PROBLEM THERMO1

For a reversible process show the relations:

(a) \[ dq = \left[ \left( \frac{\partial U}{\partial T} \right)_p + P \left( \frac{\partial V}{\partial T} \right)_p \right] dT + \left[ \left( \frac{\partial U}{\partial P} \right)_T + P \left( \frac{\partial V}{\partial P} \right)_T \right] dP \]

(b) \[ \left( \frac{\partial U}{\partial T} \right)_P = c_p - PV \alpha \]

(c) \[ \left( \frac{\partial U}{\partial P} \right)_T = PV \kappa_T - (c_p - c_v) \frac{\kappa_T}{\alpha} \]

where \( \alpha \) and \( \kappa_T \) are the coefficient of thermal expansion and isothermal compressibility factor, respectively.