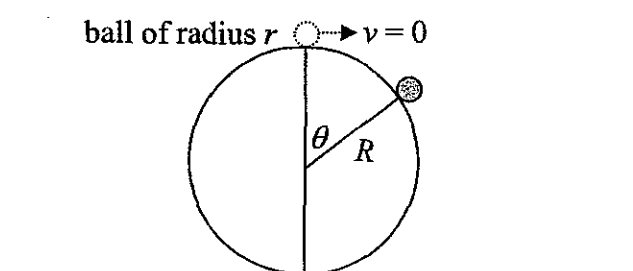1. (20 分) A ball of radius r rolls without slipping off a fixed sphere of radius R, beginning from rest at the top of the sphere. Find the angle θ at which the ball leaves the sphere.


2. (共 20 分) A mass m initially at temperature T_1 is placed in thermal contact with an equal mass of the same material initially at temperature T_2. The combination is well insulated from the environment, so that the heat transfer occurs only between the two masses. (a) (5 分) Find the equilibrium temperature of the isolated system of the two masses. (b) (10 分) Find the entropy change of the system. (c) (5 分) Show that the entropy change is positive.

3. (20 分) A charge q moves at constant velocity v along the x-axis as shown in the figure below. The charge passes the origin when $t = 0$ s. Take a point P to be located at coordinate h along the y-axis. Find the (time-dependent) magnetic field at P, including the direction of the field.
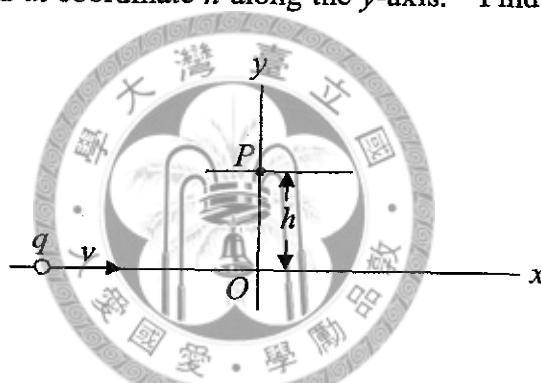
4. (共 20 分) The figure below shows a positively charged plastic rod of length L and uniform linear charge density λ. (a) (5 分) Setting the electrical potential $V = 0$ at infinity, find the electrical potential at point P. (b) (15 分) Find the electrical field at point P, including the direction of the field. (Hint: $\int dx/(x^2+a^2)^{1/2} = \ln[x + (x^2+a^2)^{1/2}]$)
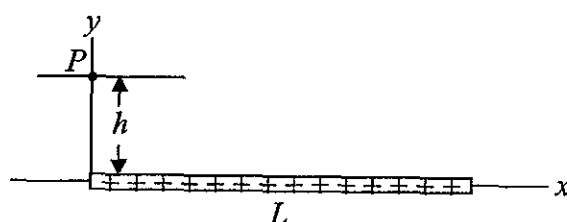
5. (共 20 分) In the circuit of the figure below, $\varepsilon = 1.2$ kV, $C = 6.5$ μF, $R_1 = R_2 = R_3 = 0.73$ MΩ. With C completely uncharged, switch S is suddenly closed (at $t = 0$). (a) (5 分) Determine the current, including the direction, through each resistor at $t = 0$ and as $t \to \infty$. (b) (5 分) Draw qualitatively a graph of the potential difference V_2 across R_2 from $t = 0$ to $t \to \infty$, indicating the numerical values of V_2 at $t = 0$ and as $t \to \infty$. (c) (10 分) What is the time constant of this circuit?

試題隨卷繳回