COMBINATION PROBLEM 1

$C_4H_{10}(g) + \frac{13}{2}\,O_2(g) \longrightarrow 4\,CO_2(g) + 5\,H_2O(l) \qquad \Delta H^o = ?$

$$Q = mc\Delta T$$
$$Q = 30\,000 \text{ g x } 4.184\ \frac{J}{g^oC}\ (23.94\ -\ 20.00)^oC$$
$$Q = 494548.8 \text{ J}$$
$$Q = 494.55 \text{ kJ}$$

$$\frac{494.55 \text{ kJ}}{10 \text{ g } C_4H_{10}} \text{ x } \frac{58.14 \text{ g } C_4H_{10}}{1 \text{ mol } C_4H_{10}} = \frac{2875.31 \text{ kJ}}{1 \text{ mol } C_4H_{10}}$$

$$\Delta H = -Q$$
$$\Delta H = -2875.31 \text{ kJ/1 mol } C_4H_{10}$$

$C_4H_{10}(g) + \frac{13}{2}\,O_2(g) \longrightarrow 4\,CO_2(g) + 5\,H_2O(l) \qquad \Delta H^o = -2875.31 \text{ kJ}$

$$\Delta H^o = [4\Delta H^o_{CO_2(g)} + 5\Delta H^o_{H_2O(l)}] - [\Delta H^o_{C_4H_{10}(g)} + \tfrac{13}{2}\Delta H^o_{O_2(g)}]$$
$$-2875.31 \text{ kJ} = [4(-393.5 \text{ kJ}) + 5(-285.8 \text{ kJ})] - [\Delta H^o_{C_4H_{10}} + \tfrac{13}{2}(0)]$$
$$\Delta H^o_{C_4H_{10}(g)} = -3003.0 \text{ kJ} + 2875.31 \text{ kJ}$$
$$\Delta H^o_{C_4H_{10}(g)} = -127.69 \text{ kJ}$$

Please note that the textbook value (pg 799) for the heat of formation of C_4H_{10} is -125.6 kJ. This is definitely close enough!