

Answers to Chapter 4 Study Questions

- strong acid: $\text{HNO}_3(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$
 - weak acid: $\text{HClO}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{ClO}^-(\text{aq})$
 - weak base: $\text{NH}_3(\text{aq}) + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$
 - neutral: $\text{NaNO}_3(\text{s}) \rightarrow \text{Na}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$
 - strong base: $\text{Ba}(\text{OH})_2(\text{s}) \rightarrow \text{Ba}^{2+}(\text{aq}) + 2 \text{OH}^-(\text{aq})$
- $\frac{29.2 \text{ g NaCl}}{0.250 \text{ L}} \times \frac{1 \text{ mol NaCl}}{58.4 \text{ g}} = 2.00 \text{ M NaCl}$
 - $$\text{Volume}_{\text{solution A}} \times \text{Molarity}_{\text{solution A}} = \text{Volume}_{\text{solution B}} \times \text{Molarity}_{\text{solution B}}$$

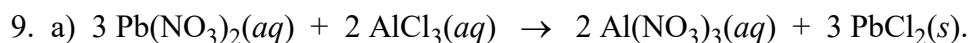
$$125 \text{ ml} \times 0.350 \text{ M NaCl} = x \text{ ml} \times 2.00 \text{ M NaCl}$$

$$x = \frac{125 \text{ ml} \times 0.350 \text{ M}}{2.00 \text{ M}} = 21.9 \text{ ml}$$
- $$200 \text{ ml solution} \times \frac{2.50 \text{ moles } \text{C}_6\text{H}_{12}\text{O}_6}{1000 \text{ ml solution}} \times \frac{180.0 \text{ g } \text{C}_6\text{H}_{12}\text{O}_6}{1 \text{ mole } \text{C}_6\text{H}_{12}\text{O}_6} = 90.0 \text{ g } \text{C}_6\text{H}_{12}\text{O}_6$$
- $\text{Mg}(\text{s}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2(\text{g})$,
 [or $\text{Mg}(\text{s}) + 2 \text{H}^+(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$]
 - $$125 \text{ ml} \times \frac{2.00 \text{ moles HCl}}{1000 \text{ ml}} \times \frac{1 \text{ mole } \text{H}_2}{2 \text{ moles HCl}} = 0.125 \text{ moles } \text{H}_2$$
- Precipitate forms. $\text{Fe}^{3+}(\text{aq}) + 3 \text{OH}^-(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s})$
 - No Reaction ((NH_4)₂CO₃ and LiCl are both soluble)
 - Precipitate forms. $\text{Ni}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{NiS}(\text{s})$
- Lots of possibilities: Pick a soluble Sr²⁺ and a soluble SO₄²⁻, such as: Sr(NO₃)₂ and Na₂SO₄.
- any strong acid + strong base: $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}$
- At neutralization, moles_{acid} = moles_{base}

$$\text{Volume}_{\text{acid}} \times \text{Molarity}_{\text{acid}} = \text{Volume}_{\text{base}} \times \text{Molarity}_{\text{base}}$$

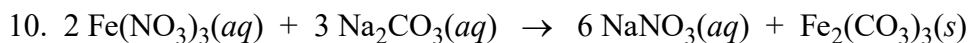
$$\text{Volume}_{\text{base}} \times 2.00 \text{ M} = 12.5 \text{ ml} \times 0.0800 \text{ M}$$

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



b) $2.48 \text{ mL} \times \frac{0.300 \text{ moles AlCl}_3}{1000 \text{ mL solution}} \times \frac{3 \text{ moles Pb}(\text{NO}_3)_2}{2 \text{ mol AlCl}_3} \times \frac{1000 \text{ mL}}{0.200 \text{ mol Pb}^{2+}} = 5.58 \text{ mL}$

c) $2.48 \text{ mL} \times \frac{0.300 \text{ moles AlCl}_3}{1000 \text{ mL solution}} \times \frac{3 \text{ moles PbCl}_2}{2 \text{ mol AlCl}_3} \times \frac{278.1 \text{ g PbCl}_2}{1 \text{ mol PbCl}_2} = 0.310 \text{ g}$



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

$$71.3 \text{ mL Fe}(\text{NO}_3)_3 \times \frac{0.500 \text{ moles Fe}(\text{NO}_3)_3}{1000 \text{ mL solution}} \times \frac{1 \text{ mole Fe}_2(\text{CO}_3)_3}{2 \text{ mol Fe}(\text{NO}_3)_3} \times \frac{291.7 \text{ g Fe}_2(\text{CO}_3)_3}{1 \text{ mol Fe}_2(\text{CO}_3)_3} \\ = 5.20 \text{ g Fe}_2(\text{CO}_3)_3$$

$$112 \text{ mL Na}_2\text{CO}_3 \times \frac{0.800 \text{ moles Na}_2\text{CO}_3}{1000 \text{ mL solution}} \times \frac{1 \text{ mole Fe}_2(\text{CO}_3)_3}{3 \text{ mol Na}_2\text{CO}_3} \times \frac{291.7 \text{ g Fe}_2(\text{CO}_3)_3}{1 \text{ mol Fe}_2(\text{CO}_3)_3} \\ = 8.71 \text{ g Fe}_2(\text{CO}_3)_3$$

Therefore, 5.20 g $\text{Fe}_2(\text{CO}_3)_3$ is formed.

11. $3.94 \text{ g Cu} \times \frac{1 \text{ mole Cu}}{63.54 \text{ g}} \times \frac{8 \text{ mol HNO}_3}{3 \text{ mol Cu}} \times \frac{1000 \text{ ml solution}}{2.50 \text{ mol HNO}_3} = 66.1 \text{ ml solution}$