A small earthquake sets a pole vibrating back and forth. The amplitude of the vibration of the top of the pole is 8.0-cm at the moment the quake stops and 10-s later it is 3.5-cm. Determine:

a) The time constant for the damping of the oscillation.
b) The amplitude of oscillation 5.0-s after the quake stops.

Given:

Initial amplitude of oscillation: $A = 8.0\text{-cm}$

Maximum displacement at t = 10 s: $x_{max,\ t=10\ s} = 3.5\text{-cm}$

Determine:

a) Time constant for the damping of the oscillation: τ

Use formula:

$$x_{max} = Ae^{-t/\tau} \quad \text{----------(1)}$$

Substituting for $x_{max,\ t=10\ s}$, A & t in (1):

$$3.5 = 8.0 \times (e^{-10/\tau}) \quad \text{----------(2)}$$

Rearranging and simplifying (2):

$$\boldsymbol{\tau = -\ 10 / \ln(3.5 / 8.0) = 12\ s}$$

b) The amplitude of oscillation 5.0-s after the quake stops: $x_{max,t=5s}$

Use formula:

$$x_{max,\ t=5s} = Ae^{-t/\tau} \quad \text{----------(3)}$$

Substituting for A, τ & t in (3):

$$\mathbf{x_{max,t=5s} = 8.0 \times (e^{-5/12}) = 5.3\ cm}$$