Honors Chemistry

Answers to Chapter 4 Study Questions

1. a) strong acid: $HNO_3(aq) \rightarrow H^+(aq) + NO_3^-(aq)$

   b) weak acid: $HClO(aq) \rightleftharpoons H^+(aq) + ClO^-(aq)$

   c) weak base: $NH_3(aq) + H_2O \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

   d) neutral: $NaNO_3(s) \rightarrow Na^+(aq) + NO_3^-(aq)$

   e) strong base: $Ba(OH)_2(s) \rightarrow Ba^{2+}(aq) + 2\ OH^-(aq)$

2. a) $\frac{29.2\ g\ NaCl}{0.250\ L} \times \frac{1\ mol\ NaCl}{58.4\ g} = 2.00\ M\ NaCl$

   b) $Volume_{solution\ A} \times Molarity_{solution\ A} = Volume_{solution\ B} \times Molarity_{solution\ B}$

   $$125\ ml \times 0.350\ M\ NaCl = x\ ml \times 2.00\ M\ NaCl$$

   $$x = \frac{125\ ml \times 0.350\ M}{2.00\ M} = 21.9\ ml$$

3. $200\ ml\ solution \times \frac{2.50\ moles\ C_6H_{12}O_6}{1000\ ml\ solution} \times \frac{180.0\ g\ C_6H_{12}O_6}{1\ mole\ C_6H_{12}O_6} = 90.0\ g\ C_6H_{12}O_6$

4. a) $Mg(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$,
   [or $Mg(s) + 2\ H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$]

   b) $125\ ml \times \frac{2.00\ moles\ HCl}{1000\ ml} \times \frac{1\ mole\ H_2}{2\ moles\ HCl} = 0.125\ moles\ H_2$

5. a) Precipate forms. $Fe^{3+}(aq) + 3\ OH^-(aq) \rightarrow Fe(OH)_3(s)$

   b) No Reaction (($(NH_4)_2CO_3$ and LiCl are both soluble)

   c) Precipate forms. $Ni^{2+}(aq) + S^{2-}(aq) \rightarrow NiS(s)$

6. Lots of possibilities: Pick a soluble Sr^{2+} and a soluble SO_4^{2-}, such as: $Sr(NO_3)_2$ and Na_2SO_4.

7. any strong acid + strong base: $H^+(aq) + OH^-(aq) \rightarrow H_2O$

8. At neutralization, $moles_{acid} = moles_{base}$

   $Volume_{acid} \times Molarity_{acid} = Volume_{base} \times Molarity_{base}$

   $Volume_{base} \times 2.00\ M = 12.5\ ml \times 0.0800\ M$

$$\text{Volume}_{base} = \frac{12.5\, ml\ x\ 0.0800\ M}{2.00\ M} = 0.500 \text{ ml}$$

9. a) $3\ Pb(NO_3)_2(aq) + 2\ AlCl_3(aq) \rightarrow 2\ Al(NO_3)_3(aq) + 3\ PbCl_2(s)$.

b) $$2.48 \text{ mL } x \ \frac{0.300\ moles\ AlCl_3}{1000\ mL\ solution}\ x\ \frac{3\ moles\ Pb(NO_3)_2}{2\ mol\ AlCl_3}\ x\ \frac{1000\ mL}{0.200\ mol\ Pb^{2+}} = 5.58 \text{ mL}$$

c) $$2.48 \text{ mL } x \ \frac{0.300\ moles\ AlCl_3}{1000\ mL\ solution}\ x\ \frac{3\ moles\ PbCl_2}{2\ mol\ AlCl_3}\ x\ \frac{278.1\ g\ PbCl_2}{1\ mol\ PbCl_2} = 0.310 \text{ g}$$

10. $2\ Fe(NO_3)_3(aq) + 3\ Na_2CO_3(aq) \rightarrow 6\ NaNO_3(aq) + Fe_2(CO_3)_3(s)$

This is a limiting reactant problem, so first determine which reactant is limiting.

$$71.3 \text{ mL } Fe(NO_3)_3 \text{ x } \frac{0.500\ moles\ Fe(NO_3)_3}{1000\ mL\ solution}\ x\ \frac{1\ mole\ Fe_2(CO_3)_3}{2\ mol\ Fe(NO_3)_3}\ x\ \frac{291.7\ g\ Fe_2(CO_3)_3}{1\ mol\ Fe_2(CO_3)_3}$$
$$= 5.20 \text{ g } Fe_2(CO_3)_3$$

$$112 \text{ mL } Na_2CO_3 \text{x } \frac{0.800\ moles\ Na_2CO_3}{1000\ mL\ solution}\ x\ \frac{1\ mole\ Fe_2(CO_3)_3}{3\ mol\ Na_2CO_3}\ x\ \frac{291.7\ g\ Fe_2(CO_3)_3}{1\ mol\ Fe_2(CO_3)_3}$$
$$= 8.71 \text{ g } Fe_2(CO_3)_3$$

Therefore, 5.20 g $Fe_2(CO_3)_3$ is formed.

11. $$3.94 \text{ g Cu x } \frac{1\ mole\ Cu}{63.54\ g}\ x\ \frac{8\ mol\ HNO_3}{3\ mol\ Cu}\ x\ \frac{1000\ ml\ solution}{2.50\ mol\ HNO_3} = 66.1 \text{ ml solution}$$