

1.  $\text{KNO}_{3(\text{sz})} \rightarrow \text{K}^+_{(\text{aq})} + \text{NO}_3^-_{(\text{aq})}$
2.  $\text{I}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HI} + \text{HIO}$
3.  $\text{I}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HI} + \text{HIO}$
4.  $2 \text{KI} + \text{Cl}_2 = 2 \text{KCl} + \text{I}_2$   
 $2 \text{KBr} + \text{Cl}_2 = 2 \text{KCl} + \text{Br}_2$   
 $\text{I}^- + \text{I}_2 \rightleftharpoons \text{I}_3^-$
5.  $\text{I}^- + \text{I}_2 \rightleftharpoons \text{I}_3^-$
6.  $\text{NaCl}_{(\text{sz})} \rightarrow \text{Na}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})}$   
 $\text{NaOH}_{(\text{sz})} \rightarrow \text{Na}^+_{(\text{aq})} + \text{OH}^-_{(\text{sz})}$   
 $\text{KNO}_{3(\text{sz})} \rightarrow \text{K}^+_{(\text{aq})} + \text{NO}_3^-_{(\text{aq})}$
7.  $\text{NH}_{3(\text{g})} \rightleftharpoons \text{NH}_{3(\text{aq})}$   
 $\text{NH}_{3(\text{aq})} + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})}$   
 $\text{NaCl} + 2 \text{H}_2\text{SO}_4 = \text{Na}_2\text{SO}_4 + 2 \text{HCl}$   
 $\text{HCl}_{(\text{g})} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})}$
8.  $2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$
9.  $2 \text{NO}_{2(\text{g})} \rightleftharpoons \text{N}_2\text{O}_{4(\text{g})}$
10.  $\text{Na}_2\text{CO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{Na}_2\text{CO}_3 + 2 \text{HNO}_3 = 2 \text{NaNO}_3 + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{AgNO}_3 + \text{HCl} = \underline{\text{AgCl}} + \text{HNO}_3$
11.  $\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{OH}^-$   
 $[\text{Al}(\text{H}_2\text{O})_6]^{3+} + \text{H}_2\text{O} \rightleftharpoons [\text{AlOH}(\text{H}_2\text{O})_5]^{2+} + \text{H}_3\text{O}^+$
12.  $\text{NaOH} + \text{HCl} = \text{NaCl} + \text{H}_2\text{O}$   
 $\text{NaOH} + \text{HNO}_3 = \text{NaCl} + \text{H}_2\text{O}$
13.  $\text{Na}_2\text{CO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{AgNO}_3 + \text{HCl} = \underline{\text{AgCl}} + \text{HNO}_3$   
 $\text{NaOH} + \text{HCl} = \text{NaCl} + \text{H}_2\text{O}$
14.  $\text{Na}_2\text{CO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{AgNO}_3 + \text{HCl} = \underline{\text{AgCl}} + \text{HNO}_3$

15.  $\text{KBr}_{(sz)} \rightarrow \text{K}^+_{(aq)} + \text{Br}^-_{(aq)}$   
 $\text{Na}_2\text{CO}_{3(s)} \rightarrow 2 \text{Na}^+_{(sz)} + \text{CO}_3^{2-}_{(sz)}$   
 $\text{Na}_2\text{CO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{CaCO}_3 + 2 \text{HCl} = \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
16.  $\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{OH}^-$   
 $\text{PO}_4^{3-} + \text{H}_2\text{O} \rightleftharpoons \text{HPO}_4^{2-} + \text{OH}^-$   
 $\text{Na}_2\text{CO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$
17.  $\text{Zn} + 2 \text{HCl} = \text{ZnCl}_2 + \text{H}_2$   
 $\text{CaCO}_3 + 2 \text{HCl} = \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{Ba}(\text{NO}_3)_2 + \text{H}_2\text{SO}_4 = \underline{\text{BaSO}_4} + 2 \text{HNO}_3$
18.  $\text{Cu}^{2+} + 2 \text{OH}^- = \underline{\text{Cu}(\text{OH})_2}$   
 $\text{Cu}^{2+} + 4 \text{NH}_3 = [\text{Cu}(\text{NH}_3)_4]^{2+}$
19.  $\text{NH}_{3(aq)} + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+_{(aq)} + \text{OH}^-_{(aq)}$   
 $\text{Cu}^{2+} + 2 \text{OH}^- = \underline{\text{Cu}(\text{OH})_2}$   
 $\underline{\text{Cu}(\text{OH})_2} + 4 \text{NH}_3 = [\text{Cu}(\text{NH}_3)_4]^{2+} + 2 \text{OH}^-$
20.  $\text{Cu}^{2+} + \text{Fe} = \text{Fe}^{2+} + \text{Cu}$
21.  $\text{Fe}^{2+} + \text{Zn} = \text{Zn}^{2+} + \text{Fe}$
22.  $2 \text{H}_2\text{O} + 2 \text{e}^- = 2 \text{OH}^- + \text{H}_2$   
