**Problem 67**

a) \[ C_8H_{18}(l) + \frac{25}{2}O_2(g) \rightarrow 8CO_2(g) + 9H_2O(g) \]
\[ \Delta H = -5069 \text{ kJ} \]

b) \[ 8C(s) + 9H_2(g) \rightarrow C_8H_{18}(l) \]

c) \[ \Delta H_{\text{rxn}}^\circ = 8 \Delta H_f^\circ (CO_2(g)) + 9 \Delta H_f^\circ (H_2O(g)) - [\Delta H_f^\circ (C_8H_{18}(l)) + 0] \]
\[ -5069 \text{ kJ} = 8(-393.5 \text{ kJ}) + 9(-241.8 \text{ kJ}) - \Delta H_f^\circ (C_8H_{18}(l)) \]
\[ -5069 \text{ kJ} = -5324.2 \text{ kJ} - \Delta H_f^\circ (C_8H_{18}(l)) \]
\[ \Delta H_f^\circ (C_8H_{18}(l)) = -255 \text{ kJ} \]

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**Problem 83**

a) No heat is transferred, \( q = 0 \)

Work is done on the system (the gas) \( \rightarrow \) \( w > 0 \)
to compress the gas

\[ \Delta E = q + w \rightarrow \Delta E > 0 \text{ (positive)} \]

b) If the cylinder, which is part of the surroundings, gets warmer, heat must leave the system (gas) to warm the cylinder \( q < 0 \) (negative)

\[ \Delta E = q + w \rightarrow \text{The amount of work done will be the same as in part (a), so the increase in } \Delta E \text{ will be smaller.} \]

c) As described above, the change in internal energy will be different in (a) and (b), so the changes in state must also be different [The final temperature of the gas will be lower in (b)].