Problem 1. \[ S&S \text{ problem 6-3} \]

Problem 2. \[ S&S \text{ problem 6-8} \]

Problem 3. \[ S&S \text{ problem 6-19} \]

Problem 4. \[ S&S \text{ problem 6-23} \]

Problem 5. Show that for a gas obeying the van der Waals equation \[(P+a/v^2)(v-b)=RT,\] with \(c_v\) a constant, an equation for an adiabatic process is
\[ T(v-b)^{R/c_v} = \text{const}. \]

Problem 6. (a) Derive the equation
\[ \left( \frac{\partial C_v}{\partial V} \right)_T = T \left( \frac{\partial^2 P}{\partial T^2} \right)_V. \]

(b) Prove that \(C_v\) of an ideal gas is a function of \(T\) only.

(c) In the case of a gas obeying the equation state
\[ \frac{Pv}{RT} = 1 + \frac{B}{v}, \]
where \(B\) is a function of \(T\) only, show that
\[ c_v = -\frac{RT}{v} \frac{d^2}{dT^2} (BT) + (c_v)_0, \]
where \((c_v)_0\) is the value at very large volumes.

Problem 7. Derive the following equations:

(a) \[ C_p = T \left( \frac{\partial V}{\partial T} \right)_P \left( \frac{\partial P}{\partial T} \right)_S. \]

(b) \[ \left( \frac{\partial P}{\partial T} \right)_S = \frac{C_p}{V\beta T}. \]

(c) \[ \frac{\left( \frac{\partial P}{\partial T} \right)_S}{\left( \frac{\partial P}{\partial T} \right)_V} = \frac{\gamma}{\gamma-1}. \]