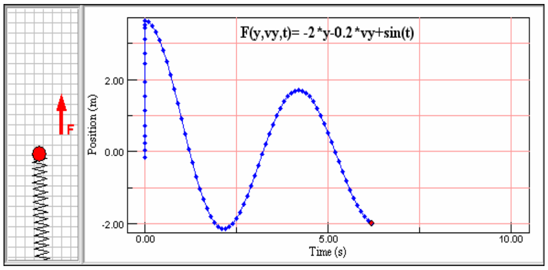
Worksheet for Exploration 16.6: Damped and Forced Motion



A mass can be driven by an external force in addition to an internal restoring force and friction. Restart. Specifically, $F_{net} = F_{restore} + F_{friction} + F_{driving}$, where the default values are

$F_{restore}$ = -2*y, $F_{friction}$ = -0.2*vy, and $F_{driving}$= sin(t).

You can change these default values as you see fit. *Remember to use the proper syntax such as -10+0.5*t, -10+0.5*t*t, and -10+0.5*t^2. Revisit Exploration 1.3 to refresh your memory.*

a. Find the mass. Hint: consider a linear restoring force.

m=_______

b. Change the restoring force to -y-0.1*y*y. Is the motion periodic? Is it harmonic?

What about -y-2.0?

c. Design your own force that produces periodic, but not necessarily harmonic, motion.

d. Drive the mass at resonance and explain the behavior of the position graph. How does the behavior change with and without friction?

Drive the system (use a linear restoring force of -1*y and initially no friction) with a function that switches a constant force on and off. This can be achieved with the step function: step(sin(t/4)). The step function is zero if the argument is negative and one if the argument is positive. The given function, step(sin(t/4)), will therefore produce a square wave with amplitude of one and an angular frequency of one quarter. Note that the total force you should use is -1*y+step(sin(t/4)). Start the mass in its original position; do not drag it.

e. Draw a graph of the force vs. time superimposed on the position vs. time graph.

f. Why does the system oscillate, stop, and oscillate again?

g. Does this behavior occur at any other frequencies? For example, notice that the function step(sin(t/4.5)) produces qualitatively different behavior. Why is this?

Note that the mass is not allowed to oscillate past about 22 m.