**3-39.** Consider the periodic function

a)

$$F(t) = \begin{cases} \sin \omega t, & 0 < t < \pi/\omega \\ 0, & \pi/\omega < t < 2\pi/\omega \end{cases}$$

which represents the positive portions of a sine function. (Such a function represents, for example, the output of a half-wave rectifying circuit.) Find the Fourier representation and plot the sum of the first four terms.

b) Find the response of a linear oscillator to this Force.

**3-38.** Use Green's method to obtain the response of a damped oscillator to a forcing function of the form

$$F(t) = \begin{cases} 0 & t < 0 \\ F_0 e^{-\gamma t} \sin \omega t & t > 0 \end{cases}$$

**3-42.** An undamped driven harmonic oscillator satisfies the equation of motion $m(d^2x/dt^2 + \omega_0^2 x) = F(t)$. The driving force $F(t) = F_0 \sin(\omega t)$ is switched on at $t = 0$. **(a)** Find $x(t)$ for $t > 0$ for the initial conditions $x = 0$ and $v = 0$ at $t = 0$. **(b)** Find $x(t)$ for $\omega = \omega_0$ by taking the limit $\omega \to \omega_0$ in your result for part **(a)**. Sketch your result for $x(t)$. *Hint*: In part **(a)** look for a particular solution of the differential equation of the form $x = A \sin(\omega t)$ and determine $A$. Add the solution of the homogeneous equation to this to obtain the general solution of the inhomogeneous equation.

**3-44.** Consider a damped harmonic oscillator. After four cycles the amplitude of the oscillator has dropped to $1/e$ of its initial value. Find the ratio of the frequency of the damped oscillator to its natural frequency.

**4-1.** Refer to Example 4.1. If each of the springs must be stretched a distance $d$ to attach the particle at the equilibrium position (i.e., in its equilibrium position, the particle is subject to two equal and oppositely directed forces of magnitude $kd$), then show that the potential in which the particle moves is approximately

$$U(x) \cong (kd/l)x^2 + [k(l - d)/4l^3]x^4$$

**4-2.** Construct a phase diagram for the potential in Figure 4-1.

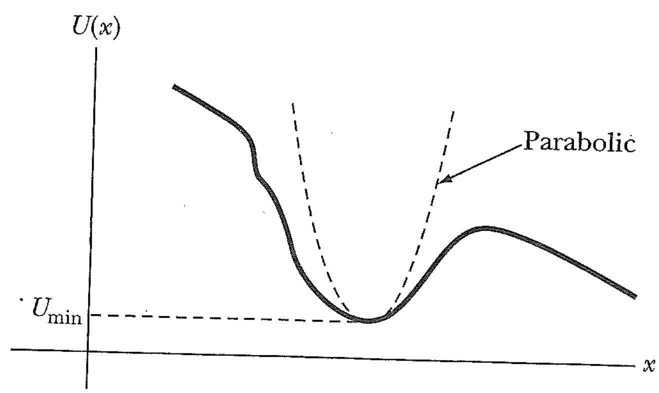


**FIGURE 4-1** Arbitrary potential $U(x)$ indicating a parabolic region where simple harmonic motion is applicable.