

22.4: The Enthalpy of an Ideal Gas is Independent of Pressure

How does pressure affect enthalpy H ? As we showed above we have the following relations of first and second order for G

$$\begin{aligned}\left(\frac{\partial G}{\partial T}\right)_P &= -S \\ \left(\frac{\partial G}{\partial P}\right)_T &= -V \\ -\left(\frac{\partial S}{\partial P}\right)_T &= \left(\frac{\partial V}{\partial T}\right)_P\end{aligned}$$

We also know that by definition:

$$G = H - TS \tag{22.4.1}$$

Consider an isothermal change in pressure, so taking the partial derivative of each side of Equation 22.4.1, we get:

$$\begin{aligned}\left(\frac{\partial G}{\partial P}\right)_T &= \left(\frac{\partial H}{\partial P}\right)_T - T\left(\frac{\partial S}{\partial P}\right)_T \\ \left(\frac{\partial H}{\partial P}\right)_T &= V - T\left(\frac{\partial V}{\partial T}\right)_P\end{aligned} \tag{22.4.2}$$

For an ideal gas

$$\frac{\partial V}{\partial T} = \frac{nR}{P}$$

so Equation 22.4.2 becomes

$$\left(\frac{\partial H}{\partial P}\right)_T = V - T\left(\frac{nR}{P}\right) = 0$$

As we can see for an ideal gas, there is no dependence of H on P .

22.4: The Enthalpy of an Ideal Gas is Independent of Pressure is shared under a [CC BY-NC-SA 4.0](https://creativecommons.org/licenses/by-nc-sa/4.0/) license and was authored, remixed, and/or curated by LibreTexts.