

27. A surface completely surrounds a $+2.0 \times 10^{-6} \text{ C}$ charge. Find the electric flux through this surface when the surface is (a) a sphere with a radius of 0.50 m, (b) a sphere with a radius of 0.25 m, and (c) a cube with edges that are 0.25 m long.

Gauss's Law tells us that the electric flux is equal to the net charge enclosed divided by the permittivity of free space or in equation form

$$\Phi_E = \vec{E} \cdot \vec{A} = EA \cos(\theta_{EA}) = \frac{Q_{\text{enclosed}}}{\epsilon_0}$$

Since in all three of these shapes the surface area encloses the charge, the flux is the same regardless of the shape.

$$\Phi_E = \frac{Q_{\text{enclosed}}}{\epsilon_0} = \frac{(2.0 \times 10^{-6} \text{ C})}{(8.85 \times 10^{-12} \text{ C}^2 / (\text{Nm}^2))} = 2.260 \times 10^5 \text{ Nm}^2 / \text{C}$$

$\Phi_E = 2.3 \times 10^5 \text{ Nm}^2 / \text{C}$
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