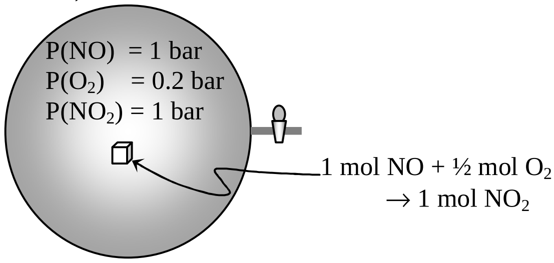
Enthalpy Changes for Chemical Reactions

$NO\,(g, 1\text{ bar}) + \tfrac{1}{2}\,O_2\,(g, 0.2\text{ bar}) \rightarrow NO_2\,(g, 1\text{ bar})$

$$\Delta_r H = \sum_{i=1}^{n_s} \nu_i\, \Delta_f H_i$$

$$\Delta_r H = \Delta_f H_{NO2} - \Delta_f H_{NO} - \tfrac{1}{2}\,\Delta_f H_{O2}$$



$$\Delta_r H = \sum_{i=1}^{n_s} \nu_i\, H_i$$

$$\Delta_r H = H_{NO2} - H_{NO} - \tfrac{1}{2}\,H_{O2}$$

$\Delta_r H$ is the change in enthalpy for unit extent in so large an amount of the reaction that the partial pressures of the constituents remain unchanged.

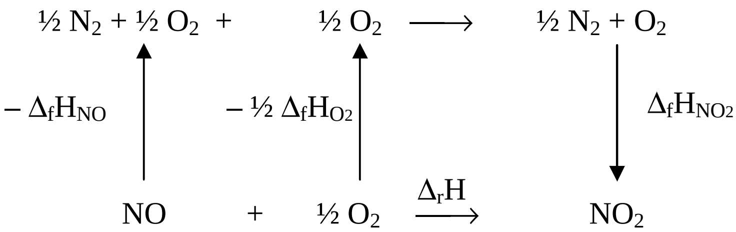
$\Delta_f H_{NO2} = H_{NO2} - \tfrac{1}{2}\,H_{N2} - H_{O2}$

$\Delta_f H_{NO} = H_{NO} - \tfrac{1}{2}\,H_{N2} - \tfrac{1}{2}\,H_{O2}$

$\Delta_r H = \quad \Delta_f H_{NO2} \quad - \quad \Delta_f H_{NO} \quad - \tfrac{1}{2}\,\Delta_f H_{O2}$

$\Delta_r H = [\, H_{NO2} - \tfrac{1}{2}\,H_{N2} - H_{O2}] \; - [(H_{NO} - \tfrac{1}{2}\,H_{N2} - \tfrac{1}{2}\,H_{O2}] \; - \; 0$

$\Delta_r H = H_{NO2} - H_{NO} - \tfrac{1}{2}\,H_{O2}$



$\Delta_r H = \Delta_f H_{NO2} - \Delta_f H_{NO} - \tfrac{1}{2}\,\Delta_f H_{O2}$

Enthalpy is a state function, the change for the reaction is independent of the path.

$$dH = \sum_{i=1}^{n_s} H_i\, dn_i \qquad\qquad dn_i = \nu_i\, d\xi$$

$$dH = \sum_{i=1}^{n_s} \nu_i\, H_i\, d\xi \qquad\qquad \text{(cst. T\&P)}$$

$$\int_{react}^{prod} dH = \sum_{i=1}^{n_s} \nu_i\, H_i \int_0^1 d\xi \qquad\qquad \Delta_r H = \sum_{i=1}^{n_s} \nu_i\, H_i$$

$$\left(\frac{\partial H}{\partial \xi}\right)_{T,P} = \sum_{i=1}^{n_s} \nu_i\, H_i = \Delta_r H$$

The reaction enthalpy is the derivative of the enthalpy with respect to the extent of the reaction.