

## Solutions to page 68

1. Here's the fast way, as shown in class. But from # 2 onwards; I'll only show it, step by step using proportions instead of the ratio.

a.  $3 \text{ moles of NH}_3 \left[ \frac{5\text{O}_2}{4\text{NH}_3} \right] = 3(5)/4 = 3.75 \text{ moles of O}_2$

**or**

a. equation shows:  $5 \text{ O}_2 \quad 4\text{NH}_3$ , so

$$\frac{5}{x} = \frac{4}{3}$$

$$4x = 15$$

$$x = 3.75 \text{ moles of O}_2$$

b.

$$3 \text{ moles of O}_2 \left[ \frac{4 \text{ NO}}{5 \text{ O}_2} \right] = \frac{3 \cdot 4}{5} = 2.4 \text{ moles NO}$$

$$2.4 \text{ moles NO} \left[ \frac{30 \text{ g}}{\text{mole}} \right] = 72 \text{ g NO}$$

**Or**

$$\frac{5}{3} = \frac{4}{x}$$

$$x = 12/5 = 2.4 \text{ moles of NO}$$

$$2.4 \text{ moles of NO (14 +16 g/mole) =72 g}$$

c.  $2.8 \text{ g NO} \left[ \frac{\text{mole}}{30 \text{ g}} \right] = 0.0933 \text{ moles NO}$

$$0.0933 \text{ moles NO} \left[ \frac{6 \text{ H}_2\text{O}}{4 \text{ NO}} \right] = 0.14 \text{ moles of H}_2\text{O}$$

**or**  $2.8 \text{ g NO} / (14 +16 \text{ g/mole}) = 0.0933 \text{ moles NO}$

$$\frac{4}{0.0933} = \frac{6}{x}$$

x = 0.14 moles of water

d.  $90 \text{ g H}_2\text{O} \left[ \frac{\text{mole}}{18 \text{ g}} \right] = 5 \text{ moles H}_2\text{O}$

$$5 \text{ moles H}_2\text{O} \left[ \frac{5 \text{ O}_2}{6 \text{ H}_2\text{O}} \right] = \frac{5 \cdot 5}{6} = 4.166 \text{ moles O}_2$$

$$4.166 \text{ moles O}_2 \left[ \frac{32 \text{ g}}{\text{mole}} \right] = 133 \text{ g O}_2$$

**or**  $90 \text{ g H}_2\text{O} / (18 \text{ g/mole}) = 5.0 \text{ moles H}_2\text{O}$

$$\frac{5}{x} = \frac{6}{5}$$

x = 25/6 = 4.2 moles O<sub>2</sub>

$$4.2 \text{ moles O}_2(32 \text{ g/mole}) = 133 \text{ g}$$

2. a. answer = 8 moles



$$1 \text{ g H}_2 / (2 \text{ g/mole}) = 0.5 \text{ mole H}_2$$

From ratio, twice as many moles of Cu will be produced:  
 0.5 (2) = 1.0 moles = 63.5 g

3. a. Given:  $\text{C}_6\text{H}_{14} + 9.5 \text{ O}_2 \rightarrow 6 \text{ CO}_2 + 7 \text{ H}_2\text{O} + 3500 \text{ kJ}$

a. How much heat in kJ will be released if only 0.34 moles of C<sub>6</sub>H<sub>14</sub> react?(treat kJ like moles)

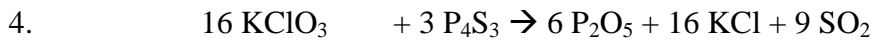
b. How many moles of CO<sub>2</sub> will escape if 4.5 moles of oxygen react?

