\(\frac{\partial U}{\partial S}\)_V = T; \quad \frac{\partial U}{\partial V}\)_S = -P

Since \(dU = dq + dw = TdS - pdV\)

And \(dU = \left(\frac{\partial U}{\partial S}\right)_V dS + \left(\frac{\partial U}{\partial V}\right)_S dV\)

Then \(\frac{\partial U}{\partial S}\)_V = T\) and \(\frac{\partial U}{\partial V}\)_S = -P

a. \(dU = C_v dT;\) \(dS = \frac{dq_{	ext{rev}}}{T} = \frac{C_v dT}{T}\) (cont. \(T\))

\(\frac{\partial U}{\partial S}\)_V = \frac{C_v dT}{C_v dT} = T

And: \(dU = dw = -pdV;\) \(\frac{\partial U}{\partial V}\)_S = -P

\(P3.26 (8th), P5.5 (7th) - \text{see M3.8a+b}\)

P3.28 (P5.10) max.: \(\frac{\partial (\frac{1}{\rho})_T}{\partial T} = V - T(\frac{\partial (\frac{1}{\rho})}{\partial T})_p\)

\(dU = dU + pdV + Vdp = TdS - p\Delta V + pdV + Vdp = TdS + Vdp\)

\(dU = \left(\frac{\partial U}{\partial S}\right)_P dS + \left(\frac{\partial U}{\partial P}\right)_S dP\); \(= \left(\frac{\partial U}{\partial S}\right)_P dS + V\left(\frac{\partial P}{\partial T}\right)_S\) since \(\frac{\partial S}{\partial P}\)_T = -\left(\frac{\partial V}{\partial T}\right)_P\)

\(\frac{\partial U}{\partial P}\)_T = -T\left(\frac{\partial V}{\partial T}\right)_P + V\left(\frac{\partial P}{\partial T}\right)_T\)

a) For \(p.g.\): \(V = nRT/P\)

\(\frac{\partial (\frac{1}{\rho})_T}{\partial T} = -T\left(\frac{\partial (\frac{nRT}{P})}{\partial T}\right)_P\) \(\mu V = -\frac{nRT}{P} + V = 0\)

b) Ignore - algebra+work long.
\[ \mu = \left( \frac{\partial \gamma}{\partial \nu} \right)_T, \quad \text{show} \quad \mu \Delta V = p - \Delta T/\kappa \]

\[ C_v = \left( \frac{\partial U}{\partial T} \right)_V \]

so \[ \mu C_v = \left( \frac{\partial \gamma}{\partial \nu} \right)_U \left( \frac{\partial U}{\partial T} \right)_V \]

chain rule: \[ \left( \frac{\partial U}{\partial s} \right)_T \left( \frac{\partial T}{\partial \nu} \right)_U \left( \frac{\partial U}{\partial T} \right)_V = -1 \]

\[ \left( \frac{\partial T}{\partial \nu} \right)_U \left( \frac{\partial U}{\partial T} \right)_V = -\left( \frac{\partial U}{\partial U} \right)_T \]

\[ U(s, \nu) \quad dU = \left( \frac{\partial U}{\partial s} \right)_V ds + \left( \frac{\partial U}{\partial \nu} \right)_s d \nu = Tds - p d \nu \]

\[ \left( \frac{\partial U}{\partial \nu} \right)_T = T \left( \frac{\partial s}{\partial \nu} \right)_T - p \left( \frac{\partial s}{\partial s} \right)_T^2 = T \left( \frac{\partial T}{\partial \nu} \right)_U - p \left( \frac{\partial s}{\partial s} \right)_T = \left( \frac{\partial U}{\partial \nu} \right)_T \]

so \[ \mu C_v = - \left( \frac{\partial U}{\partial \nu} \right)_T = \mu C_v = p - T \left( \frac{\partial p}{\partial s} \right)_U \]