

Step 3: Assuming the above equations are true, the values are substituted and the equation is rewritten to: $s \left(\frac{\partial g}{\partial T} \right)_P^{-1} \left(\frac{\partial g}{\partial P} \right)_T + P \left(\frac{\partial g}{\partial v} \right)_P^{-1} \left(\frac{\partial g}{\partial P} \right)_v$

How can the first part, $s \left(\frac{\partial g}{\partial T} \right)_P^{-1} \left(\frac{\partial g}{\partial P} \right)_T$, of this equation be simplified?

$$dg = -s dT + v dP = \left(\frac{\partial g}{\partial T} \right)_P dT + \left(\frac{\partial g}{\partial P} \right)_T dP$$

$$\left(\frac{\partial g}{\partial T} \right)_P = -s \rightarrow \left(\frac{\partial g}{\partial T} \right)_P^{-1} = -\frac{1}{s} \quad \text{and} \quad \left(\frac{\partial g}{\partial P} \right)_T = v$$

$$s \left(\frac{\partial g}{\partial T} \right)_P^{-1} \left(\frac{\partial g}{\partial P} \right)_T = s \left(-\frac{1}{s} \right) v = -v$$