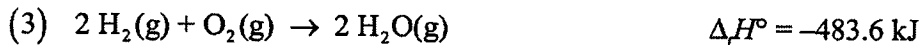
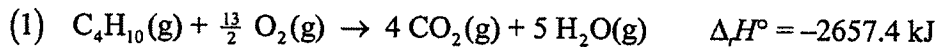
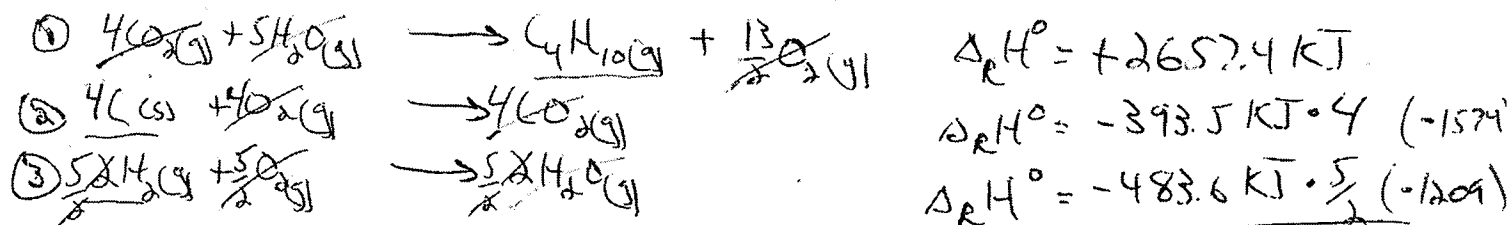


6. In an experiment to find the standard molar enthalpy of formation of butane (from its elements), the following values were determined experimentally from calorimetry:



Use Hess' law to determine the standard molar enthalpy of formation of butane. [3]



$\Delta_f H^\circ = -125.6 \text{ kJ/mol}$

7. One method of preparing methanol combines carbon monoxide and hydrogen at high temperature and pressure, in the presence of a catalyst.



a) Determine the enthalpy change for the reaction. [1]

$\Delta_r H = \sum n \cdot \Delta_f H_m - \sum n \cdot \Delta_{fr} H_m$

$\Delta_r H = 1 \cdot \text{mol} \cdot -239.2 \text{ kJ/mol} - (1 \cdot \text{mol} \cdot -110.5 \text{ kJ/mol} + 2 \cdot \text{mol} \cdot 0 \text{ kJ/mol}) = \boxed{-128.7 \text{ kJ}}$

b) Determine the mass of liquid water that could be heated from 20.0 °C to 85.0 °C from the energy released by the formation of 1.00 kg of methanol. $CH_3OH(l)$ [2]

$m = 1000 \text{ g}$
 $M = \frac{C: 1 \cdot 12.00 \text{ g/mol} + H: 4 \cdot 1.01 \text{ g/mol} + O: 1 \cdot 16.00 \text{ g/mol}}{32.04 \text{ g/mol}}$

$n = \frac{m}{M} = \frac{1000 \text{ g}}{32.04 \text{ g/mol}}$

$n = 31.2 \text{ mol}$

$\Delta_f H = n \cdot \Delta_f H_m$

$\Delta_f H = 31.2 \text{ mol} \cdot -128.7 \text{ kJ}$

$\Delta_f H = 4,016.9 \text{ kJ}$

$Q = mc\Delta t$

$m = \frac{Q}{c\Delta t}$

$m = \frac{4,016.9 \text{ kJ}}{(4.19 \frac{\text{kJ}}{\text{kg} \cdot \text{C}} \cdot (85.0^\circ\text{C} - 20.0^\circ\text{C}))}$

$m = 14.7 \text{ kg}$