COMBINATION PROBLEM 8

$C_2H_5OH(l) + 3\,O_2(g) \longrightarrow 2\,CO_2(g) + 3\,H_2O(l) \qquad \Delta H^o = ?$

$$Q = mc\Delta T$$
$$Q = 8\,000 \text{ g x } 4.184 \frac{J}{g^oC} (40 - 20)^oC$$
$$Q = 669440 \text{ J}$$
$$Q = 669.44 \text{ kJ}$$

$$\frac{669.44 \text{ kJ}}{21.9 \text{ g } C_2H_5OH} \text{ x } \frac{46.08 \text{ g } C_2H_5OH}{1 \text{ mol } C_2H_5OH} = \frac{1408.58 \text{ kJ}}{1 \text{ mol } C_2H_5OH}$$

$$\Delta H = -Q$$
$$\Delta H = -1408.58 \text{ kJ/1 mol } C_2H_5OH$$

$C_2H_5OH(l) + 3\,O_2(g) \longrightarrow 2\,CO_2(g) + 3\,H_2O(l) \qquad \Delta H^o = -1408.58 \text{ kJ}$

$$\Delta H^o = [2\Delta H^o_{CO_2(g)} + 3\Delta H^o_{H_2O(l)}] - [\Delta H^o_{C_2H_5OH(g)} + 3\Delta H^o_{O_2(g)}]$$
$$-1408.58 \text{ kJ} = [2(-393.5 \text{ kJ}) + 3(-285.8 \text{ kJ})] - [\Delta H^o_{C_2H_5OH} + 3(0)]$$
$$\Delta H^o_{C_2H_5OH(g)} = -1644.4 \text{ kJ} + 1408.58 \text{ kJ}$$
$$\Delta H^o_{C_2H_5OH(g)} = -235.82 \text{ kJ}$$

Please note that the textbook value (pg 799) for the heat of formation of $C_2H_5OH(l)$ is -235.2 kJ. This is definitely close enough!