P.3–13 **Determine the work done in carrying a -2 (μC) charge from $P_1(2, 1, -1)$ to $P_2(8, 2, -1)$ in the field $\mathbf{E} = \mathbf{a}_x y + \mathbf{a}_y x$**

a) along the parabola $x = 2y^2$,

b) along the straight line joining P_1 and P_2.

P.3–16 A finite line charge of length L carrying uniform line charge density ρ_ℓ is coincident with the x-axis.

a) Determine V in the plane bisecting the line charge.

P.7–1 **Express the transformer emf induced in a stationary loop in terms of time-varying vector potential A.**

P.7–4 A conducting equilateral triangular loop is placed near a very long straight wire, shown in Fig. 6–48, with $d = b/2$. A current $i(t) = I \sin \omega t$ flows in the straight wire.

a) Determine the voltage registered by a high-impedance rms voltmeter inserted in the loop.

b) Determine the voltmeter reading when the triangular loop is rotated by 60° about a perpendicular axis through its center.

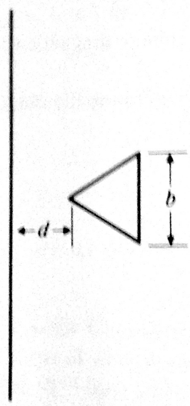

FIGURE 6–48
A long, straight wir
(Problem P.6–38).

P.7–13 The vector magnetic potential **A** and scalar electric potential V defined in Section 7–4 are not unique in that it is possible to add to **A** the gradient of a scalar ψ, $\nabla\psi$, with no change in **B** from Eq. (7–55).

$$\mathbf{A}' = \mathbf{A} + \nabla\psi. \tag{7–116}$$

In order not to change **E** in using Eq. (7–57), V must be modified to V'.

a) Find the relation between V' and V.

b) Discuss the condition that ψ must satisfy so that the new potentials $\mathbf{A}'$ and V' remain governed by the uncoupled wave equations (7–63) and (7–65).

P.7–14 Substitute Eqs. (7–55) and (7–57) in Maxwell's equations to obtain wave equations for scalar potential V and vector potential **A** for a linear, isotropic but inhomogeneous medium. Show that these wave equations reduce to Eqs. (7–65) and (7–63) for simple media. (*Hint:* Use the following gauge condition for potentials in an inhomogeneous medium:

$$\nabla \cdot (\epsilon \mathbf{A}) + \mu\epsilon^2 \frac{\partial V}{\partial t} = 0.) \tag{7–117}$$

$$\mathbf{B} = \nabla \times \mathbf{A} \qquad \text{(T)}. \tag{7-55}$$

$$\mathbf{E} = -\nabla V - \frac{\partial \mathbf{A}}{\partial t} \qquad \text{(V/m)}. \tag{7-57}$$

$$\nabla^2 \mathbf{A} - \mu\epsilon \frac{\partial^2 \mathbf{A}}{\partial t^2} = -\mu \mathbf{J}. \tag{7-63}$$

$$\nabla^2 V - \mu\epsilon \frac{\partial^2 V}{\partial t^2} = -\frac{\rho}{\epsilon}, \tag{7-65}$$