

所別：生物物理研究所碩士班 科目：普通物理

- (1)(15%) An object of mass  $m$  moving with velocity  $v$  in a resistive medium experiences a drag force  $\gamma v^2$ . What is its terminal speed when this object falls through this medium under gravity  $g$ ?
- (2)(20%) A glass lens is coated on one side with a thin film of  $\text{MgF}_2$  to reduce reflection from the lens surface. The index of refraction of  $\text{MgF}_2$  is 1.38; that of the glass is 1.50. What is the least coating thickness that eliminates (via interference) the reflections at the middle of the visible spectrum ( $\lambda = 550 \text{ nm}$ )? Assume the light is approximately perpendicular to the lens surface.
- (3) (15%)
- [a] (5%) Give the microscopic interpretation of temperature in terms of the kinetic theory of gas.
  - [b] (5%) State the theorem of equipartition of energy.
  - [c] (5%) State the Second Law of Thermodynamics in terms of entropy.
- (4) (15%) A block of mass  $m$  and density  $\rho$  has a vertical height  $h$  and floats in a fluid of density  $\rho_f$ . The block is pushed down a little and then released.
- [a] (8%) Show that the system undergoes simple harmonic oscillation.
  - [b] (7%) Find the period of the subsequent small oscillation.
- (5)(15%) Find the change of entropy for  $n$  moles of an ideal monatomic gas in the following processes:
- [a] (8%) the pressure changes from  $P_1$  to  $P_2$  at constant volume
  - [b] (7%) the temperature changes from  $T_1$  to  $T_2$  at constant pressure
- (6)(20%) A strip of Potassium (a metal with free electrons) of size  $y_1$  and  $z_1$  carrying a current  $I$  in  $+x$  direction as shown. The strip lies in a uniform magnetic field in the  $y$ -direction with magnitude  $B$ . Which side of the strip will have a positive Hall emf? If the Hall emf is found to be  $V$ . What is the density of free electrons in the potassium?

