Physics 2010
Fall 2004
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EXAM 4

2

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A 3.00 kg mass is attached to a spring (k = 52.0 N/m) that is hanging vertically from a fixed support. The mass is moved to a position 0.800 m lower than the **unstretched** position of the end of the spring. The spring is then released and the mass-spring system executes SHM. Take the 0.800 m of the mass as the reference location for its gravitational PE.

A. *[6 pts.]* What is the equilibrium position of the mass-spring system?

$mg = kx_{EQ}$ $\quad x_{EQ} = \frac{mg}{k} = \frac{(3\,kg)(9.8\,m/s^2)}{52.0\,N/m}$

$\boxed{x_{EQ} = 0.565\,m}$

B. *[6 pts.]* What is the amplitude of the SHM the mass-spring system executes?

AMPLITUDE (A) = 0.800 m − 0.565 m

$\boxed{A = 0.235\,m}$

C. *[6 pts.]* What is the period of the oscillation of this system?

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{3\,kg}{52\,N/m}}$

$\boxed{T = 1.51\,s}$

D. *[6 pts.]* What is the total mechanical energy of the mass-spring system at the moment the mass is released?

$E = \frac{1}{2}kx_{MAX}^2 = (.5)(52\,N/m)(.8\,m)^2$

$\boxed{E = 16.6\,J}$

E. *[12 pts.]* What are (i) the KE of the mass and (ii) the speed of the mass when the spring is at its equilibrium position?

$v = v_{MAX} = \omega A = \sqrt{\frac{k}{m}}\,A = \sqrt{\frac{52\,N/m}{3\,kg}}\,(.235\,m)$

$\boxed{v_{MAX} = 0.978\,m/s}$

$KE = KE_{MAX} = \frac{1}{2}mv_{MAX}^2 = (.5)(3\,kg)(0.978\,m/s)^2$

$\boxed{KE_{MAX} = 1.44\,J}$