

Reading

Required Reading

- Chapter 3, pp. 58-98.

Problems

Problem 1 – Scalar vs. Vector Fields

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

| | | |
|---|--------|--------|
| $ax^2 + bx + c$ | Scalar | Vector |
| $b\hat{a}_x + 10x\hat{a}_y$ | Scalar | Vector |
| $2r\hat{a}_r + \sin\phi\hat{a}_\phi$ | Scalar | Vector |
| $\vec{A}(x, y, z) \cdot \vec{B}(x, y, z)$ | Scalar | Vector |
| $\vec{A}(x, y, z) \times \vec{B}(x, y, z)$ | Scalar | Vector |
| $[\vec{A}(x, y, z) \times \vec{B}(x, y, z)] \cdot \vec{C}(x, y, z)$ | Scalar | Vector |

Problem 2 – Triple Integration

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

Problem 3 – Gradient

Calculate the gradient of the following two functions.

$$xy^2z + yz \qquad \rho z \sin\phi + z^2 \cos^2\phi + \rho^3$$

Problem 4 – Divergence

Calculate the divergence of the following two functions.

$$x^2yz\hat{a}_x + xz\hat{a}_z \qquad \rho \sin\phi\hat{a}_\rho + \rho^2z\hat{a}_\phi + \cos\phi\hat{a}_z$$

Problem 5 – Curl

Calculate the curl of the following two functions.

$$yz\hat{a}_x + 4xy\hat{a}_y + y\hat{a}_z \qquad \rho z \sin\phi\hat{a}_\rho + 8\rho z^2\hat{a}_\phi$$

Problem 6 – Laplacian

Calculate the Laplacian of the following two functions.

$$e^{-z} \sin(2x) \cos(3y) \qquad xyz\hat{a}_x + 3x^2\hat{a}_z$$