(P6.1)

(a)

$\left(\frac{\partial H}{\partial S}\right)_V$

Expansion Rule: $dH = TdS + VdP$

$$\left(\frac{\partial H}{\partial S}\right)_V = T\left(\frac{\partial S}{\partial S}\right)_V + V\left(\frac{\partial P}{\partial S}\right)_V$$

$$= T + V\left(\frac{\partial P}{\partial T}\right)_V\left(\frac{\partial T}{\partial S}\right)_V \quad \text{(chain rule)}$$

$$= T\left(1 + \frac{V}{C_V}\left(\frac{\partial P}{\partial T}\right)_V\right)$$

(b)

$\left(\frac{\partial H}{\partial P}\right)_V$

Expansion rule:$dH = TdS + VdP$

$$\left(\frac{dH}{\partial P}\right)_V = T\left(\frac{\partial S}{\partial P}\right)_V + V\left(\frac{\partial P}{\partial P}\right)_V$$

$$= T\left(\frac{\partial S}{\partial T}\right)_V\left(\frac{\partial T}{\partial P}\right)_V + V = C_V\left(\frac{\partial T}{\partial P}\right)_V + V$$

(c)

$\left(\frac{\partial G}{\partial H}\right)_P$

chain using T since it is measureable

$$\left(\frac{\partial G}{\partial T}\right)_P\left(\frac{\partial T}{\partial H}\right)_P = \left(\frac{\partial G}{\partial T}\right)_P / \left(\frac{\partial H}{\partial T}\right)_P = \frac{\left(\frac{\partial G}{\partial T}\right)_P}{C_P}$$

Use expansion rule: $dG = -SdT + VdP$

$$\left(\frac{\partial G}{\partial T}\right)_P = -S\left(\frac{\partial T}{\partial T}\right)_P + V\left(\frac{\partial P}{\partial T}\right)_P = -S$$

thus:

$$\left(\frac{\partial G}{\partial H}\right)_P = -\frac{S}{C_P}$$