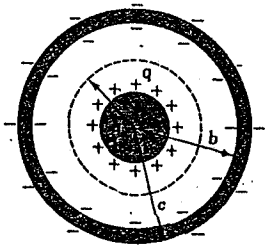
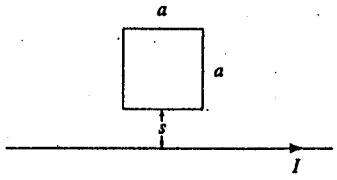
所別：大氣物理研究所碩士班 不分組 科目：電磁學

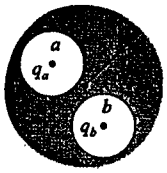
1. (20%) Consider a solid conducting sphere of radius $a$ inside a concentric conducting spherical shell, as shown in the figure. The shell has an inner radius $b$ and an outer radius $c$. A charge of $q$ coulombs is placed on the inner solid conductor, and a charge of $-q'$ is on the outer conductor. They are uniformly distributed on the spherical surfaces.
Find electric field $E$ in all regions.




2. (20%) A square loop of wire (side $a$) lies on a table, a distance $s$ from a very long straight wire, which carries a current $I$, as shown in the figure.
   (a) Find the flux of $B$ through the loop.
   (b) If someone now pulls the loop directly away from the wire, at speed $v$, what emf is generated? In what direction (clockwise or counterclockwise) does the current flow?
   (c) What if the loop is pulled to *right* at speed $v$, instead of away?




3. (20%) Two spherical cavities, of radii $a$ and $b$, are hollowed out from the interior of a (neutral) conducting sphere of radius $R$. At the center of each cavity a point charge is placed—call these charge $q_a$ and $q_b$.
   (a) Find the surface charges $\sigma_a$, $\sigma_b$, and $\sigma_R$.
   (b) What is the field outside the conductor?
   (c) What is the field within each cavity?
   (d) What is the force on $q_a$ and $q_b$?




4. (20%) A metal sphere of radius $a$ carries a charge $Q$. It is surrounded, out to radius $b$, by linear dielectric material of permittivity $\varepsilon$. Find the potential at the center (relative to infinity)

5. (20%) Explaining (1) the Maxwell's equations (2)Poynting theorem.

參考用