 $2 \text{Cl}^- = + 2 \text{e}^- \rightarrow \text{Cl}_2$   
 $2 \text{I}^- + \text{Cl}_2 = 2 \text{Cl}^- + \text{I}_2$
23.  $2 \text{H}_2\text{O} = 4 \text{e}^- + \text{O}_2 + 2 \text{H}^+$   
 $2 \text{H}_2\text{O} + 2 \text{e}^- = 2 \text{OH}^- + \text{H}_2$
24.  $\text{Mg} + 2 \text{H}_2\text{O} = \text{Mg}(\text{OH})_2 + \text{H}_2$   
 $\text{Mg}(\text{OH})_2 \rightleftharpoons \text{Mg}^{2+} + 2 \text{OH}^-$   
 $\text{Mg} + 2 \text{HCl} = \text{MgCl}_2 + \text{H}_2$
25.  $4 \text{Al} + 3 \text{O}_2 = 2 \text{Al}_2\text{O}_3$   
 $2 \text{Al} + 6 \text{H}_2\text{O} = 2 \text{Al}(\text{OH})_3 + 3 \text{H}_2$
26.  $\text{Ca} + 2 \text{H}_2\text{O} = \text{Ca}(\text{OH})_2 + \text{H}_2$   
 $\text{Ca} + 2 \text{HCl} = \text{CaCl}_2 + \text{H}_2$
27.  $\text{CuO} + 2 \text{HCl} = \text{CuCl}_2 + \text{H}_2\text{O}$   
 $\text{Zn} + 2 \text{HCl} = \text{ZnCl}_2 + \text{H}_2$
28.  $\text{CuO} + \text{H}_2 = \text{Cu} + \text{H}_2\text{O}$
29.  $2 \text{NaOH} + \text{Br}_2 = \text{NaBr} + \text{NaOBr} + \text{H}_2\text{O}$   
 $\text{Br}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HBr} + \text{HOBr}$

30.  $\text{AgNO}_3 + \text{HCl} = \underline{\text{AgCl}} + \text{HNO}_3$   
 $\text{AgNO}_3 + \text{NaCl} = \underline{\text{AgCl}} + \text{NaNO}_3$   
 $2 \text{AgNO}_3 + 2 \text{NaOH} = \underline{\text{Ag}_2\text{O}} + 2 \text{NaNO}_3 + \text{H}_2\text{O}$   
 $2 \text{Al} + 6 \text{HCl} = 2 \text{AlCl}_3 + 3 \text{H}_2$
31.  $\text{H}_2\text{O}_2 + 2 \text{KI} = 2 \text{KOH} + \text{I}_2$   
 $2 \text{H}_2\text{O}_2 = 2 \text{H}_2\text{O} + \text{O}_2$
32.  $4 \text{P} + 5 \text{O}_2 = \text{P}_4\text{O}_{10}$
33.  $\text{HSO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{SO}_4^{2-} + \text{H}_3\text{O}^+$   
 $\text{HCO}_3^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 + \text{OH}^-$
34.  $\text{CaCO}_3 + 2 \text{HNO}_3 = \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{AgNO}_3 + \text{NaCl} = \underline{\text{AgCl}} + \text{NaNO}_3$
35.  $2 \text{NO}_{(g)} + \text{O}_{2(g)} = 2 \text{NO}_{2(g)}$   
 $\text{NH}_{3(g)} + \text{HCl}_{(g)} = \text{NH}_4\text{Cl}_{(sz)}$
36.  $\text{CaO} + \text{H}_2\text{O} = \text{Ca}(\text{OH})_2$   
 $\text{Ca}(\text{OH})_2 \rightleftharpoons \text{Ca}^{2+} + 2 \text{OH}^-$   
 $\text{P}_2\text{O}_5 + 3 \text{H}_2\text{O} = 2 \text{H}_3\text{PO}_4$   
 $\text{H}_3\text{PO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{PO}_4^- + \text{H}_3\text{O}^+$
37.  $\text{HCl} + \text{H}_2\text{O} = \text{Cl}^- + \text{H}_3\text{O}^+$   
 $\text{HNO}_3 + \text{H}_2\text{O} = \text{NO}_3^- + \text{H}_3\text{O}^+$   
 $\text{Ag}^+ + \text{Cl}^- = \underline{\text{AgCl}}$
38.  $\text{FeCl}_3 + 3 \text{NaOH} = \underline{\text{Fe}(\text{OH})_3} + 3 \text{NaCl}$   
 $\underline{\text{Fe}(\text{OH})_3} + 3 \text{HCl} = \text{FeCl}_3 + 3 \text{H}_2\text{O}$   
 $2 \text{FeCl}_3 + 2 \text{KI} = 2 \text{FeCl}_2 + 2 \text{KCl} + \text{I}_2$
39.  $2 \text{KMnO}_4 + 16 \text{HCl} = 2 \text{KCl} + 2 \text{MnCl}_2 + 8 \text{H}_2\text{O} + 5 \text{Cl}_2$   
 $\text{Cl}_2 + \text{H}_2\text{O} = \text{HCl} + \text{HOCl}$
40.  $\text{Ca}^{2+} + 2 \text{C}_{17}\text{H}_{31}\text{COO}^- = \underline{\text{Ca}(\text{C}_{17}\text{H}_{31}\text{COO})_2}$   
 $\text{Mg}^{2+} + 2 \text{C}_{17}\text{H}_{31}\text{COO}^- = \underline{\text{Mg}(\text{C}_{17}\text{H}_{31}\text{COO})_2}$
41.  $\text{Na}_2\text{SO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{SO}_2$   
 $\text{SO}_2 + \text{I}_2 + 2 \text{H}_2\text{O} = \text{H}_2\text{SO}_4 + 2 \text{HI}$   
 $\text{SO}_2 + 2 \text{H}_2\text{S} = 3 \text{S} + 2 \text{H}_2\text{O}$
- 42.
