5. Consider the explosive reaction of diborane in the air:

$B_2H_{6(g)} + 3O_{2(g)} \rightarrow B_2O_{3(s)} + 3H_2O_{(g)}$ $\Delta H = -2035$ kJ

a.) Calculate the heat released when 1.0 gram of diborane is burned?

$\frac{1.0g}{1} \cdot \frac{1 mol}{27.6g} \cdot \frac{-2035 kJ}{1 mol} = -73.7 kJ$

b.) What amount of heat is generated when 500. liters of O_2 is reacted at STP?

$\frac{500.0L}{} \cdot \frac{1 mol O_2}{22.4L} \cdot \frac{-2035 kJ}{3 mol O_2} = -15100 kJ$

c.) How much heat is released when a mixture of 30.0 g of B_2H_6 and 30.0 g of O_2 is reacted?

$\frac{30.0g B_2H_6}{27.6 g/mol}$ 1.09 mol $\frac{30.0g O_2}{32 g/mol}$ 0.9375 mol (L.R.) ($\frac{3}{1}$)

$\frac{0.9375 mol O_2}{1} \cdot \frac{-2035 kJ}{3 mol O_2} = -636 kJ$

6. Compare the two fuels H_2 and CH_4:

Ignition of H_2 gas: $2H_2 + O_2 \rightarrow 2H_2O$ $\Delta H = -572$ kJ

Combustion of CH_4 (methane): $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ $\Delta H = -891$ kJ

a.) Which source of energy gives more energy per gram? (*Show calculations for both amounts in kJ/g*)

H_2: $\frac{-572 kJ}{2 mol H_2} \cdot \frac{1 mol H_2}{2g} = -143 kJ/g$

CH_4: $\frac{-891 kJ}{1 mol CH_4} \cdot \frac{1 mol CH_4}{16g} = -55.7 kJ/g$

$H_2 > CH_4$

b.) Find the amount of energy that is released when 25.0 liters of methane reacts with 60.0 liters of oxygen at STP.

25.0L CH_4 (L.R.) 60.0L O_2 ($\frac{2}{1}$) > 50.0L

$\frac{25.0L CH_4}{1} \cdot \frac{1 mol CH_4}{22.4L} \cdot \frac{-89 kJ}{1 mol CH_4} = -99.3 kJ$

7. Given: $Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$ $\Delta H = -23$ kJ

What amount of heat energy is released when 3.31 grams of iron(III) oxide reacts with 1.18 grams of carbon monoxide?

$\frac{3.31g Fe_2O_3}{159.7 g/mol}$ 0.0207 mol ($\frac{3}{1}$) $\frac{1.18g CO}{28 g/mol}$

$\frac{0.0421 mol CO}{L.R.} \cdot \frac{-23 kJ}{3 mol CO} = -0.323 kJ$