ECEn 560
Electromagnetic Wave Theory

Homework #0 - Review Problems
Due January 7, 2010 in class

1. Compute the curl and divergence of the following vector fields:
   (a) $x^2\hat{y} + y^2\hat{x}$
   (b) $\rho\hat{\phi}$
   (c) $\sin\theta\hat{\phi}$
2. Prove the following identities:
   (a) $\nabla \times (\nabla\phi) = 0$
   (b) $\nabla \cdot (\nabla \times \overline{A}) = 0$
   (c) $\nabla^2\overline{A} = -\nabla \times (\nabla \times \overline{A}) + \nabla(\nabla \cdot \overline{A})$

   To simplify the algebra, you can do this by checking for a vector field with, say, an x component only.
3. For the vector $\overline{A} = \hat{\rho}\rho^2 + \hat{z}2z$, verify the divergence theorem for the cylindrical region enclosed by $\rho = 5$, $z = 0$, $z = 3$.
4. Find the (a) complex Poynting vector and (b) time average Poynting vector for a plane wave. (c) What is the electric field strength corresponding to 10 W/m^2 time average power density?
5. A plane wave with electric field intensity 1 V/m strikes an infinite perfect electric conductor (PEC) plane at a normal incidence angle. Find the current induced on the PEC plane.