Calculate an enthalpy of reaction from enthalpies of formation

(a) Calculate the standard enthalpy change for the combustion of 1 mol of benzene, $C_6H_6(l)$, to form $CO_2(g)$ and $H_2O(l)$. Determine the the quantity of heat produced by the combustion of 1g of benzene.

$$C_6H_6(l) + \frac{15}{2} O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(l)$$

$$\Delta H^\circ_{rxn} = 6\Delta H_f^\circ CO_2 + 3\Delta H_f^\circ (H_2O) - [\Delta H_f^\circ (C_6H_6) + \frac{15}{2}\Delta H_f^\circ O_2]$$

$$= 6(-393.5\ kJ) + 3(-285.8) - [49.0\ kJ + \frac{15}{2}(0)]$$

$$= -2361 - 857.4 - 49.0 = -3267\ kJ$$

$$C_6H_6(l) : \frac{-3267\ kJ}{mol} \times \frac{1\ mol}{78.1\ g} = \boxed{-41.8\ kJ/g}$$

Calculate an enthalpy of formation using an enthalpy of reaction
The standard enthalpy change for the reaction:

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g) \quad \Delta H_{rxn} = 178.1\ kJ$$

Given the standard enthalpies of formation of CaO(s) and $CO_2(g)$ calculate the standard enthalpy of formation of $CaCO_3(s)$.

$$\Delta H^\circ_{rxn} = [\Delta H_f^\circ CaO + \Delta H_f^\circ (CO_2)] - \Delta H_f^\circ (CaCO_3)$$

$$178.1\ kJ = -635.5\ kJ + (-393.5\ kJ) - \Delta H_f\ CaCO_3$$

$$\Delta H_f\ CaCO_3 = -635.5\ kJ + -393.5\ kJ - 178.1\ kJ = -1207.1\ \frac{kJ}{mol}$$