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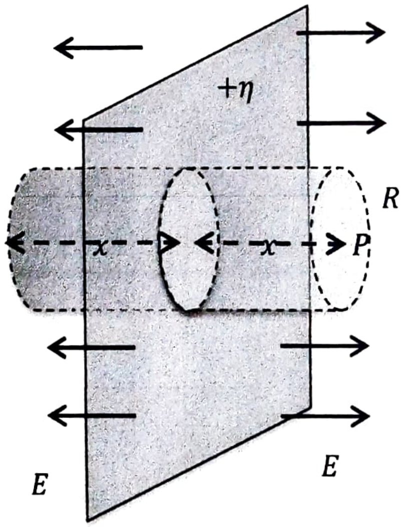
After this activity, you should know: *• Use Gauss's Law in situations with planar symmetry.*

1. A very large flat insulating sheet with uniform charge per area η (SI units: C/m^2) sits in the y-z plane at $x = 0$. We want to find the electric field at a point P a distance x from the sheet. Assume P is far from the edges and x is small compared to the size of the sheet.

   Assume that η is positive. From symmetry, the electric field must point directly away from the sheet. We choose to draw the Gaussian surface as a cylinder of radius R that extends a distance x on both sides of the sheet.

   a. Which statement is true regarding the flux through the Gaussian surface? **Choose one answer below!**

   - The electric flux through all the surfaces is zero.
   - The flux through the endcaps is zero and the flux through the curved section is positive.
   - The flux through the endcaps is zero and the flux through the curved section is negative.
   - The flux through the curved section is zero. The flux through the right endcaps is positive and through the left endcaps is negative.
   - The flux through the curved section is zero. The flux through the endcaps are both positive.



   b. Write the flux through the Gaussian surface in terms the unknown E and R and/or x. Check units.

   $EA = E \cdot 2\pi R^2$

   c. Write the charge enclosed and the electric flux in terms of the charge per area η and R and/or x.

   $q_{enc} = \eta \cdot \pi R^2$ $\qquad \Phi_E = \frac{\eta \pi R^2}{\epsilon_0}$

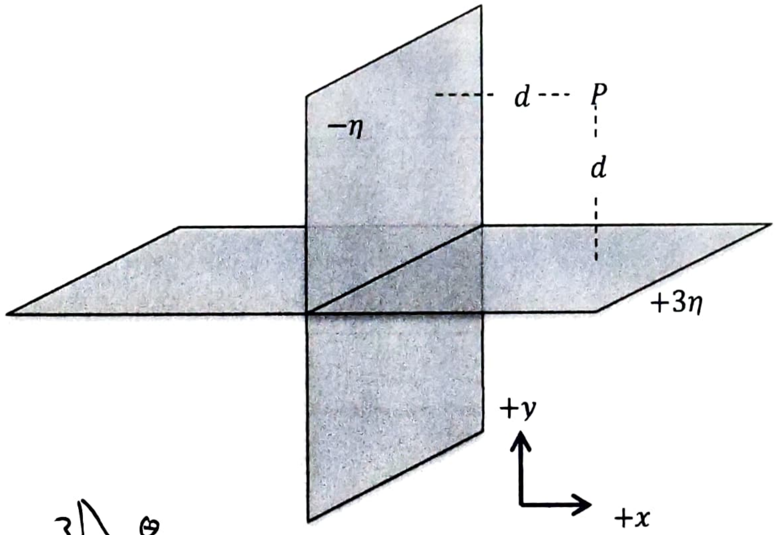
   d. Determine electric field in terms of η and/or x.

   $2E\pi R^2 = \frac{\eta \pi R^2}{\epsilon_0}$ $\qquad E = \frac{\eta}{2\epsilon_0}$

   e. Does the electric field depend on the distance from the sheet?

   no

2. Two large flat sheets with uniform charge per area $+3\eta$ and $-\eta$ are arranged as shown. We want to the electric field at point P a distance d from both sheets. Assume that d is small so that we can treat the sheets as infinite.



   a. What is the magnitude of the electric field at point P?

$$\frac{-\eta}{2\epsilon_0}\hat{i} + \frac{3\eta}{2\epsilon_0}\hat{j}$$

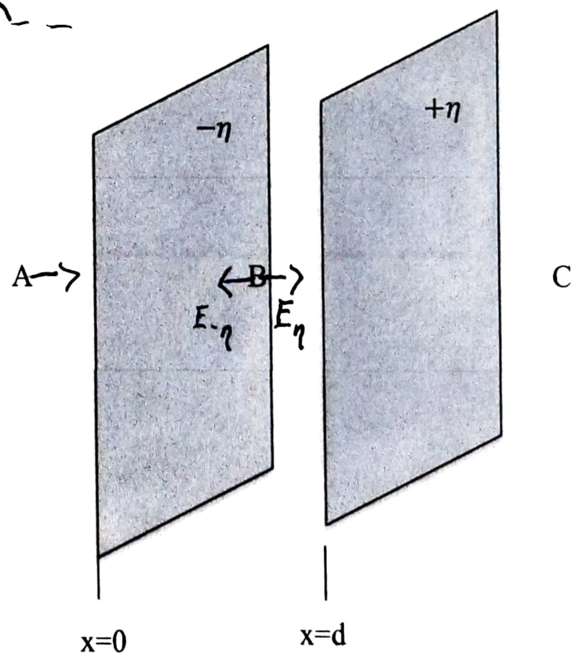
   b. What is the direction of the electric field at point P? Give angle relative to the +x axis.

$\theta + \phi = 180$

$\theta + 71.56 = 180$

$\theta = 108.43^0$

3. Two very large flat sheets are oriented parallel to each other and are oppositely charged. The sheets are separated by a distance d.



   a. Draw a vector showing the electric field at point A due to the negative sheet. Draw a second vector showing E at point A due to the positive sheet.
   b. What is the net electric field at point A? *Hint: does the electric field of a sheet depend on distance?*

$$\frac{-\eta}{2\epsilon_0}$$

   c. Draw two vectors showing E at point B due to the negative sheet and E due to the positive sheet.
   d. What is the x component of the net electric field at point B?

0

   e. Make a graph of the x component of the electric field versus x.