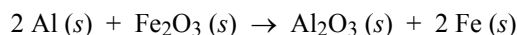


Calculating changes in enthalpy (ΔH)

1. Using enthalpies of formation, calculate the standard change in enthalpy for the thermite reaction:

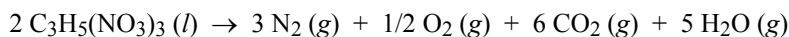


$$\Delta H_{\text{rxn}}^{\circ} = \sum n \Delta H_f^{\circ} (\text{prod.}) - \sum m \Delta H_f^{\circ} (\text{reac.})$$

$$\Delta H_{\text{rxn}}^{\circ} = (1 \text{ mol})(-1669.8 \text{ kJ/mol}) + (2 \text{ mol})(0) - [(2 \text{ mol})(0) + (1 \text{ mol})(-822.2 \text{ kJ/mol})]$$

$$\Delta H_{\text{rxn}}^{\circ} = \mathbf{-847.6 \text{ kJ}}$$

2. a) Nitroglycerin is a powerful explosive, giving four different gases when detonated.



Given that the enthalpy of formation of nitroglycerin, ΔH_f° , is -364 kJ/mol , calculate the energy (heat at constant pressure) released by this reaction.

$$\Delta H_{\text{rxn}}^{\circ} = \sum n \Delta H_f^{\circ} (\text{prod.}) - \sum m \Delta H_f^{\circ} (\text{reac.})$$

$$\Delta H_{\text{rxn}}^{\circ} = (3 \text{ mol})(0) + (1/2 \text{ mol})(0) + (6 \text{ mol})(-393.5 \text{ kJ/mol}) + (5 \text{ mol})(-241.8 \text{ kJ/mol}) - (2 \text{ mol})(-364 \text{ kJ/mol})$$

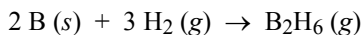
$$\Delta H_{\text{rxn}}^{\circ} = \mathbf{-2842 \text{ kJ}}$$

- b) Calculate the energy liberated when 10.0 g of nitroglycerin are detonated.

$$10.0 \text{ g NG} \times \frac{1 \text{ mol NG}}{227 \text{ g NG}} = 0.0441 \text{ mol NG}$$

$$0.0441 \text{ mol NG} \times \frac{-2842 \text{ kJ}}{2 \text{ mol NG}} = \mathbf{-62.7 \text{ kJ}}$$

3. Diborane (B_2H_6) is a highly reactive boron hydride, which was once considered as a possible rocket fuel for the U.S. space program. Calculate ΔH for the synthesis of diborane from its elements, according to the equation



using the following data:

	ΔH
$2 \text{B} (s) + 3/2 \text{O}_2 (g) \rightarrow \text{B}_2\text{O}_3 (s)$	-1273 kJ
$\text{B}_2\text{H}_6 (g) + 3 \text{O}_2 (g) \rightarrow \text{B}_2\text{O}_3 (s) + 3 \text{H}_2\text{O} (g)$	-2035 kJ
$\text{H}_2 (g) + 1/2 \text{O}_2 (g) \rightarrow \text{H}_2\text{O} (l)$	-286 kJ
$\text{H}_2\text{O} (l) \rightarrow \text{H}_2\text{O} (g)$	+44 kJ
$2 \text{B} (s) + 3/2 \text{O}_2 (g) \rightarrow \text{B}_2\text{O}_3 (s)$	$\Delta H = -1273 \text{ kJ}$
$3 \text{H}_2 (g) + 3/2 \text{O}_2 (g) \rightarrow 3 \text{H}_2\text{O} (l)$	$\Delta H = 3(-286 \text{ kJ})$
$\text{B}_2\text{O}_3 (s) + 3 \text{H}_2\text{O} (g) \rightarrow \text{B}_2\text{H}_6 (g) + 3 \text{O}_2 (g)$	$\Delta H = +2035 \text{ kJ}$
$3 \text{H}_2\text{O} (l) \rightarrow 3 \text{H}_2\text{O} (g)$	$\Delta H = 3(+44 \text{ kJ})$
<hr/>	
$2 \text{B} (s) + 3 \text{H}_2 (g) \rightarrow \text{B}_2\text{H}_6 (g)$	$\Delta H = 36 \text{ kJ}$