Department of Physics, National Dong Hwa University

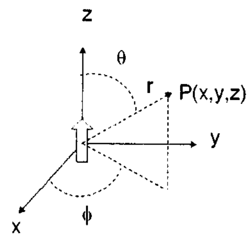
DEP. of PHYS.- Electrodynamics, Midterm Exam. - April 16, 2008

1. If the vector potential can be described as $A(\vec{r})=\frac{\mu_o}{4\pi}\int\frac{J(r')}{|\vec{r}-\vec{r}'|}dV'$

a. Calculate the expression of $\nabla(\nabla\cdot A(\vec{r}))$? (10%).

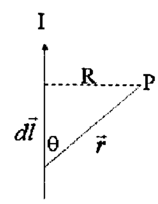
b. Calculate the expression of $\nabla^2 A(\vec{r})$?(10%).

2. A pure dipole $\vec{m}=m_o\hat{z}$ put at the origin, please calculate the vector potential and magnetic field at point P(x, y, z) in left figure. (20 %)



3. If the vector potential $\vec{A}=\frac{1}{2}\vec{B}\times\vec{r}$ is a suitable solution for magnetic field of $\vec{B}$, prove $\nabla\times\vec{A}=\vec{B}$. (10 %) $\vec{B}$ is uniform

4. Find the magnetic field at point P due to a long straight current wire. (10%) wire → ∞



5. A current I is uniformly distributed over a wire of circular cross section, which radius is *a*,

a. Find the volume current density J (10%)

b. Suppose the current is proportional to *ks*, find the total current (10%). $I = ks\hat{s}$

6. If the vector potential is $A(\vec{r})=\frac{\mu_o}{4\pi}\frac{1}{r^3}\vec{m}\times\vec{r}$

a. Find the magnetic field B which is determined by calculating $\nabla\times\vec{A}=\vec{B}$ (10%).

b. If a small magnetic dipole moment is placed into such magnetic field, please write down the potential U (10%).

Note: $\nabla\cdot(A\times B)=B\cdot(\nabla\times A)-A\cdot(\nabla\times B);$

$\nabla\times(A\times B)=(B\cdot\nabla)A-(A\cdot\nabla)B+A(\nabla\cdot B)-B(\nabla\cdot A)$