43.  $\text{Na}_2\text{S} + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{S}$   
 $\text{Na}_2\text{SO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{SO}_2$   
 $\text{Na}_2\text{CO}_3 + 2 \text{HCl} = 2 \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{H}_2\text{S} + \text{I}_2 = \underline{\text{S}} + 2 \text{HI}$   
 $\text{SO}_2 + \text{I}_2 + 2 \text{H}_2\text{O} = \text{H}_2\text{SO}_4 + 2 \text{HI}$

44.  $\text{FeS} + 2 \text{HCl} = \text{FeCl}_2 + \text{H}_2\text{S}$   
 $2 \text{AgNO}_3 + \text{H}_2\text{S} = \underline{\text{Ag}_2\text{S}} + 2 \text{HNO}_3$   
 $2 \text{H}_2\text{S} + 3 \text{O}_2 = 2 \text{H}_2\text{O} + 2 \text{SO}_2$
45.  $\text{NH}_4\text{Cl} + \text{NaOH} = \text{NH}_3 + \text{H}_2\text{O} + \text{NaCl}$
46.  $2 \text{Na} + 2 \text{H}_2\text{O} = 2 \text{NaOH} + \text{H}_2$   
 $2 \text{K} + 2 \text{H}_2\text{O} = 2 \text{KOH} + \text{H}_2$   
 $2 \text{H}_2 + \text{O}_2 = 2 \text{H}_2\text{O}$
47.  $\text{MgSO}_4 + 2 \text{NaOH} = \underline{\text{Mg(OH)}_2} + \text{Na}_2\text{SO}_4$   
 $\underline{\text{Mg(OH)}_2} + 2 \text{HCl} = \text{MgCl}_2 + 2 \text{H}_2\text{O}$   
 $\text{Al}_2(\text{SO}_4)_3 + 6 \text{NaOH} = \underline{\text{Al(OH)}_3} + 2 \text{Na}_2\text{SO}_4$   
 $\underline{\text{Al(OH)}_3} + 3 \text{HCl} = \text{AlCl}_3 + 3 \text{H}_2\text{O}$   
 $\underline{\text{Al(OH)}_3} + \text{NaOH} \rightleftharpoons \text{Na}[\text{Al(OH)}_4]$
48.  $\text{Cu} + 4 \text{HNO}_3 = \text{Cu}(\text{NO}_3)_2 + 2 \text{H}_2\text{O} + 2 \text{NO}_2$   
 $(\text{Cu} + \text{H}_2\text{SO}_4 = \text{CuO} + \text{H}_2\text{O} + \text{SO}_2)$   
 $\text{Cu} + 2 \text{H}_2\text{SO}_4 = \text{CuSO}_4 + \text{H}_2\text{O} + \text{SO}_2$
49.  $\text{CaCO}_3 + 2 \text{HCl} = \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$   
 $\text{CaO} + \text{H}_2\text{O} = \text{Ca(OH)}_2$   
 $\text{CaO} + 2 \text{HCl} = \text{CaCl}_2 + \text{H}_2\text{O}$   
 $\text{CaO} + \text{CO}_2 = \text{CaCO}_3$
50.  $\text{FeCl}_3 + 3 \text{NaOH} = \underline{\text{Fe(OH)}_3} + 3 \text{NaCl}$   
 $\text{I}_2 + 2 \text{NaOH} = \text{NaI} + \text{NaOI} + \text{H}_2\text{O}$   
 $\text{I}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HI} + \text{HOI}$   
 $\text{HI} + \text{HOI} \rightleftharpoons 2 \text{H}^+ + \text{I}^- + \text{OI}^-$