NYU Physics I—oscillations

Consider a mass M on a spring of spring constant k, released from rest at $t = 0$ but from a distance X (in the x-direction, which is parallel to the spring) away from the equilibrium position for the mass. Assume there are no other forces acting!

With a partner, do the following graphing assignments. They might require some planning, because we want to align all the time axes. In all the parts below, when we say "label" we mean "give the horizontal and vertical position of". That is, we want the graphs to be quantitatively correct.

1 Plot the position of the mass as a function of time for a few periods. Label minima, maxima, and zero crossings in time, and label the amplitude.

2 Plot the velocity of the mass as a function of time for the same time interval, on a new figure, but time-aligned with the previous plot. Label minima, maxima, and zero crossings in time, and label the velocity amplitude.

3 Plot the acceleration of the mass as a function of time for the same time interval, on a new figure, but time-aligned with the previous plot. Label minima, maxima, and zero crossings in time, and label the acceleration amplitude.

4 Plot the kinetic energy of the mass as a function of time for the same time interval, on a new figure, but time-aligned with the previous plot. Label minima, maxima, and zero crossings (if any) and label the kinetic-energy amplitude.

5 Plot the kinetic energy of the mass as a function of time for the same time interval, on a new figure, but time-aligned with the previous plot. Label minima, maxima, and zero crossings (if any) and label the kinetic-energy amplitude.

6 Work out the potential energy of a spring stretched by x by integrating force times distance.

7 Plot the potential energy of the mass as a function of time for the same time interval, on a new figure, but time-aligned with the previous plot. Label minima, maxima, and zero crossings (if any) and label the potential-energy amplitude.

8 Guess what you will get if you plot the sum of the potential and kinetic energy plots!

9 Plot the total of potential plus kinetic energy as a function of time for the same time interval, on a new figure, but time-aligned with the previous plot. Label minima, maxima, and zero crossings (if any) and label the total-energy amplitude.

10 Guess what your plots would have looked like if there had been a bit of damping—a bit of air drag or friction.