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 moles of NH_3 $\left[\frac{5O_2}{4NH_3}\right] = 3(5)/4 = 3.75 \text{ moles of } O_2$

or

a. equation shows: 5 O_2 4NH_3, so

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

4x = 15

x = 3.75 moles of O_2

b.

3 moles of O_2 $\left[\frac{4NO}{5O_2}\right] = \frac{3*4}{5} = 2.4 \, moles\ NO$

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

Or

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

x = 12/5 = 2.4 moles of NO

2.4 moles of NO (14 +16 g/mole) =72 g

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

0.0933 moles NO $\left[\frac{6H_2O}{4NO}\right] = 0.14 \, moles\ of\ H_2O$

or 2.8 g NO /(14 +16 g/mole) =0.0933 moles NO

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

x = 0.14 moles of water

d. 90 g H_2O $\left[\frac{mole}{18\,g}\right]$ = 5 moles H_2O

5 moles H_2O $\left[\frac{5\,O_2}{6\,H_2O}\right] = \frac{5*5}{6}$ = 4.166 moles O_2

4.166 moles O_2 $\left[\frac{32\,g}{mole}\right] = 133\,g\,O_2$

or 90 g H_2O / (18 g/mole) = 5.0 moles H_2O

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

x = 25/6 = 4.2 moles O_2

4.2 moles O_2(32 g/mole) = 133 g

2. a. answer = 8 moles

b. $H_2 + Cu_2S \rightarrow 2\ Cu + H_2S$

1g H_2/(2g/mole) = 0.5 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: $C_6H_{14} + 9.5\ O_2 \rightarrow 6\ CO_2 + 7\ H_2O + 3500$ kJ

a. How much heat in kJ will be released if only 0.34 moles of C_6H_{14} react?(treat kJ like moles)

b. How many moles of CO_2 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 moles of C_6H_{14} $\left(\frac{3500\,kJ}{1C_6H_{14}}\right) = \frac{0.34*3500}{1} = 1190kJ$

b.

x = 2.84 moles CO_2

4. $16\ KClO_3 + 3\ P_4S_3 \rightarrow 6\ P_2O_5 + 16\ KCl + 9\ SO_2$

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

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

0.0005625 moles SO_2*(64 g/mole) = 0.036 g SO_2

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

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

Apply the ratio: = 0.10 moles of KCl

Then convert to grams: 0.10 (39+35.5) = 7.5 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 moles of C = 3.5 * 12 = 42 g of C

b. 1010 g KNO_3 $\left[\frac{mole}{39+14+3*16g}\right]$ = 10 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_2.

7.5 moles of CO_2. $\left[\frac{44g}{mole}\right]$ = 330 g of CO_2.

7.5 moles of CO_2. $\left[\frac{28g}{mole}\right]$ = 210 g g of CO

Total = 330 + 210 = 540 g.

c. 4.4 g = 0.10 moles of CO_2.

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_2CrO_4 and HCl needed to destroy the alcohol in 2.0 L of vodka?

$3\ C_2H_6O + 4\ H_2CrO_4 + 12\ HCl \rightarrow C_2H_4O_2 + 4\ CrCl_3 + 13\ H_2O$

Vodka is 40%alcohol, so: 0.40 (2.0 L) = 0.80 L of alcohol = 800 mL

$$800\ mL\left[\frac{0.7893\ g}{ml}\right] = 631.44\,g\ of\ C_2H_6O$$

$$\left[\frac{mole}{2(12)+6(1)+16}\right] = 13.72\ moles\ of\ C_2H_6O$$

Apply the ratio from the equation:

$$13.72\ moles\ of\ C_2H_6O\left(\frac{12\,HCl}{3C_2H_6O}\right) = \frac{13.72*12}{3}$$

= 54.88 moles of HCl

= 54.88 moles HCl (36.5g/mole) = 2003 g HCl

If they had asked for H_2CrO_4.

Repeat the procedure. Start with 13.72 $moles\ of\ C_2H_6O$. Apply the ratio of 4/3

18.3 moles of H_2CrO_4

18.3 moles H_2CrO_4 ([2 + 52+64]g /mole) = 2159 g H_2CrO_4.