### Reading

Chapter 3, pp. 56-96.

### Problems

#### Problem 1

Identify each function below as either a scalar field or vector field by circling the correct answer.

- \( x^2 + \frac{a}{y} - z \)   **Scalar Field**  **Vector Field**
- \( y \hat{a} + 3 \hat{a}_y \)   **Scalar Field**  **Vector Field**
- \( 2a_r + \cos \phi \hat{a}_\phi \)   **Scalar Field**  **Vector Field**
- \( \sin \theta \sin \phi \)   **Scalar Field**  **Vector Field**

#### Problem 2

Derive the equation for the volume of a sphere by performing a volume integration in spherical coordinates.

#### Problem 3

Calculate the gradient of the following scalar functions

- \( A = x^2 y + xyz \)
- \( B = \rho z \sin \phi + z^2 \cos^2 \phi + \rho^3 \)

#### Problem 4

Calculate the divergence of the following vector functions:

- \( \vec{A} = x^2 yz \hat{a}_x + xz \hat{a}_z \)
- \( \vec{B} = \rho \sin \phi \hat{a}_\rho + \rho^2 z \hat{a}_\phi + \cos \phi \hat{a}_z \)

#### Problem 5

Calculate the curl of the following vector functions:

- \( \vec{A} = yz \hat{a}_x + 4xy \hat{a}_y + y \hat{a}_z \)
- \( \vec{B} = \rho \z \sin \phi \hat{a}_\rho + 8 \rho \z^2 \hat{a}_\phi \)

#### Problem 6

Calculate the Laplacian of the following fields where \( h \) is just a constant:

- \( A = e^{-z} \sin (2x) \cos (hy) \quad h = \text{constant} \)
- \( \vec{B} = xyz \hat{a}_x + 3x \hat{a}_z \)