$F \sim (ms^{-2})(ms^{-1})m^2 \to m^4 s^{-3}$

① $\frac{P}{\rho} \sim F^a z^b$

$\frac{kg(ms^{-2})m^{-2}}{kg\, m^{-3}} \qquad (m^4 s^{-3})^a (m)^b$

$m^2 s^{-2}$

$2 = 4a + b$

$-2 = -3a \Rightarrow a = \frac{2}{3}$

$b = 2 - 4(2/3) = \frac{6}{3} - \frac{8}{3} = -\frac{2}{3}$

$\frac{P}{\rho} \sim F^{2/3} z^{-2/3}$

(2) $Ra = \frac{BH^3}{\nu K}$

turbulent case

$$B \sim \frac{W}{(H/W)} = \frac{W^2}{H}$$

$$\Rightarrow Ra = \frac{W^2}{H}\frac{H^3}{\nu K} = \frac{W^2 H^2}{\nu K}$$

$\nu \sim 10^{-5}\, m^2 s^{-1}$ for molecular viscosity

$K \sim 10^{-5}\, m^2 s^{-1}$ for thermal diffusivity

$$Ra \sim \frac{(10\, ms^{-1})^2 (10^4 m)^2}{(10^{-5} m^2 s^{-1})(10^{-5} m^2 s^{-1})} = \frac{10^2 \times 10^8 \cancel{m^2} \cancel{s^{-2}} \cancel{m^2}}{10^{-10} \cancel{m^4} \cancel{s^{-2}}}$$

$$= 10^{20} \Rightarrow$$ turbulent heat transport important!

$$Re = \frac{W/(H/W)}{\nu \frac{W}{H^2}} = \frac{W^2}{H \nu}\frac{H^2}{W} = \frac{WH}{\nu} = \frac{(10\, m/s)(10^4 m)}{10^{-5}\, m^2 s^{-1}} = 10^{10}$$

→ Should use kinematic coefficient of turbulent viscosity!

\+ turbulent thermal diffusivity in eqns.

→ But these are difficult to compute

depend on mixing length scale (not 10 km!) of eddies