

# 淡江大學 108 學年度日間部轉學生招生考試試題

系列：物理學系三年級

科目：電磁學

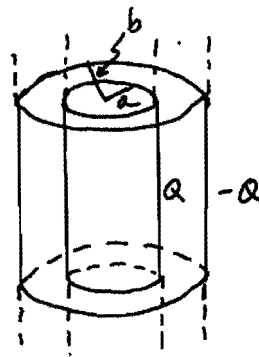
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考試日期：7月24日(星期三) 第1節

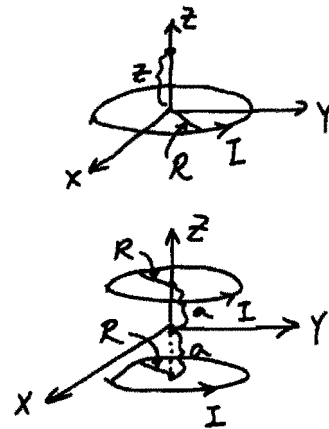
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1. Consider two long coaxial cylindrical metal shells as shown. The inner one is of radius  $a$  and with charge  $Q$  per unit length while the outer one is of radius  $b$  and with charge  $-Q$  per unit length.

- Use Gauss's law to find the electric fields everywhere. (10%)
- Use the result in (a) to find the total energy of the electric field per unit length. (10%)
- Use the result in (a) to find the potential everywhere. Take  $V = 0$  at infinity. (10%)



- Find the magnetic field at the center of a circular loop of radius  $R$  with a current  $I$ . (10%)
  - Find the magnetic field at a distance  $z$  above the center of the loop on the symmetry axis. (10%)
  - Two circular loops of radius  $R$ , both carrying a current  $I$  in the same direction and with the symmetry axis on the  $z$ -axis, are located at  $z = a$  and  $z = -a$ . Find the magnetic field on the  $z$ -axis. (10%)
  - What is the magnetic field at the origin in the case of (c)? (5%)



3. A metal bar of mass  $m$  falls under the gravitational force  $mg$ . It is also connected to a circuit (width  $l$ ) with a resistor  $R$ . A uniform magnetic field  $\vec{B}$ , pointing into the page, fills the entire region.

- Find the current induced in the metal bar in terms of its velocity  $v$ . What is the direction of the current? (10%)
- Find the magnetic force on the metal bar. What is the direction of this force? (10%)
- What is the equation of motion of the bar? (10%)
- From (c), find the terminal velocity of the bar. (5%)

