September 21, 2004 – mini-Quiz #2 – 8.03

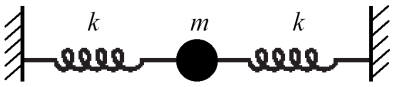
Your name . . . . . .

Circle your recitation – R01 – R02 – R03 – R04 – R05

An object with a mass$m$ of 100 grams is attached between two massless springs, each with a spring constant k of 0.1 N/m. The object can freely oscillate on a frictionless horizontal surface (see the figure). At time *t=0*, its position is at *x=0* which is its equilibrium point, and its velocity is 0.2 m/sec in the positive x-direction. Its position at time t is:

$$x(t) = Asin(\omega t + \phi)$$

Give the units in all your answers.



2 points
What is ω?
$\omega = \sqrt{(2k/m)} = \sqrt{(0.2/0.1)} = \sqrt{2}$ sec^{-1} (radians/sec)

2 points
What is the frequency in Hz?
$f = \omega/2\pi = \sqrt{2}/(2\pi)$ Hz (Hz = sec^{-1})

3 points
What is ϕ?
x=0 when t=0, thus $0 = Asin\phi$, thus $\phi = 0$ or π radians.

3 points
What is A?
v=0.2 for t=0. $dx/dt = \omega Acos\omega t$ (for $\phi = 0$).
Thus $v = A\omega$, thus $A = v/\omega = 0.2/\sqrt{2}$ m.

For $\phi = \pi$, $dx/dt = \omega Acos(\omega t + \pi)$
Thus $v = -A\omega$, thus $A = -v/\omega = -0.2/\sqrt{2}$ m.

NOTICE that these two solutions are identical as $sin(\omega t + \pi) = -sin(\omega t)$.