Exercise 4.3

Thursday, 30 April 2020 19:38

to show: $\left(\frac{\partial u}{\partial T}\right)_p = c_p - P\beta v$

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

$c_p = \left(\frac{\partial h}{\partial T}\right)_p = \left(\frac{\partial (u+Pv)}{\partial T}\right)_p$

$$c_p - P\beta v = \left(\frac{\partial (u+Pv)}{\partial T}\right)_p - P\frac{1}{v}\left(\frac{\partial v}{\partial T}\right)_p v$$

$$= \left(\frac{\partial u}{\partial T}\right)_p + \left(\frac{\partial (Pv)}{\partial T}\right)_p - P\left(\frac{\partial v}{\partial T}\right)_p$$

$$= \left(\frac{\partial u}{\partial T}\right)_p + P\left(\frac{\partial v}{\partial T}\right)_p - P\left(\frac{\partial v}{\partial T}\right)_p$$

as we can take p out of the partial derivative, as we have kept it constant

$$= \left(\frac{\partial u}{\partial T}\right)_p \quad \square$$