Basic Math & Coordinate Systems

Reading assignment
Ulaby, 3-1, 3-2, 3-3, Inside back cover
Connor and Salon, I-1 $\rightarrow$ I-14

Software
Maple (check your solutions)

Problem 1 - Dot and cross products

Given $\vec{A} = r^3\,\hat{r} + 4\sin(\theta)\,\hat{\phi}$ and $\vec{B} = 3\hat{r} + 2\hat{\theta} + \frac{12\sin(\theta)}{r^3}\hat{\phi}$

Find $\vec{A} \bullet \vec{B}$ and $\vec{A} \times \vec{B}$.

Problem 2 - Area integrals
For each of the following surfaces, sketch the surface, and find its area.

a. $r = 3,\ 0 \le \varphi \le \pi/3,\ -2 \le z \le 2.$
b. $0 \le r \le 5,\ \theta = \pi/3,\ 0 \le \varphi \le 2\pi.$
c. Identify **ds** for each of the surfaces.

Problem 3 - Volume integrals
a. Sketch each of the following volumes and then calculate the volume by integration.

1) $2 \le x \le 5,\ 0 \le y \le 3,\ -2 \le z \le 3.$
2) $1 \le r \le 3,\ 0 \le \varphi \le \pi/3,\ -2 \le z \le 2.$

b. Integrate the function ($a\ e^{-r/a} / r$) over the volume of a sphere of radius a.

Problem 4 - Useful areas and volumes

a. What is the surface area of a sphere of radius *r*?
b. What is the surface area of the side of a cylinder with radius *r* and length *l* ?
c. What is the volume of a sphere of radius *r*?
d. What is the volume of a cylinder of radius *r* and length *l* ?