

國立中央大學98學年度碩士班考試入學試題卷

所別：大氣物理研究所碩士班 一般生 科目：大氣動力學 共 / 頁 第 / 頁

*請在試卷答案卷(卡)內作答

1. Using the transformation of vertical coordinate, show that geostrophic wind V_g may be expressed in isentropic coordinates as

$$V_g = \frac{1}{f} \mathbf{k} \times \nabla_{\theta} (c_p T + \Phi)$$

where f is the Coriolis parameter, θ potential temperature, T temperature, Φ geopotential, and c_p the specific heat of air at constant pressure. (10%)

2. Starting from the vertical momentum equation, derive the stability criteria for vertical displacement of dry air using the parcel method. (10%)
3. Derive the thermal-wind equation and use this equation to explain why the westerly wind speed increases with height during winter in the mid-latitude Northern Hemisphere. (10%)
4. Write down the gradient wind equation with the three forces in balance and use this equation to show that the geostrophic wind is an overestimate (underestimate) of the balanced wind in a regular cyclonic (anticyclonic) system. (10%)
5. Explain how the two major physical processes (stretching and tilting) contribute to the generation of vertical vorticity. (10%)
6. Describe the flux-gradient theory based on eddy viscosity coefficient (K_m) and use the mixing length hypothesis to derive a plausible formulation for K_m . (10%)
7. The quasi-geostrophic system provides the equation of geopotential tendency involving processes of vorticity advection and differential thickness advection. Discuss how these two processes contribute to the geopotential tendency at the ridge and trough of 500-hPa. (15%)
8. Assuming the conservation of absolute vorticity, show how the so-called Rossby waves may be produced at westward propagation for a sinusoidal meridional displacement. (10%)
9. Discuss the energy flowchart in an unstable baroclinic wave and explain why the baroclinic instability is easier to occur for a larger slope of zonal mean potential temperature surface. (15%)

參考用