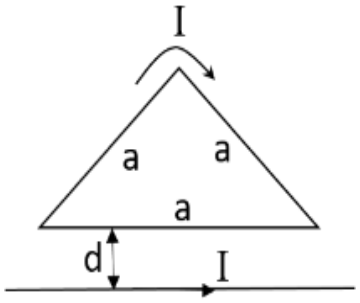
DEPARTMENT OF PHYSICS
INDIAN INSTITUTE OF TECHNOLOGY, MADRAS

PH1020 Physics II

Tutorial 4 (19.2.2018)

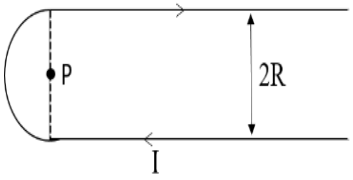
---

1. Find the force on a triangular loop due to a current carrying wire (see figure). Both the loop and the infinite wire carry a steady current I.



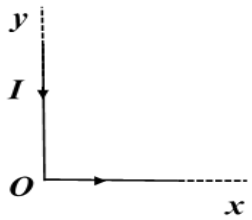
2. A conducting material with rectangular cross section PQRS is placed with the sides PQ along the x-axis and QR along y-axis. A uniform current $I_0\hat{e_z}$ flows across the cross section. Conduction electrons therefore move with a drift velocity $\mathbf{v} = -v_0\hat{e_z}$ and the conductor is placed in a magnetic field $\mathbf{B} = B_0\hat{e_y}$. (a) How are the electrons deflected? (b) Find the resulting potential difference between the opposite faces containing QR and PS.

3. A thin conducting wire in the configuration shown in the figure carries a steady current I. Find the magnetic field **B** at the point P, the center of the semicircle.



4. A long cylindrical conductor of radius R has a cylindrical hole of radius $b(b < R)$. The axis of the hole is parallel to the axis of the conductor. The remaining portion of the conductor has a uniform volume current density **J** parallel to the axis. Show that the magnetic field in the hole is uniform.

5. A steady current I flows through an L-shaped wire as shown in the figure. Calculate the magnetic field in the xy-plane over the domain $x > 0$ and $y > 0$.



6. A steady current density in a medium is given by $\mathbf{J}(\rho, \phi, z) = J_0 e^{-\lambda\rho^2} \hat{e_z}$ where J_0 and λ are positive constant of appropriate dimensions. Assume $\mu = \mu_0$ for the medium. (a) Find the magnetic field arising out of this current. (b) Sketch the magnitude of the field as a function ρ.