

所別：大氣物理研究所碩士班 一般生 科目：大氣動力學

1. Explain or interpret the following short questions. (40%)

- (a) What is the purpose of scale analysis? (4%)
- (b) What are the advantages of using the pressure as the vertical coordinate? (4%)
- (c) If you use the geostrophic wind equation to describe the flow motion, are isobars curved or straight? Explain your answer. (4%)
- (d) Why should the gradient wind be used in the tropics? (4%)
- (e) What is the difference between vorticity and circulation? What is the relationship between them? (4%)
- (f) Explain why the vorticity equation is used to describe the atmospheric motion, instead of the circulation equation, e.g. Bjerknes circulation theorem. (4%)
- (g) Prove that the Coriolis force cannot change the kinetic energy of an air parcel. (4%)
- (h) Suppose you stand outside and feel a fresh breeze blowing against your face. Could this be a geostrophic wind? Explain. (4%)
- (i) List some of the reason, why the polar front theory doesn't apply to storms in the tropics. (4%)
- (j) The vertical component of the pressure gradient force is much larger than horizontal component, nevertheless the horizontal component plays an important role in the equations of motion. (4%)

2. Thermal wind: (15%)

Geostrophic wind is expressed as

$$v_g = \frac{1}{f} \frac{\partial \phi}{\partial x}$$
$$u_g = \frac{-1}{f} \frac{\partial \phi}{\partial y}$$

- (a) Derive the thermal wind equation and express it in terms of the horizontal temperature gradient. Use this equation to explain why the general circulation in both hemisphere has the maximum westerlies in midlatitudes. (5%)

注意：背面有試題

所別：大氣物理研究所碩士班 一般生 科目：大氣動力學

- (b) What is thermal wind? Explain it in terms of layer mean temperature (T), and show the direction of thermal wind with respect to isotherms. (4%)
 - (c) How does the geostrophic wind change with respect to height in the weather system with the warm-air advection? (3%)
 - (d) Does thermal wind exist in the barotropic atmosphere? Explain your answer. (3%)
3. State the assumptions made in deriving quasi-geostrophic equations. What is secondary circulation? What role does it play in quasi-geostrophic system? (15%)
4. State the mechanism of Rossby wave. Write down the dispersion relation of barotropic Rossby wave. Describe the characteristics of unstable baroclinic wave. What are the necessary conditions for instability in quasi-geostrophic system? (15%)
5. Draw a sketch of a 500mb chart that clearly shows a trough and a ridge. Where would you expect to find the maximum and minimum values of absolute vorticity? Where would you expect to find converging and diverging wind motions? Below what point on your 500mb chart, would you expect middle latitude storm development to occur? All answers should be given with some physical explanation. (15%)