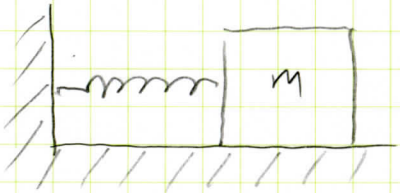
TMS PR 3.1

TMS 3-1 A 100 g MASS ATTACHED TO A 10^4 dyne/cm SPRING IS DISPLACED 3 cm & RELEASED FROM REST. FIND

a) ν_N & τ_N
b) $\bar{E}$
c) v_{MAX}



NSL: $\Sigma F = ma$

$-kx = ma = m\ddot{x}$

DE: $\ddot{x} + \omega_N^2 x = 0$

SOLUTION: $x = A\cos(\omega_N t - \delta)$

APPLY INITIAL CONDITIONS: $x(t=0) = A = 3\text{cm}$ $\dot{x}(t=0) = 0$

$$x(t=0) = A\cos(-\delta) = A = 3\text{cm}$$

$$\Rightarrow -\delta = 0$$

$$\dot{x}(t=0) = -\omega_N A\sin(-\delta) = 0$$

$$\Rightarrow -\delta = 0$$

$$\Rightarrow x(t) = A\cos(\omega_N t)$$

a) $\nu_N = \frac{\omega_N}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{10^4}{100}} = \frac{5}{\pi} = \boxed{1.591\,\text{Hz} = \nu_N}$

$\tau_N = \frac{1}{\nu_N} = \boxed{0.628\,\text{SEC} = \tau_N}$

b) $\bar{E} = \frac{1}{2}kA^2 = \frac{1}{2}(10^4)(3)^2 = \boxed{4.50 \times 10^4\,\text{ERG} = \bar{E}}$

c) $\bar{E} = \frac{1}{2}m v_{MAX}^2 \Rightarrow v_{MAX} = \sqrt{\frac{2\bar{E}}{m}} = \sqrt{\frac{2(\frac{1}{2}kA^2)}{m}} = \sqrt{\frac{k}{m}}A = \omega_N A$

$$v_{MAX} = \omega_N A = \sqrt{\frac{k}{m}}A = \sqrt{\frac{10^4}{100}}(3) = \boxed{30\ \text{cm/s} = v_{MAX}}$$