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:

a) \( f(x, y, z) = x^2 + y^3 + z^4 \),

b) \( f(x, y, z) = x^2 y^3 z^4 \),

c) \( f(x, y, z) = e^x \sin(y) \ln(z) \).

Exercise 3
Let \( \vec{r} = (x, y, z) \) be a position vector and \( r \) its magnitude. Calculate

a) \( \vec{\nabla} x \),

b) \( \vec{\nabla} (x + y + z) \),

c) \( \vec{\nabla} (r^3) \),

d) \( \vec{\nabla} (1/r) \),

e) \( \vec{\nabla} (\tan^{-1}(y/x)) \).

Exercise 4 (G 1.15)
Calculate the divergence of the following vector functions:

a) \( \vec{v}_a = x^2 \hat{x} + 3xz^2 \hat{y} - 2xz \hat{z} \),

b) \( \vec{v}_b = xy \hat{x} + 2yz \hat{y} + 3zx \hat{z} \),

c) \( \vec{v}_c = y^2 \hat{x} + (2xy + z^2) \hat{y} + 2yz \hat{z} \),
Exercise 5
Compute the divergence of the following vector function
\[ \vec{v} = \frac{\hat{r}}{r^n}. \]

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
\[ \vec{A} = \frac{1}{2} B(\rho) (\hat{\rho} \times \vec{\rho}), \]
where \( \vec{\rho} = (x, y, 0) \), \( \rho = \sqrt{x^2 + y^2} \), and \( B(\rho) \) is some function. What happens if \( B = const \)?