A Simple “Introductory” Exercise: Motion of a Harmonic Oscillator

In general, you should be able to work the daily exercise using what we covered on Mathematica in class, but you will also usually need to find some things yourself using the documentation in the program.

A simple harmonic oscillator is constructed from a mass $m$ and a spring with stiffness constant $k$. It moves in one dimension $x(t)$ with velocity $v(t)$ where

$$x(t) = A \cos(\omega t + \phi)$$
and
$$v(t) = \dot{x}(t) = -\omega A \sin(\omega t + \phi)$$

where $\omega = \sqrt{k/m}$. The kinetic energy of the mass is $K = \frac{1}{2}mv^2$. At the initial time $t = 0$, the position and velocity are given by

$$x_0 = x(0) = A \cos \phi$$
and
$$v_0 = v(0) = -\omega A \sin \phi$$

so that

$$A = \sqrt{x_0^2 + \frac{v_0^2}{\omega^2}}$$
and
$$\phi = \tan^{-1} \left( -\frac{v_0}{\omega x_0} \right)$$

Plot the kinetic energy as a function of time, from $t = 0$ to $t = 10$ sec, for an oscillator with $m = 1.75$ kg, $k = 2$ N/m, and which starts from $x_0 = 0.25$ m with velocity $v_0 = 1.25$ m/sec.

Send the grader an email with your notebook as an attachment.