淡江大學八十七學年度碩士班入學考試試題

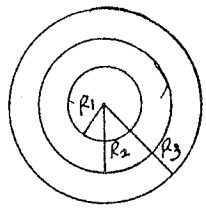
系別： 物理系　　科目： 古典物理

1. A particle is moving in a circular orbit of radius r_0 under the action of a central force given by $F(r) = -a/r^2 - b/r^4$, where a and b are constants. Show that the orbit is stable only if $r_0^2 a > b$.

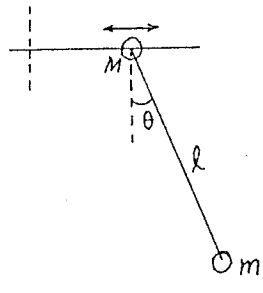
2. (a) State the second law of thermodynamics.

   (b) One mole of a monatomic ideal gas, maintained at constant pressure, is brought in contact with a heat reservoir at temperature T_f. If the initial temperature of the gas is T_i, calculate the total change of entropy after the whole system has reached thermal equilibrium.

3. Find the capacitance of three concentric conducting shells, as shown in the figure, of radii R_1, R_2, and R_3, respectively.



4. A simple pendulum of mass m and length l, with a mass M at the support. M can move without friction on a horizontal line. Find the frequency of small oscillations of the pendulum.



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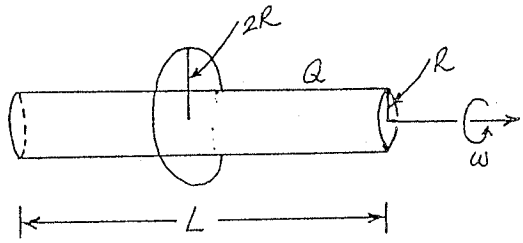
5. A very long insulating cylinder of length L and radius R ($L >> R$) has a charge Q uniformly distributed over its surface. The cylinder is rotating with angular velocity ω. A single-turn coil of radius $2R$ and resistance ρ is wrapped around the cylinder as shown.



   (a) Find the magnetic field inside the cylinder.

   (b) If the rotation of the cylinder is slowed down as $\omega(t) = \omega_0(1 - t/t_0)$, what is the induced current in the coil? In what direction does the current flow?