**Exercise 10 (a):**
By energy conservation we have

$$E = T + V \tag{1}$$

where $T = \frac{1}{2}m(\frac{dx}{dt})^2$, i.e., the kinetic energy and V is the potential energy.

Since we start at $x = a$ and we have zero initial velocity $E = V(a)$. We also know that the oscillator can reach $x = a$ to $x = 0$ in $T/4$ time, where T is the time period of oscillation. Thus:

$$\frac{2}{m}(E - V) = \frac{dx}{dt}^2 \tag{2}$$

$$dt = -\frac{dx}{\sqrt{\frac{2}{m}(E - V)}} \tag{3}$$

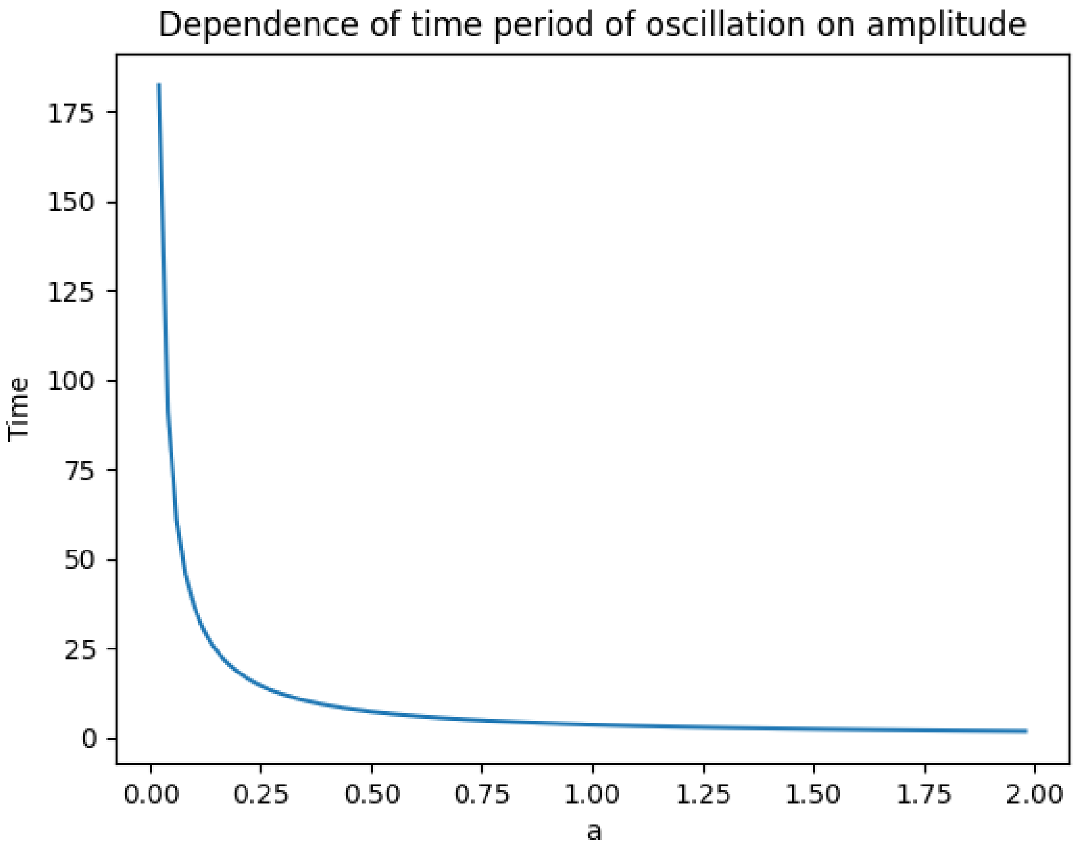
-ve sign is due to the fact that x goes from a to 0

$$\int_0^{\frac{T}{4}} dt = \int_a^0 -\frac{dx}{\sqrt{\frac{2}{m}(E - V)}} \tag{4}$$

$$\int_0^{\frac{T}{4}} dt = \int_0^a \frac{dx}{\sqrt{\frac{2}{m}(E - V)}} \tag{5}$$

$$\boxed{T = 4\int_0^a \frac{dx}{\sqrt{\frac{2}{m}(E - V)}}} \tag{6}$$

**Exercise 10 (b):**




Plot of the dependence of time period on amplitude for anharmonic oscillator

**Exercise 10 (c):**

The restorative force grows as $x^3$ with distance x but the distance travelled is just amplitude a, so the particle is pulled back to $x = 0$ faster for larger a. Thus time decreases with a.