Challenge problem 1: part a)

$$E = \frac{1}{2} m \left(\frac{dx}{dt}\right)^2 + V(x)$$

$$T = \frac{1}{4} t\,(0 \to a)$$

at $x = 0$ / $x = a$ $\quad \frac{dx}{dt} = 0$

at $x = a$: $\quad E = V(a)$

$$V(a) - V(x) = \frac{1}{2} m \left(\frac{dx}{dt}\right)^2$$

$$\frac{dx}{dt} = \sqrt{\frac{2}{m}\left(V(a) - V(x)\right)} \qquad m = 1$$

$$\frac{dt}{dx} = \frac{1}{\sqrt{2}} \frac{1}{\sqrt{V(a) - V(x)}}$$

$$dt = \frac{1}{\sqrt{2}} \frac{dx}{\sqrt{V(a) - V(x)}}$$

$$t = \int_0^a \frac{1}{\sqrt{2}} \frac{dx}{\sqrt{V(a) - V(x)}}$$

$$T = \int_0^a \frac{4}{\sqrt{2}} \frac{dx}{\sqrt{V(a) - V(x)}}$$