P3.24 (8th), P5.5 (7th) show, for a p.g.:

$\left(\frac{\partial U}{\partial S}\right)_V = T$; $\left(\frac{\partial U}{\partial V}\right)_S = -p$

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 $\left(\frac{\partial U}{\partial S}\right)_V = T$ and $\left(\frac{\partial U}{\partial V}\right)_S = -p$

a: $dU = C_V dT$; $dS = \frac{dq_{rev}}{T} = \frac{C_V dT}{T}$ (const. V)

$\left(\frac{\partial U}{\partial S}\right)_V = \frac{C_V dT}{\frac{C_V dT}{T}} = T$

and: $dU = dw = -pdV$, $\left(\frac{\partial U}{\partial V}\right)_S = -p$

P3.26a,b(8th), P5.7(7th) - see M3.8a+b

P.3.28 (P5.10) prove: $\left(\frac{\partial H}{\partial p}\right)_T = V - T\left(\frac{\partial V}{\partial T}\right)_p$

$dH = dU + pdV + Vdp = TdS - \cancel{pdV} + \cancel{pdV} + Vdp = TdS + Vdp$

$dH = \left(\frac{\partial H}{\partial S}\right)_p dS + \left(\frac{\partial H}{\partial p}\right)_S dp$; $\therefore \left(\frac{\partial H}{\partial S}\right)_p = T$ and $\left(\frac{\partial H}{\partial p}\right)_S = V$

MAXWELL:

$\left(\frac{\partial H}{\partial p}\right)_T = \left(\frac{\partial H}{\partial S}\right)_p \left(\frac{\partial S}{\partial p}\right)_T + V \cancelto{1}{\left(\frac{\partial p}{\partial p}\right)_T}$ since $\left(\frac{\partial S}{\partial p}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_p$

$= \boxed{-T\left(\frac{\partial V}{\partial T}\right)_p + V}$

a) for p.g., $V = nRT/p$

$\left(\frac{\partial H}{\partial p}\right)_T = -T\left(\frac{\partial}{\partial T}\frac{nRT}{p}\right)_p + V = -\frac{nRT}{p} + V = 0$

b) ignore – algebra too long.

P3.30 $\mu_J = \left(\frac{\partial T}{\partial V}\right)_u$, show $\mu_J C_v = p - \alpha T/\kappa_T$

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

so $\mu_J C_v = \left(\frac{\partial T}{\partial V}\right)_U \left(\frac{\partial U}{\partial T}\right)_V$

chain rule: $\left(\frac{\partial V}{\partial U}\right)_T \left(\frac{\partial T}{\partial V}\right)_U \left(\frac{\partial U}{\partial T}\right)_V = -1$

$$\left(\frac{\partial T}{\partial V}\right)_U \left(\frac{\partial U}{\partial T}\right)_V = -\left(\frac{\partial U}{\partial V}\right)_T$$

$U(S,V)$ $dU = \left(\frac{\partial U}{\partial S}\right)_V dS + \left(\frac{\partial U}{\partial V}\right)_S dV = TdS - pdV$

maxwell:

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial S}{\partial V}\right)_T - p\cancel{\left(\frac{\partial V}{\partial V}\right)_T} = T\left(\frac{\partial p}{\partial T}\right)_V - p \qquad \left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial p}{\partial T}\right)_V$$

so $\boxed{\mu_J C_V = -\left(\frac{\partial U}{\partial V}\right)_T = \pi_T = p - T\left(\frac{\partial p}{\partial T}\right)_V}$