Chapter-23

1. A uniformly charged ring of radius 10.0 cm has a total charge of 75.0 *µ*C. Find the electric field on the axis of the ring at (a) 1.00 cm, (b) 5.00 cm, (c) 30.0 cm, and (d) 100 cm from the center of the ring.

 Ans: 

 where we choose the *x* axis along the axis of the ring. The field is parallel to the axis, directed away from the center of the ring above and below it.

 (a) At *x* = 0.010 0 m, 

 (b) At *x* = 0.050 0 m, 

 (c) At *x* = 0.300 m, 

 (d) At *x* = 1.00 m, 

1. A charge of 170 *µ*C is at the center of a cube of edge 80.0 cm. No other charges are nearby. (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) 

3. A particle with charge *q* is located a distance *d* from an infinite plane. Determine the electric flux through the plane due to the charged particle. (b) **What If?** A particle with charge *q* is located a *very small* distance from the center of a *very large* square on the line perpendicular to the square and going through its center. Determine the approximate electric flux through the square due to the charged particle. (c) How do the answers to parts (a) and (b) compare? Explain.

 Ans: (a) One-half of the total flux created by the charge *q* goes through the plane. Thus,

 

 (b) The square looks like an infinite plane to a charge *very close* to the surface. Hence,

 

 (c) 

 4. A uniformly charged, straight filament 7.00 m in length has a total positive charge of 2.00 *m*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

 