is

$$\boxed{\frac{C}{l} = \frac{\rho_L}{V} = \frac{2\pi\epsilon}{\ln (b/a)}} \qquad (\mathrm{F\,m^{-1}}) \tag{2}$$

where ϵ is the permittivity of the medium between conductors.

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

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

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 **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

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

Similarly for the negatively charged line

$$V_- = -\frac{\rho_L}{2\pi\epsilon} \ln \frac{s}{r_1} \tag{2}$$

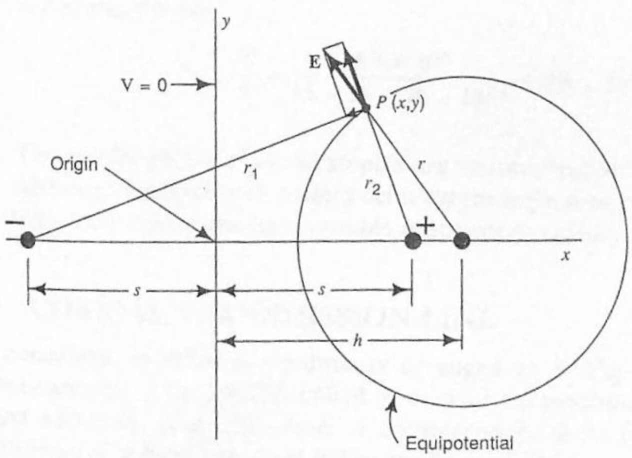

FIGURE 4-13
Two lines of charge separated by a distance $2s$.