101. (a) We require $U = \frac{1}{2}E$ at some value of x. Using Eq. 16-21, this becomes

$$\frac{1}{2}kx^2 = \frac{1}{2}\left(\frac{1}{2}kx_m^2\right) \quad \Longrightarrow \quad x = \frac{x_m}{\sqrt{2}} \ .$$

We compare the given expression x as a function of t with Eq. 16-3 and find $x_m = 5.0$ m. Thus, the value of x we seek is $x = 5.0/\sqrt{2} \approx 3.5$ m.

(b) We solve the given expression (with $x = 5.0/\sqrt{2}$), making sure our calculator is in radians mode:

$$t = \frac{\pi}{4} + \frac{3}{\pi}\cos^{-1}\left(\frac{1}{\sqrt{2}}\right) = 1.54 \text{ s} \ .$$

Since we are asked for the interval $t_{\text{eq}} - t$ where t_{eq} specifies the instant the particle passes through the equilibrium position, then we set $x = 0$ and find

$$t_{\text{eq}} = \frac{\pi}{4} + \frac{3}{\pi}\cos^{-1}(0) = 2.29 \text{ s} \ .$$

Consequently, the time interval is $t_{\text{eq}} - t = 0.75$ s.