9/3/2004. **Due:** Monday, September 13, 2004 (in class).

Physics 301/571: Electromagnetic Theory I

Read: Griffiths chapter 1.1,1.2

"**G**" refers to Griffiths' book.
Problems with stars are not for credit and will NOT be graded.

Homework 1

Exercise 1 (G 1.3)

Find the angle between the body diagonals of a cube.

Exercise 2 (G 1.11)

Find the gradients of the following functions:

$$\begin{array}{ll} a) & f(x,y,z) = x^2 + y^3 + z^4, \\ b) & f(x,y,z) = x^2 y^3 z^4, \\ c) & f(x,y,z) = e^x \sin(y) \ln(z). \end{array}$$

Exercise 3

Let $\vec{r} = (x, y, z)$ be a position vector and r its magnitude. Calculate

$$\begin{array}{ll} a) & \vec{\nabla} x, \\ b) & \vec{\nabla}(x + y + z), \\ c) & \vec{\nabla}(r^3), \\ d) & \vec{\nabla}(1/r), \\ e) & \vec{\nabla}(\tan^{-1}(y/x)), \end{array}$$

Exercise 4 (G 1.15)

Calculate the divergence of the following vector functions:

$$\begin{array}{lrcl} a) & \vec{v}_a & = & x^2\hat{\mathbf{x}} + 3xz^2\hat{\mathbf{y}} - 2xz\hat{\mathbf{z}}, \\ b) & \vec{v}_b & = & xy\hat{\mathbf{x}} + 2yz\hat{\mathbf{y}} + 3zx\hat{\mathbf{z}}, \\ c) & \vec{v}_c & = & y^2\hat{\mathbf{x}} + (2xy + z^2)\hat{\mathbf{y}} + 2yz\hat{\mathbf{z}}, \end{array}$$

Exercise 5

Compute the divergence of the following vector function

$$\vec{v} = \frac{\hat{\mathbf{r}}}{r^n}.$$

What happens if $n = 2$?

Exercise 6 (G 1.18)

Calculate the curls of the vector functions in the Exercise 4.

*Exercise 7

Calculate the curl of the vector field

$$\vec{A} = \frac{1}{2} B(\rho)\,(\hat{\mathbf{z}} \times \vec{\rho}),$$

where $\vec{\rho} = (x, y, 0)$, $\rho = \sqrt{x^2 + y^2}$, and $B(\rho)$ is some function. What happens if $B = const$?