Magnetic Dipole Vector Potential

1. The magnetic dipole potential is given by

$$\vec{A}_{dip} = \frac{\mu_o}{4\pi} \frac{\vec{m} \times \hat{r}}{r^2}$$

where

$$\vec{m} = I \int \int d\vec{a}$$

For a point dipole $\vec{m} = m\hat{z}$ show that

$$\vec{B} = \frac{\mu_o m}{4\pi r^3} (2\cos\theta \hat{r} + \sin\theta \hat{\theta})$$

2. Consider a spinning very thin disk of radius R, carrying a uniform surface charge density σ. It is rotating at constant angular velocity ω.

   (a) Determine the magnetic dipole moment of the spinning disk.

   (b) Determine the magnetic dipole potential along the lines (i) z-axis and (ii) y-axis in cartesian co-ordinates.

   (c) Determine the magnetic field using the dipole potential at positions (i) $\vec{r} = z\hat{z}$ and (ii) $\vec{r} = x\hat{x}$