Phys101 – Sec # 40 Quiz # 12 (Chapter 15)

Name: Key **ID #** ____________

1- A 0.4-kg mass attached to a spring of force constant 40 N/m vibrates with a simple harmonic motion of amplitude 10 cm. Calculate the shortest time that is taken by the mass to move from x = 0 to x = 10 cm. **[0.157 s]**

$m = 0.4$ kg

$k = 40$ N/m

$X_m = 10$ cm

time from $x=0$ to $x = X_m$ equals $\frac{T}{4}$.

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.4}{40}} = 0.628$

$\text{time} = \frac{T}{4} = 0.157$ s

2- A mass of 1.0 kg connected to a light spring of force constant 30 N/m oscillates on a horizontal frictionless surface with magnitude 3 cm. Find the kinetic energy of the system when the displacement equals 2 cm. **[7.5*10**(-3) J]**

$m = 1$ kg

$k = 30$ N/m

$X_m = 3$ cm

when $x = 2$ find $K = ?$

$K = E - U = \frac{1}{2}kX_m^2 - \frac{1}{2}kx^2$

$= \frac{1}{2}(30)(0.03^2 - 0.02^2)$

$= 15\,(5 \times 10^{-4}) = 7.5 \times 10^{-3}$ J

3- A particle at the end of a spring executes simple harmonic motion with an amplitude of 4.0 cm. At what displacement (x) will its speed be equal to one half its maximum speed? **[3.46 cm]**

$v^2 = \omega^2(X_m^2 - x^2)$ where $\omega = \sqrt{\frac{k}{m}}$

$\left(\frac{v_m}{2}\right)^2 = \frac{k}{m}(X_m^2 - x^2)$

where $v_m = X_m\omega = X_m\sqrt{\frac{k}{m}}$

$\Rightarrow \frac{X_m^2 \cancel{k}}{4\cancel{m}} = \frac{\cancel{k}}{\cancel{m}}(X_m^2 - x^2)$

$\frac{X_m^2}{4} = X_m^2 - x^2$

$x^2 = \frac{3X_m^2}{4} \Rightarrow x = \frac{\sqrt{3}X_m}{2} = \frac{\sqrt{3}\,4}{2}$

$= 3.46$ cm

another method طريقة أخرى

$v = -v_m \sin\omega t$

$\frac{\cancel{v_m}}{2} = -\cancel{v_m}\sin\omega t \Rightarrow \omega t = \sin^{-1}\left(\frac{-1}{2}\right) =$

$x = X_m \cos\omega t$

$= 4\cos(\pi/6)$

$= 3.46$ cm