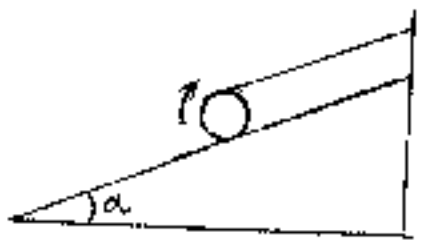
八十五學年度 物理 系（所）應用物理 組碩士班研究生入學考試

科目 普通物理 科號 0502 共 二 頁第 一 頁 *請在試卷【答案卷】內作答

按題目順序作答

1. A man takes one end of a chain lying in a block on the floor, vertically up with a constant velocity v. Find the force used on the end of the chain when the vertical length is x. Assume that the density of the chain is σ. (15%)

2. a) Calculate the moment of inertia of a risk of radius R and mass M.
   b) As shown in the figure, a risk wrapped by the rope rolls down along an inclided plane of tangent α starting from rest. Find the limitation of the coefficient of friction μ between the disk and the inclined plane. (15%)



3. a) Show that in relativistic mechanics, the kinetic energy of a particle moving with velocity v relative to the observer is given by the expression

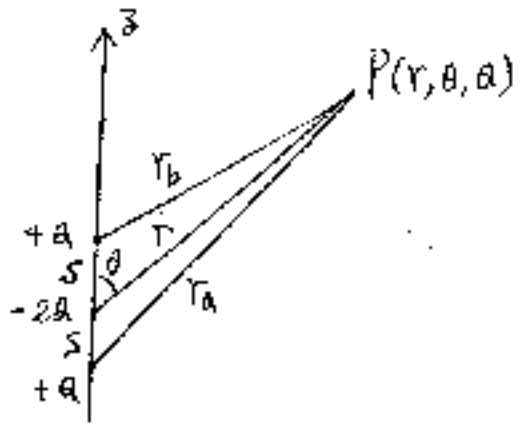
$$E_k = \frac{m_0 c^2}{\sqrt{1 - v^2/c^2}} - m_0 c^2,$$

where m_0 is the rest mass.

   b) Prove that if v<<c, E_k can be reduced to $E_k = \frac{1}{2} m_0 v^2$. (15%)

4. Plot a Carnot cycle in a P-V diagram when the working substance is an ideal gas. If V_1, V_2, V_3 and V_4 are the volume of the gas at the end of each transformation, find the relation between V_1, V_2, V_3 and V_4 . (20%)

5. The linear electric quadrupole is an arrangement of three charge as shown in the figure, where r>>s.
   a) Calculate the electric potential V at point P.
   b) Calculate also the electric field $\vec{E}$ at P. (20%)



6. A sphere of electric charge has a density ρ which is a function of r from the center as shown in the figure. Use Gauss's law to show that the electric field intensity E at $r > \beta$ is

$$E = \frac{\rho_0}{12\varepsilon_0 r^2}(\beta^2 + \alpha^2)(\beta + \alpha), \quad (15\%)$$