Physics 301/571: Electromagnetic Theory I

Read: Griffiths chapter 1.3-1.5

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

Homework 2

Exercise 1 (G 1.30)

Calculate the volume integral of the function $T = z^2$ over the tetrahedron with corners at $(0,0,0)$, $(1,0,0)$, $(0,1,0)$, and $(0,0,1)$.

Exercise 2

Find the value of scalar field T at point (x, y, z) if $T(0,0,0) = 0$ and

$$\vec{\nabla}T = (2x + y)\,\hat{\mathbf{x}} + x\,\hat{\mathbf{y}} + \hat{\mathbf{z}}.$$

Exercise 3

Using Gauss's theorem find the flux $\oint_S \vec{r}\cdot d\vec{a}$ of the position vector through the closed surface enclosing the volume V (the shape is arbitrary).

Exercise 4

Using Stokes' theorem find the line integral $\oint_P \vec{v}\cdot d\vec{l}$ of the vector field

$$\vec{v} = (3z + y^2 x)\,\hat{\mathbf{x}} + \ln(x^2 + y^4 + 1)\,\hat{\mathbf{y}} + (y \sin z - 2x)\,\hat{\mathbf{z}}$$

along the closed contour P which lies in the xz plane and encloses an area S. The direction of the contour is counterclockwise if looked at from the positive y direction.

Exercise 5

The function T is given in spherical coordinates as $T(r, \theta, \phi) = r^2 \cos^2\theta + r^2 \sin^2\theta \sin\phi \cos\phi$.

a) Compute the Laplacian of T in spherical coordinates.

b) Convert T to Cartesian coordinates x, y, z and compute the Laplacian in those coordinates.

*Exercise 6 (G 1.42, partial)

a) Find the divergence of the function

$$\vec{v} = s(2 + \sin^2\phi)\,\hat{\mathbf{s}} + s\sin\phi\cos\phi\,\hat{\phi} + 3z\,\hat{\mathbf{z}}$$

in cylindrical coordinates.
b) Find the curl of $\vec{v}$.