

Answer on Question #84692 Physics / Other

A thin metallic shell of radius $R = 40$ cm has a charge of $Q = -25$ nC on it. At the center of the sphere is a point charge of $q = 35$ nC. What is the electric field $r = 50$ cm from the center of the shell?

Solution:

The Gauss's law for the electric flux through a closed surface

$$\oiint \mathbf{E} d\mathbf{A} = \frac{1}{\epsilon_0} Q_{\text{net}}$$

Let us consider a closed surface as a sphere of radius $r > R$. Thus

$$\oiint \mathbf{E} d\mathbf{A} = E \oiint dA = E \times 4\pi r^2$$

$$Q_{\text{net}} = Q + q = -25 \text{ nC} + 35 \text{ nC} = 10 \text{ nC}$$

So, electric field

$$\begin{aligned} E &= \frac{Q_{\text{net}}}{4\pi\epsilon_0 r^2} \\ &= \frac{10 \times 10^{-9} \text{ C}}{4\pi \times 8.85 \times 10^{-12} \frac{\text{F}}{\text{m}} \times 0.5^2 \text{ m}^2} \\ &= 360 \frac{\text{N}}{\text{C}} \end{aligned}$$

Answer: $360 \frac{\text{N}}{\text{C}}$ outward

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