Exercise 2.10

Sunday, 26 April 2020 12:25

$$\beta = \frac{2bT}{v} = \frac{1}{v}\left(\frac{\partial v}{\partial T}\right)_p \longrightarrow 2bT = \left(\frac{\partial v}{\partial T}\right)_p$$

$$\kappa = \frac{a}{v} = -\frac{1}{v}\left(\frac{\partial v}{\partial p}\right)_T \longrightarrow a = -\left(\frac{\partial v}{\partial p}\right)_T \longrightarrow -a = \left(\frac{\partial v}{\partial p}\right)_T$$

Writing down the exact differential

$$dv = \left(\frac{\partial v}{\partial T}\right)_p dT + \left(\frac{\partial v}{\partial p}\right)_T dP$$

↓ substituting gives

$$dv = 2bT\,dT - a\,dP$$

↓ integrating gives

$$v = bT^2 - aP + \text{constant}$$

↓ re-arranging

$$v - bT^2 + aP = \text{constant}$$