Constants

$R_d = 287 \frac{J}{deg\, kg}$

$R_v = 461 \frac{J}{deg\, kg}$

$R^* = 8.3143 \frac{J}{deg\, mol}$

$\epsilon = 0.622$

$\Gamma_d = 9.8 \frac{^\circ C}{km} = \frac{g}{c_p}$

$\frac{R}{c_p} = 0.286$

$c_p = 1004 \frac{J}{deg\, kg}$

$c_v = 717 \frac{J}{deg\, kg}$

Equations

$p = \rho R T$

$pV = nR^* T$

$p = \rho R_d T$

$e = \rho_v R_v T$

$dq = dw + du$

$p_{sfc} = \int_0^\infty (g\rho)\, dz$

$p(z) = p(o) e^{\frac{-Z}{H}}$

$H = \frac{RT}{g_o}$

$\theta = T \left(\frac{p_o}{p}\right)^{\frac{R}{c_p}}$

$Z_2 - Z_1 = \left(\frac{R_d}{g_o}\right) \int_{p_2}^{p_1} T_v \frac{dp}{p}$

$\frac{dp}{dz} = -\rho g$

$e = p \left(\frac{w}{\epsilon + w}\right)$

$w_s = \left(\frac{e_s}{P - e_s}\right) \simeq \epsilon \frac{e_s}{p}$

$T_v = \frac{T}{1 - \left(\frac{e}{p}\right)(1-\epsilon)} = T\,(1 + 0.61w)$

$RH = 100 * \frac{w}{w_s} = 100 * \frac{e}{e_s}$

$\ln \frac{e_s}{6.11mb} = \frac{L}{R_v} \left(\frac{1}{273} - \frac{1}{T}\right)$

$\frac{L}{R_v} = 5422\ deg$