Center of sphere is at lower right corner of box.

Consider the cubical Gaussian surface shown in the figure. At the front, lower, right hand corner there is a charged sphere of net charge \(-3Q\) which is uniformly distributed over its surface.

a) What is the magnitude of the electric field at point \(P\) (the upper right hand corner of the front)?

By spherical symmetry, can use equation for a point charge:

\[ \Phi = \frac{1}{4\pi \varepsilon_0} \frac{3Q}{a^2} \]

To use Gauss' Law, must construct a Gaussian sphere, drawn in above.

\[ \Phi \cdot dA = \frac{q_{	ext{enc}}}{\varepsilon_0} \]

\[ E \left( \frac{4}{3} \pi r^3 \right) = \frac{q_{	ext{enc}}}{\varepsilon_0} \]

\[ E = \frac{3Q}{4\pi \varepsilon_0 a^2} \]

b) What is the net flux through the surface of the cubical box?

\[ \varepsilon_0 \Phi = q_{\text{enc}} \quad \text{or} \quad \Phi = \frac{q_{\text{enc}}}{\varepsilon_0} \]

The box encloses one quarter of the upper half of the sphere, or one eighth of the entire sphere.

\[ \Phi = \frac{1}{\varepsilon_0} \left[ \frac{1}{8} (-2Q) \right] = \frac{-3Q}{8\varepsilon_0} \]