

Study Questions - Lecture 23

1. What are the units of the terms for mechanical production rate and the thermal production rate of turbulence?
2. Show that the units of the terms for mechanical and thermal production rate match the units of turbulent kinetic energy (TKE) produced per time and unit mass.
3. Given the following terms, calculate the mechanical, thermal, and total production rate of TKE per unit mass: $\overline{w'T'} = 0.30 \text{ K m s}^{-1}$, $\overline{u'w'} = -0.52 \text{ m}^2 \text{ s}^{-2}$, $\overline{T} = 304.1 \text{ K}$ (31°C) and a wind gradient of $\Delta\overline{u}/\Delta z = 0.07 \text{ m s}^{-1} \text{ m}^{-1}$.
4. What is the Richardson flux number (Rf) in this situation?
5. What is the turbulence regime in this situation? What is the dynamic stability (stable, neutral, unstable)?
6. Calculate the height above ground in the surface layer, where the mechanical production rate and the thermal production rate are equal.
7. What is the value of the dynamic stability parameter ζ in this situation at a height $z = 10 \text{ m}$?
8. What is the dynamic stability (stable, neutral, unstable) determined through ζ and does this match the dynamic stability determined through Rf ?