所別：大氣物理研究所碩士班 一般生 科目：普通物理

1. Terminology and short problem (20%)
   (a) The principle of superposition. Give an example.
   (b) Coriolis force. How the force affects the moving air mass in the northern hemisphere?
   (c) The Doppler effect. State its application.
   (d) State the zeroth, first, and second lows of thermodynamics.
   (e) Give and state Maxwell's equations.

2. In the atmosphere, the drag force acting on a body can be written as $D = 1/2\ C\rho A v^2$, where C is a dimensionless drag coefficient, ρ is the air density, A is the effective cross-sectional area, v is the speed of the object. A raindrop whose radius R is 1.5 mm fall from a cloud whose height h about the earth is 1200m. Assume $C = 0.6$ and $\rho = 1.2$ kg/m^3. (a) What is the terminal speed of the falling drop? (b) What would have been the speed just before impact if there had been no drag force? (20%)

3. A spherical, helium-filled balloon has a radius R of 12 m. The balloon, support cables, and basket have a mass m of 200 kg. Take $\rho_{He} = 0.16$ kg/m^3 and $\rho_{air} = 1.25$ kg/m^3. (a) What maximum load M can the balloon carry? The mercury column in an onboard barometer has a measured height $h = 740.0$ mm. The temperature is -5.0 °C, at which temperature the density of mercury is 1.36×10^4 kg/m^3. The free-fall acceleration $g = 9.8$ m/s^2. (b) What is the atmospheric pressure? (20%)

4. An oil drops of 3 microns radius and density of 510 kg/m^3 is used in a Millikan oil drop experiment. If the drop is balanced in an electric filed of 5 x 10 N/C, (a) determine the charge on the drop. The other oil drop of 6 microns radius is also balanced in the filed. (b) Calculate the electric fields on the surface of the two drops. (c) Are they the same, why? (20%)

5. A cylinder contains oxygen at 20°C and a pressure of 1 atm at a volume of 12 L. The temperature is raised to 35°C and the volume reduced to 8.5L. (a) What is the final pressure of the gas? (b) Calculate the ratio of the number density before and after it being changed. Assume that the gas is idea. (20%)