Chapter-23

1. A flat surface of area 3.20 m2 is rotated in a uniform electric field of magnitude E = 6.20 X 105 N/C. Determine the electric flux through this area (a) when the electric field is perpendicular to the surface and (b) when the electric field is parallel to the surface.

Ans: For a uniform electric field passing through a plane surface,  where *θ* is the angle between the electric field and the normal to the surface.

 (a) The electric field is perpendicular to the surface, so *θ* = 0°:

 

 (b) The electric field is parallel to the surface: *θ* = 90°, so cos*θ* = 0, and the flux is 

1. A charge of 170 *µ*C is at the center of a cube of edge 80.0 cm. No other charges are earby. (a) Find the flux through each face of the cube. (b) Find the flux through the whole surface of the cube. (c) **What If?** Would your answers to either part (a) or part (b) change if the charge were not at the center? Explain.

Ans: The total flux through the surface of the cube is

 

 (a) By symmetry, the flux through each face of the cube is the same.

 

 

 (b) 

 (c) 

1. A uniformly charged, straight filament 7.00 m in length has a total positive charge of 2.00 *µ*C. An uncharged cardboard cylinder 2.00 cm in length and 10.0 cm in radius surrounds the filament at its center, with the filament as the axis of the cylinder. Using reasonable approximations, find (a) the electric field at the surface of the cylinder and (b) the total electric flux through the cylinder.

Ans: The approximation in this case is that the filament length is so large when compared to the cylinder length that the “infinite line” of charge can be assumed.

 (a) We have

 

 where the linear charge density is

 

 so

 

 (b) We can find the flux by multiplying the field and the lateral surface area of the cylinder:

 

 so

 