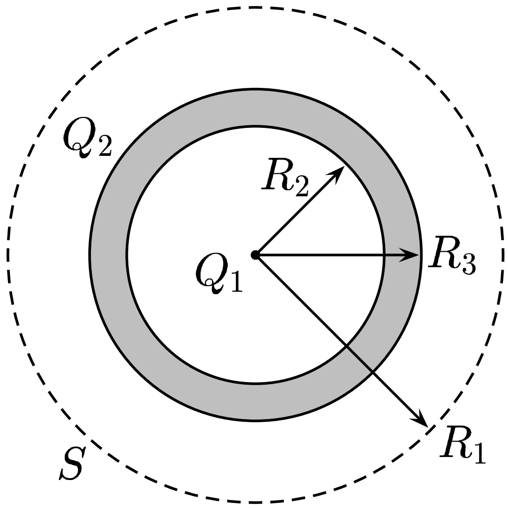
Consider an electrostatic situation. A point charge $Q_1 > 0$ is located at the center of a hollow thick spherical shell (made of an insulating material) that has an inner radius of R_2 and an outer radius of R_3. Naturally, the charge on the shell's inner surface is $-Q_1$, and the charge on the shell's outer surface is $Q_2 > 0$. Let S (dashed circular line) be a concentric spherical surface (Gaussian surface) with a radius R_1.



Find E_1, the magnitude of the radial electric field vector at the surface of the Gaussian surface S, which is a distance R_1 from the center of the spherical conducting shell.

A) $\vec{E} = \dfrac{1}{4\,\pi\,\epsilon_0}\,\dfrac{Q_1}{R_1^2}$

B) $\vec{E} = \dfrac{1}{4\,\pi\,\epsilon_0}\,\dfrac{Q_2}{R_1^2}$

C) $\vec{E} = \dfrac{1}{4\,\pi\,\epsilon_0}\,\dfrac{Q_1 + Q_2}{R_1^2}$

Since the charge distribution is spherically symmetric, $\|\vec{E}\|$ must be the

same everywhere on S. And by symmetry $\vec{E}$ must be directed radially, either outward or inward. However there is a charge enclosed in the Gaussian sur-

face, therefore $\Phi_S = \oint_S \vec{E} \cdot \vec{A} = \dfrac{Q_1 - Q_1 + Q_2}{\epsilon_0}$, or specifically $\vec{E} = \dfrac{1}{4\,\pi\,\epsilon_0}\,\dfrac{Q_2}{R_1^2}$.

Answer **B**.

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