

gy density, J m^{-3}

$\times 10^3$

$\times 10^6$

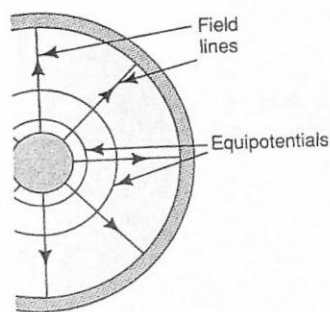
2×10^{-7}

$.6 \times 10^8$

arge Q per unit length l of one con-
between the two conductors. The
are concentric circles, as indicated
radius r is given by (2-10-1), where
length on the inner conductor. The
is, from (2-10-2),

(1)

of charge to potential, $C = Q/V$.
e ratio Q/l equals the linear charge
length C/l of the coaxial line



(b)

is

$$\frac{C}{l} = \frac{\rho_L}{V} = \frac{2\pi\epsilon}{\ln(b/a)} \quad (\text{F m}^{-1}) \quad (2)$$

where ϵ is the permittivity of the medium between conductors.

Since $\epsilon = \epsilon_0\epsilon_r$, where $\epsilon_0 = 8.85 \text{ pF m}^{-1}$, (2) can be expressed more conveniently as

$$\frac{C}{l} = \frac{55.6\epsilon_r}{\ln(b/a)} = \frac{24.2\epsilon_r}{\log(b/a)} \quad (\text{pF m}^{-1}) \quad \text{Coaxial line capacitance} \quad (3)$$

where ϵ_r = relative permittivity of medium between conductors

b = inside radius of outer conductor

a = radius of inner conductor (in same units as b)

4-13 TWO LINES OF CHARGE

Let two long parallel lines of charge be separated by a distance $2s$ as in Fig. 4-13. Assume that the linear charge density of the two lines is equal but of opposite sign. The resultant electric field \mathbf{E} at a point P , distant r_1 from the negative line and r_2 from the positive line, is then the vector sum of the field of each line taken alone.

Let the origin of the coordinates in Fig. 4-13 be the reference for potential. Imagine that only the positively charged line is present. Then from (4-12-1) the potential difference between P and the origin is

$$V_+ = \frac{\rho_L}{2\pi\epsilon} \ln \frac{s}{r_2} \quad (1)$$

Similarly for the negatively charged line

$$V_- = -\frac{\rho_L}{2\pi\epsilon} \ln \frac{s}{r_1} \quad (2)$$

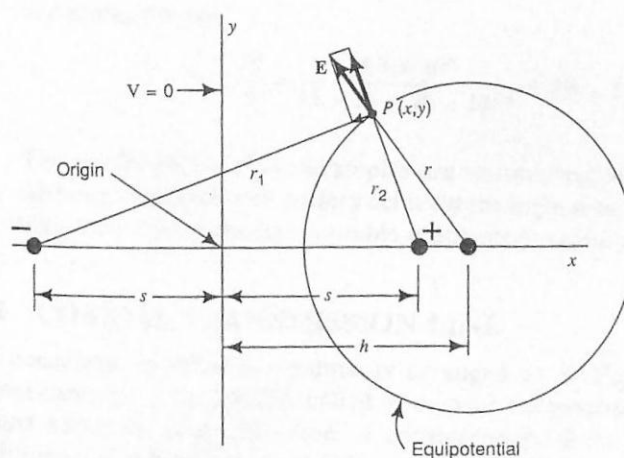


FIGURE 4-13
Two lines of charge separated
by a distance $2s$.