

**Reading assignment**

Paul, Whites, and Nasar, Chap. 1 and 2.1 -> 2.7

**Problem 1 - Dot and cross products**

Given  $\mathbf{A} = r^3 \mathbf{a}_r + 4 \sin \theta \mathbf{a}_\theta$  and  $\mathbf{B} = 3 \mathbf{a}_r + 2 \mathbf{a}_\theta + 12 \sin \theta / r^3 \mathbf{a}_\phi$

Find  $\mathbf{A} \cdot \mathbf{B}$  and  $\mathbf{A} \times \mathbf{B}$

**Problem 2 - Area integrals**

For each of the following surfaces, sketch the surface, and find its area.

- $r = 3, 0 \leq \theta \leq \pi/3, -2 \leq z \leq 2.$
- $0 \leq r \leq 5, \theta = \pi/3, 0 \leq z \leq 2.$
- Identify  $d\mathbf{s}$  for each of the surfaces.

**Problem 3 - Volume integrals**

- Sketch each of the following volumes and then calculate its value by integrating over the appropriate differential volume element.
  - $2 \leq x \leq 5, 0 \leq y \leq 3, -2 \leq z \leq 3.$
  - $1 \leq r \leq 3, 0 \leq \theta \leq \pi/3, -2 \leq z \leq 2.$
- Integrate the function  $(a e^{-r/a} / r)$  over the volume of a sphere of radius  $a$ .

**Problem 4 - Useful areas and volumes**

- What is the surface area of a sphere of radius  $r$ ?
- What is the surface area of the side of a cylinder with radius  $r$  and length  $l$ ?
- What is the volume of a sphere of radius  $r$ ?
- What is the volume of a cylinder of radius  $r$  and length  $l$ ?