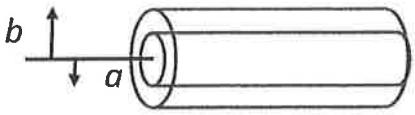
臺灣綜合大學系統 105 學年度學士班轉學生聯合招生考試試題

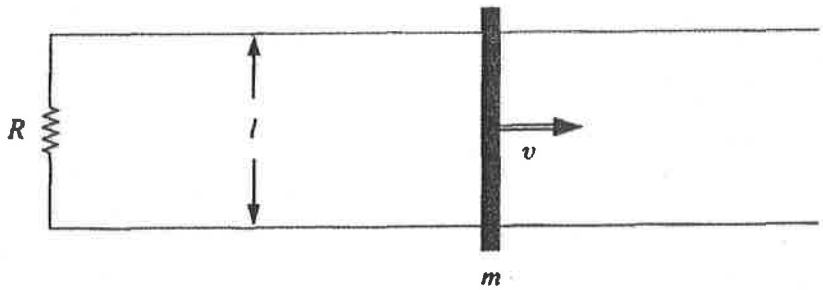
科目名稱	電磁學	類組代碼	C01
		科目碼	C0101
※本項考試依簡章規定各考科均「不可以」使用計算機		本試題共計	2 頁

以下每題為 20 分，共 5 題，滿分為 100 分。題目中包含子題者，該題配分照子題數目平均分配。

1. Suppose the electric field in some region is found to be $\vec{E} = kr^3\hat{r}$, in spherical coordinates (k is some constant).
   (a) Find the charge density ρ.
   (b) Find the total charge contained in a sphere of radius R, centered at the origin.
2. Find the capacitance per unit length of two coaxial metal cylindrical tubes, of radii a and b as shown.



3. An infinitely long cylinder, of radius R, carries a "frozen-in" magnetization, parallel to the axis, $\vec{M} = ks\hat{z}$, where k is a constant and s is the distance from the axis; there is no free current anywhere. Find the magnetic field inside and outside the cylinder by two different methods:
   (a) Locate all the bound currents, and calculate the field they produce.
   (b) Use Ampere's law to find $\vec{H}$, and then get $\vec{B}$.
4. A metal bar of mass m slides frictionlessly on two parallel conducting rails a distance l apart as shown. A resistor R is connected across the rails and a uniform magnetic field $\vec{B}$, pointing into the page, fills the entire region.



   (a) If the bar moves to the right at speed v, what is the current in the resistor? In what direction does it flow?
   (b) What is the magnetic force on the bar? In what direction?
   (c) If the bar starts out with speed v_0 at time t = 0, and is left to slide, what is its speed at a later time t?
   (d) The initial kinetic energy of the bar was, of course, $\frac{1}{2}mv_0^2$. Check that the energy delivered to the resistor is exactly $\frac{1}{2}mv_0^2$.

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5. In a perfect conductor, the conductivity is infinite, so $\vec{E} = 0$, and any net charge resides on the surface.

   (a) Show that the magnetic field is constant ($\frac{\partial \vec{B}}{\partial t} = 0$) inside a perfect conductor.

   (b) Show that the magnetic flux through a perfectly conducting loop is constant.