Pr. 6-6 solution

(a)

From Eq. (6-9) we get

$$0 \;=\; \Big(\frac{\partial u}{\partial v}\Big)_T \;=\; T\Big(\frac{\partial P}{\partial T}\Big)_v - P \;\;\Rightarrow\;\; \Big(\frac{\partial P}{\partial T}\Big)_v \;=\; \frac{P}{T} \;\;\Rightarrow\;\; \Big(\frac{\partial T}{\partial P}\Big)_v \;=\; \frac{T}{P}$$

and from Eq. (6-21)

$$0 \;=\; \Big(\frac{\partial h}{\partial P}\Big)_T \;=\; v - T\Big(\frac{\partial v}{\partial T}\Big)_P \;\;\Rightarrow\;\; \Big(\frac{\partial v}{\partial T}\Big)_P \;=\; \frac{v}{T} \;\;\Rightarrow\;\; \Big(\frac{\partial T}{\partial v}\Big)_P \;=\; \frac{T}{v}$$

and therefore

$$dT(P,v) \;=\; \Big(\frac{\partial T}{\partial P}\Big)_v dP + \Big(\frac{\partial T}{\partial v}\Big)_P dv \;=\; \frac{T}{P}dP + \frac{T}{v}dv \;\;\Rightarrow\;\; \frac{dT}{T} \;=\; \frac{dP}{P} + \frac{dv}{v} \tag{1}$$

$$\tag{2}$$

$$\Rightarrow\; d\ln T \;=\; d\ln P + d\ln v \;\;\Rightarrow\;\; \ln T \;=\; \ln P + \ln v \;\; + \text{const} \;\;\Rightarrow\; T \;=\; APv \tag{3}$$

(b)

From Eq. (6-38) it is clear that we need also c_P (or c_v) to find the entropy.

Pr. 6-8 solution

From Eq. (6.22) $dh \;=\; c_P dT + v\big(1 - T\beta\big)dP$ and therefore at constant h

$$dP_h \;=\; -\frac{c_P}{v(1-\beta T)}dT_h$$

Next, from Eq. (6-31) we get

$$ds \;=\; \frac{c_P}{T}dT - v\beta dP$$

Now consider ds at constant h, then

$$ds_h \;=\; \frac{c_P}{T}dT_h - vT\beta dP_h \;=\; \frac{c_P}{T}dT_h + \beta\frac{c_P}{1-\beta T}dT_h \;=\; \Big(\frac{c_P}{T} + \beta\frac{c_P}{1-\beta T}\Big)dT_h$$

and therefore

$$\Big(\frac{\partial s}{\partial T}\Big)_h \;=\; \frac{c_P}{T(1-\beta T)}$$