Chapter 6 Problem 27 [†]

Given
$\vec{E} = \{4.0\hat{j} + 3.0\hat{k}\} \times 10^3\ N/C$
$r = 2.0\ m$

Solution
a) Find the flux through a circle that lies in the xy-plane.

The area of the circle is

$$A = \pi r^2 = \pi(2.0\ m)^2 = 12.6\ m^2$$

Area is a vector and the direction is perpendicular to the plane of the circle. Since it lies in the xy-plane, then the vector is in the $\hat{k}$ direction. It could either be positive or negative, but I will make it positive. Now the flux through the circle is

$$\Phi = \vec{E} \cdot \vec{A}$$

The flux is then

$$\Phi = (\{4.0\hat{j} + 3.0\hat{k}\} \times 10^3\ N/C) \cdot (12.6\hat{k}\ m^2)$$

$$\Phi = (3.0 \times 10^3\ N/C)(12.6\ m^2) = 3.8 \times 10^4\ Nm^2/C$$

[†]Problem from Univesity Physics by Ling, Sanny and Moebs (OpenStax)