**Answer** Since kJ are part of the equation, you can treat them like moles.

$$0.34 \text{ moles of } C_6H_{14} \left( \frac{3500 \text{ kJ}}{1 C_6H_{14}} \right) = \frac{0.34 * 3500}{1} = 1190 \text{ kJ}$$

b.

$$x = 2.84 \text{ moles } CO_2$$



a. How many grams of sulfur dioxide escape each time 0.0010 moles of  $KClO_3$  react?

$$0.0010 \text{ moles of } KClO_3 \left( \frac{9 SO_2}{16 KClO_3} \right) = \frac{0.0010 * 9}{16} = 0.0005625 \text{ moles}$$

$SO_2$

$$0.0005625 \text{ moles } SO_2 * (64 \text{ g/mole}) = 0.036 \text{ g } SO_2$$

b.  $4.4 \text{ g of } P_4S_3 \left[ \frac{\text{mole}}{4(31) + 3(32) \text{ g}} \right] = 0.02 \text{ moles of } P_4S_3.$   
Then apply the ratio and you will obtain 0.06 moles of  $SO_2$ .

c.  $12.2 \text{ g } KClO_3 / (39 + 35.3 + 48 \text{ g/mole}) = 0.10 \text{ moles of } KClO_3$

Apply the ratio:  $= 0.10 \text{ moles of } KCl$

Then convert to grams:  $0.10 (39 + 35.5) = 7.5 \text{ g } KCl$

5. a. equation reveals that 4  $KNO_3$  react with 7 moles of C, so  
Apply the ratio and you will get 3.5 moles of C  
 $3.5 \text{ moles of } C = 3.5 * 12 = 42 \text{ g of } C$

b.  $1010 \text{ g } KNO_3 \left[ \frac{\text{mole}}{39 + 14 + 3 * 16 \text{ g}} \right] = 10 \text{ moles } KNO_3$   
from the equation we get the ratio, (remember we are comparing  $KNO_3$  to both CO and  $CO_2$ )

;  $x = 30/4 = 7.5$  moles of CO and 7.5 moles of CO<sub>2</sub>.

$$7.5 \text{ moles of CO}_2 \cdot \left[ \frac{44 \text{ g}}{\text{mole}} \right] = 330 \text{ g of CO}_2.$$

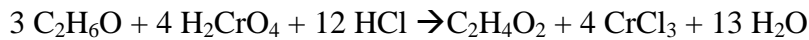
$$7.5 \text{ moles of CO}_2 \cdot \left[ \frac{28 \text{ g}}{\text{mole}} \right] = 210 \text{ g g of CO}$$

$$\text{Total} = 330 + 210 = 540 \text{ g.}$$

c.  $4.4 \text{ g} = 0.10$  moles of CO<sub>2</sub>.

From the ratio,  $0.10/3 = 0.033$  moles of S

6. The question was: Vodka is 40% alcohol by volume. Alcohol's density is 0.7893g/mL. What's the minimum mass of H<sub>2</sub>CrO<sub>4</sub> and HCl needed to destroy the alcohol in 2.0 L of vodka?



Vodka is 40% alcohol, so:  $0.40 ( 2.0 \text{ L}) = 0.80 \text{ L of alcohol} = 800 \text{ mL}$

$$800 \text{ mL} \left[ \frac{0.7893 \text{ g}}{\text{ml}} \right] = 631.44 \text{ g of C}_2\text{H}_6\text{O}$$

$$\left[ \frac{\text{mole}}{2(12) + 6(1) + 16} \right] = 13.72 \text{ moles of C}_2\text{H}_6\text{O}$$

Apply the ratio from the equation:

$$13.72 \text{ moles of C}_2\text{H}_6\text{O} \left( \frac{12 \text{ HCl}}{3 \text{ C}_2\text{H}_6\text{O}} \right) = \frac{13.72 * 12}{3}$$

$$= 54.88 \text{ moles of HCl}$$

$$= 54.88 \text{ moles HCl (36.5g/mole)} = 2003 \text{ g HCl}$$

If they had asked for H<sub>2</sub>CrO<sub>4</sub>.

Repeat the procedure. Start with 13.72 moles of C<sub>2</sub>H<sub>6</sub>O . Apply the ratio of 4/3

$$18.3 \text{ moles of H}_2\text{CrO}_4$$

18.3 moles  $\text{H}_2\text{CrO}_4$  ( $[2 + 52+64]\text{g /mole}$ ) = 2159 g  $\text{H}_2\text{CrO}_4$ .