> Zn(OH)_4^{2-} + H_2$