

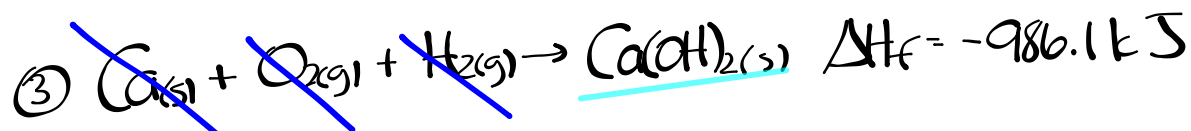
$$\Delta H_f = -1273 \text{ kJ}$$

Predicting ΔH_r Using Formation Reactions

The Standard Enthalpy Change (ΔH_r°) for a reaction can be found by writing the formation equation and corresponding standard enthalpy change for each compound in the given equation and then applying Hess' Law.



Step 1: Write formation equations (with standard enthalpy change) each compound in the given equation.



Step 2: Apply Hess' Law



$$\Delta H_r = -65.4 \text{ kJ}$$

Enthalpies of Formation to Predict ΔH_r

$$\Delta H_r = \underset{\substack{\text{Ca(OH)}_2 \\ *}}{\Delta H_f} + \underset{\substack{\text{CaO} \\ \text{Rev.}}}{(-\Delta H_f)} + \underset{\substack{\text{H}_2\text{O} \\ \text{Rev.}}}{(-\Delta H_f)}$$

$$\Delta H_r = \underset{\text{Ca(OH)}_2}{\Delta H_f} - (\underset{\text{CaO}}{\Delta H_f} + \underset{\text{H}_2\text{O}}{\Delta H_f})$$

$$\Delta H_r = \underset{\text{products}}{\Delta H_{fp}} - \underset{\text{reactants}}{\Delta H_{fr}}$$

$$\Delta H_r = \sum n H_{fp} - \sum n H_{fr}$$



$$\Delta H_r = \sum n H_{fp} - \sum n H_{fr}$$

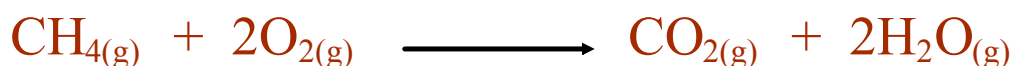
$$\Delta H_r = \left[(1 \text{ mol}) \left(-986.1 \frac{\text{kJ}}{\text{mol}} \right) \right] -$$

$$\left[(1 \text{ mol}) \left(-634.9 \frac{\text{kJ}}{\text{mol}} \right) + (1 \text{ mol}) \left(-285.8 \frac{\text{kJ}}{\text{mol}} \right) \right]$$

$$\Delta H_r = (-986.1 \text{ kJ}) - (-920.7 \text{ kJ})$$

$$\Delta H_r = -65.4 \text{ kJ}$$

Ex. What is the standard molar enthalpy of combustion of methane fuel?



$$\Delta H_r = \sum n H_{f,p} - \sum n H_{f,r}$$

$$\Delta H_r = \left[(1 \text{ mol}) \left(-393.5 \frac{\text{kJ}}{\text{mol}} \right) + (2 \text{ mol}) \left(-241.8 \frac{\text{kJ}}{\text{mol}} \right) \right] - \left[(1 \text{ mol}) \left(-74.4 \frac{\text{kJ}}{\text{mol}} \right) + (2 \text{ mol}) \left(0 \frac{\text{kJ}}{\text{mol}} \right) \right]$$

$$\Delta H_r = (-877.1 \text{ kJ}) - (-74.4 \text{ kJ})$$

$$\Delta H_r = -802.7 \text{ kJ}$$

$$\Delta H_r = n H_r$$

$$H_r = \frac{\Delta H_r}{n} = \frac{-802.7 \text{ kJ}}{1 \text{ mol}} = -802.7 \text{ kJ/mol}$$

Homework

Worksheet