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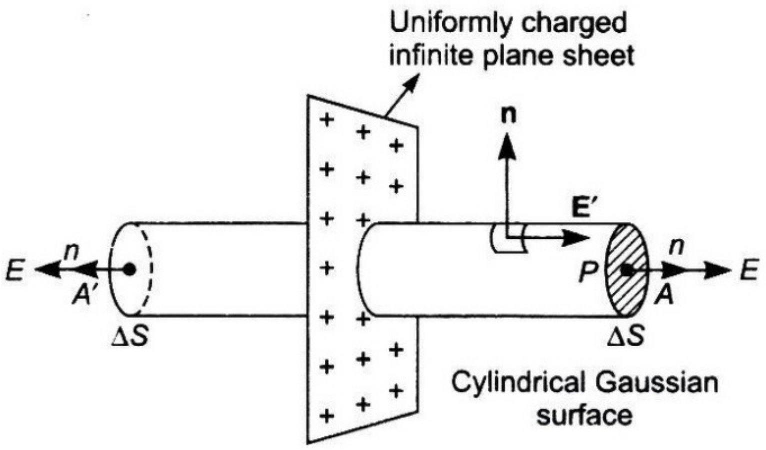
ELECTRIC FIELD DUE AN INFINITE CONDUCTING SHEET OF CHARGE

(అనంత విద్యుద్వాహక ఫలక వల్ల విద్యుత్ క్షేత్ర తీవ్రత)

The following figure shows a charged conducting surface of charge density σ. The aim of this topic is to determine an expression for the electric field at a point 'P', a nearer point outside the conductor as shown in the figure. To derive an expression for 'E', construct a cylindrical Gaussian surface. From the figure, the direction of electric field near the surface is perpendicular to the surface.



The cylindrical Gaussian surface has three surfaces, viz., left end, right end and curved surface. At the right end, E and dS are parallel to each other. At the left end there is no electric field.

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Therefore, the flux through the two ends are EdS and zero respectively. On the curved surface, E and dS are perpendicular to each other. Therefore, the total flux is given by

$$\Phi = \oint_{\substack{right\\end}} E.dS + \oint_{\substack{left\\end}} E.dS + \oint_{\substack{curved\\surface}} E.dS \Rightarrow ES + 0 + 0 = ES \qquad \text{--(1)}$$

According to Gauss law,

$$Es = \frac{q}{\varepsilon_0} = \frac{\sigma s}{\varepsilon_0}$$

From the definition of σ, σ =q/S (charge/Area)

$$\therefore E = \frac{\sigma}{\varepsilon_0} \qquad \text{--(2)}$$

Thus, equation (2) gives an expression for electric field due to an infinite conducting sheet of charge

Model questions(మాదిరి ప్రశ్నలు):

1. Derive an expression for electric field due to an infinite conducting plane sheet of charge
2. Using Gauss law, derive an expression for electric field intensity at a point near the infinite plane sheet of charge.

References

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2. Internet

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