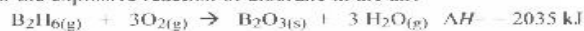


5. Consider the explosive reaction of diborane in the air:



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

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

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

$$\frac{500. \text{ L}}{1} \cdot \frac{1 \text{ mol O}_2}{22.4 \text{ L}} \cdot \frac{-2035 \text{ kJ}}{3 \text{ mol O}_2} = \boxed{-15100 \text{ kJ}}$$

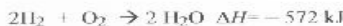
c.) How much heat is released when a mixture of 30.0 g of B_2H_6 and 30.0 g of O_2 is reacted?

$$\begin{array}{l} \frac{30.0 \text{ g B}_2\text{H}_6}{27.6 \text{ g/mol}} = 1.09 \text{ mol} \\ \frac{30.0 \text{ g O}_2}{32 \text{ g/mol}} = 0.9375 \text{ mol} \end{array} \quad \begin{array}{l} \text{L.R.} \\ \text{L.R.} \end{array}$$

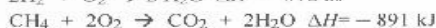
$$\frac{0.9375 \text{ mol O}_2}{1} \cdot \frac{-2035 \text{ kJ}}{3 \text{ mol O}_2} = \boxed{-636 \text{ kJ}}$$

6. Compare the two fuels H_2 and CH_4 :

Ignition of H_2 gas:



Combustion of CH_4 (methane):



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

$$\begin{array}{l} \text{H}_2: \\ \frac{-572 \text{ kJ}}{2 \text{ mol H}_2} \cdot \frac{1 \text{ mol H}_2}{2 \text{ g}} = \frac{-143 \text{ kJ}}{\text{g}} \end{array} \quad \begin{array}{l} \text{CH}_4: \\ \frac{-891 \text{ kJ}}{1 \text{ mol CH}_4} \cdot \frac{1 \text{ mol CH}_4}{16 \text{ g}} = \frac{-55.7 \text{ kJ}}{\text{g}} \end{array}$$

$\text{H}_2 > \text{CH}_4$

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

$$\begin{array}{l} \frac{25.0 \text{ L CH}_4}{1} \cdot \frac{1 \text{ mol CH}_4}{22.4 \text{ L}} \cdot \frac{-891 \text{ kJ}}{1 \text{ mol CH}_4} = \boxed{-99.3 \text{ kJ}} \end{array}$$

7. Given: $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g}) \quad \Delta H = -23 \text{ kJ}$

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

$$\begin{array}{l} \frac{3.31 \text{ g Fe}_2\text{O}_3}{159.7 \text{ g/mol}} = 0.0207 \text{ mol} \\ \frac{1.18 \text{ g CO}}{28 \text{ g/mol}} = 0.0421 \text{ mol} \end{array} \quad \begin{array}{l} \text{L.R.} \\ \text{L.R.} \end{array}$$

$$\frac{0.0421 \text{ mol CO}}{1} \cdot \frac{-23 \text{ kJ}}{3 \text{ mol CO}} = \boxed{-0.323 \text{ kJ}}$$