TFY4240

Problemset 5 Autumn 2014

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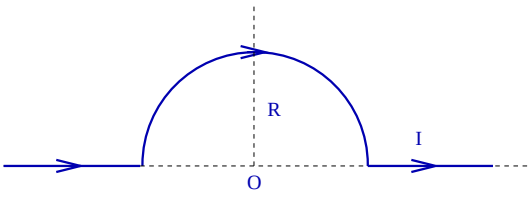
Problem 1.
Consider an infinitesimal static magnetic dipole of magnetic dipole moment $\boldsymbol{m}$. In a coordinate system centered at the dipole, the vector potential associated with can in the Coulomb gauge be written

$$\boldsymbol{A}(\boldsymbol{r}) = \frac{\mu_0}{4\pi}\frac{\boldsymbol{m}\times\hat{\boldsymbol{r}}}{r^2}. \tag{1}$$

a) Use expression (1) to obtain an expression for the magnetic induction, $\boldsymbol{B}(\boldsymbol{r})$. Express your answer in *coordinate free form*.

b) Compare your answer from the previous subproblem with the expression for the electric field from a static electric dipole.

Problem 2.



An infinitely long wire carries a (time-independent) current I. The wire is bent so as to have a semi-circular detour, of radius R, around the origin O (see figure).

a) Derive an expression for the magnetic field (vector), $\mathbf{H}$, at the origin O of the coordinate system.

b) Determine the numeric value of this magnetic field given the current $I = 1\text{A}$ and radius $R = 1\text{cm}$.

Problem 3.
Examples 6.1 and 6.3 from Griffiths.