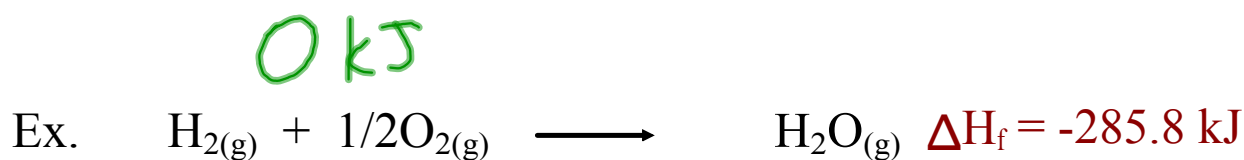


Midterm

Reference Energy State

Reference energy state - elements are defined as the reference point at which the potential energy is shown to be zero.

Therefore: E_p of $H_{2(g)} = 0$ kJ



*allows us to describe the enthalpy change for a formation reaction from zero to a final value

Predicting ΔH_r Using Formation Reactions

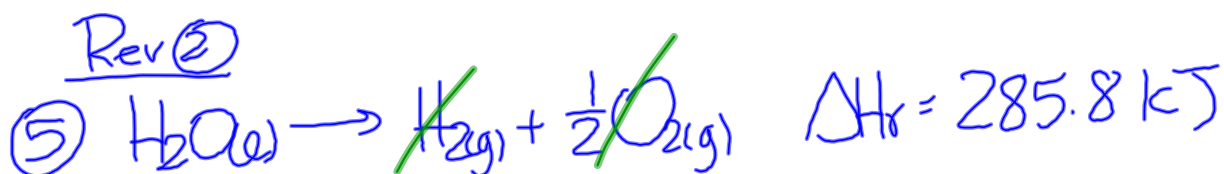
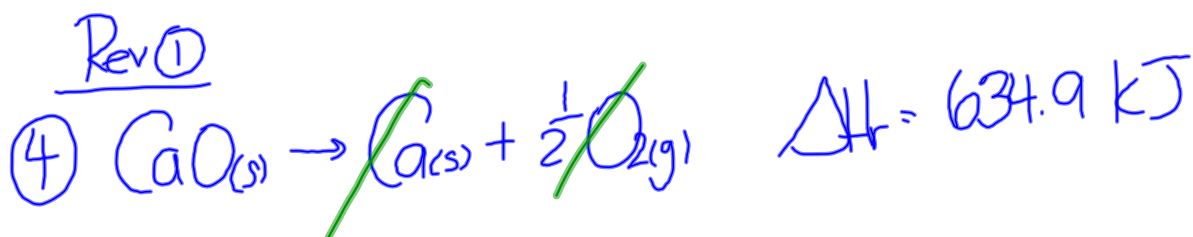
The Standard Enthalpy Change (ΔH_r°) for a reaction can be found by writing the formation equation and corresponding standard enthalpy change for each compound in the given equation and then applying Hess's Law.



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



Step 2: Apply Hess's Law



Enthalpies of Formation to Predict ΔH_r

$$\Delta H_r = \Delta H_f + (-\Delta H_f) + (-\Delta H_f)$$

Ca(OH)_2 CaO H_2O

$$\Delta H_r = \Delta H_f - (\Delta H_f + \Delta H_f)$$

Ca(OH)_2 CaO H_2O

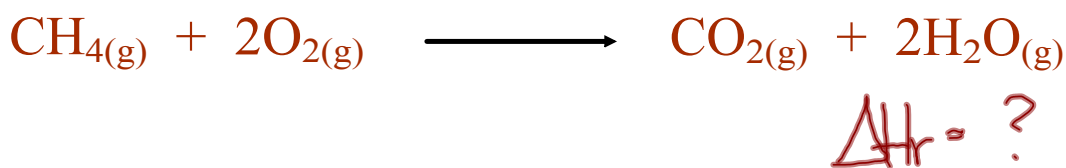
$$\Delta H_r = \Delta H_{fp} - \Delta H_{fr}$$

productsreactants

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

knowing that $\Delta H = nH$

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



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

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

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

$$\Delta H_r = \left[(-393.5 \text{ kJ}) + (-483.6 \text{ kJ}) \right] - \left[(-74.4 \text{ kJ}) \right]$$

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

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