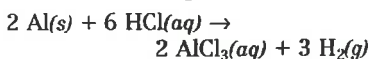


# Stoichiometry & Solutions

## Section 7.3 Review

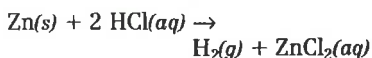
### Applying Inquiry/ Communication Skills

1. Aluminum reacts with hydrochloric acid according to the equation:



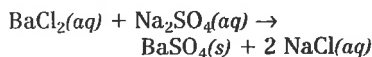
Calculate the volume of  $1.50 \text{ mol}\cdot\text{L}^{-1}$  hydrochloric acid that is required for  $5.40 \text{ g}$  aluminum to react completely.

2. Zinc metal reacts with hydrochloric acid according to the equation:

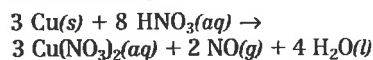


A piece of zinc metal requires  $75.0 \text{ mL}$  of  $3.00 \text{ mol}\cdot\text{L}^{-1}$  hydrochloric acid for a complete reaction. Determine the mass of the zinc metal used.

3. Calculate the volume of  $0.110 \text{ mol}\cdot\text{L}^{-1}$  sodium sulfate required to precipitate the maximum mass of barium sulfate from  $60.0 \text{ mL}$  of  $0.145 \text{ mol}\cdot\text{L}^{-1}$  barium chloride solution. The balanced equation is:



4. Copper reacts with concentrated nitric acid according to the equation following:



Calculate the volume of nitric acid ( $16.0 \text{ mol}\cdot\text{L}^{-1}$ ) required for a complete reaction if  $25.0 \text{ g}$  copper metal are used.

### Making Connections

6. About  $20\,000 \text{ t}$  of titanium dioxide are produced each year in Quebec by the sulfate process. Calculate the mass of pure iron(II) titanate that must be mined to obtain this mass of product and the volume of concentrated sulfuric acid ( $18 \text{ mol}\cdot\text{L}^{-1}$ ) that the plant has to purchase each year. Determine the environmental consequences of extracting titanium using the sulfate process.

## Practice

### Understanding Concepts

1. Ammonium sulfate is a "high-nitrogen" fertilizer. It is manufactured by reacting sulfuric acid with ammonia. In a laboratory study of this process,  $50.0 \text{ mL}$  of sulfuric acid reacts with  $24.4 \text{ mL}$  of a  $2.20 \text{ mol/L}$  ammonia solution to yield the product ammonium sulfate in solution. From this evidence, calculate the molar concentration of the sulfuric acid at this stage in the process.
2. Slaked lime is sometimes used in water treatment plants to clarify water for residential use. The lime is added to an aluminum sulfate solution in the water. Fine particles in the water stick to the floc precipitate produced, and settle out with it. Calculate the volume of  $0.0250 \text{ mol/L}$  calcium hydroxide solution that can be completely reacted with  $25.0 \text{ mL}$  of  $0.125 \text{ mol/L}$  aluminum sulfate solution.
3. In designing a solution stoichiometry experiment for her class to perform, a chemistry teacher wants  $75.0 \text{ mL}$  of  $0.200 \text{ mol/L}$  iron(III) chloride solution to react completely with an excess of  $0.250 \text{ mol/L}$  sodium carbonate solution.
- (a) What is the *minimum* volume of this sodium carbonate solution needed?
- (b) What would be a *reasonable* volume of this sodium carbonate solution to use in this experiment? Provide your reasoning.

### Answers

1.  $0.537 \text{ mol/L}$   
2.  $375 \text{ mL}$   
3. (a)  $90.0 \text{ mL}$   
(b)  $100 \text{ mL}$

$12 + 6$

# Stoichiometry & Solutions Assignment



5.40g      1.5 mol/L  
 $M_{\text{Al}} = 26.98 \text{ g/mol}$        $V = ?$

$n = 0.2 \text{ mol}$

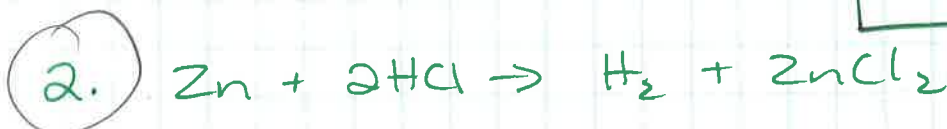
$\frac{0.2}{2} \times 6 = 0.6 \text{ mol HCl}$

$V = \frac{n}{C}$   
 $= \frac{0.6}{1.5}$

$V = 0.4 \text{ L}$

$n = C \times V$   
 $V = \frac{n}{C}$

(3)



? mass      75 mL  
 $= 0.075 \text{ L}$   
 3 mol/L

$\frac{0.225}{2} \quad n = C \times V$   
 $= 0.1125 \text{ mol} \quad = 0.225$

$\times 65.39 \text{ g/mol}$

7.36 g Zn



(3)



60 mL      0.11 mol/L  
 $= 0.06 \text{ L}$

0.145 mol/L      1:1  
 $\therefore 0.0087 \text{ mol}$

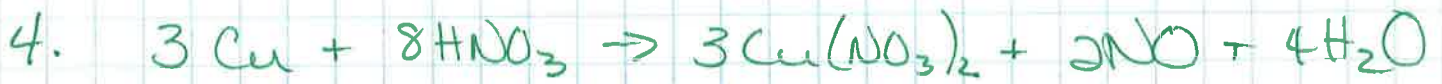
$n = C \times V$   
 $= 0.0087 \text{ mol}$

$V = \frac{n}{C}$   
 $= \frac{0.0087}{0.11}$

$= 0.079 \text{ L}$

79 mL

(3)



$$\begin{aligned} & 25\text{g} \\ & \div 63.55\text{g/mol} \\ & = \boxed{0.3934\text{ mol}} \end{aligned}$$

$$\begin{aligned} V &= ? \\ c &= 16\text{ mol/L} \end{aligned}$$

$$8 = 1.049\text{ mol} \quad \checkmark$$

$$\begin{aligned} V &= \frac{n}{c} \\ &= \frac{1.049}{16} \quad \checkmark \\ &= 0.0656\text{ L} \\ &= \underline{\underline{65.6\text{ mL}}} \quad \checkmark \end{aligned}$$

(3)

6. Bonus



? g

V?

20000t

c = 18 mol/L

= 20000000000.0

$2 \times 10^{10}$  g

$$\frac{2 \times 10^{10} \text{ g}}{79.87 \text{ g/mol}} = 250406911 \text{ mol}$$

$2.5 \times 10^8$  mol

18

$$\begin{array}{r} \text{TiO}_2 \quad 47.87 \\ \quad \quad 32.00 \\ \hline \quad \quad 79.87 \text{ g/mol} \end{array}$$

+