IDE Worksheet #4

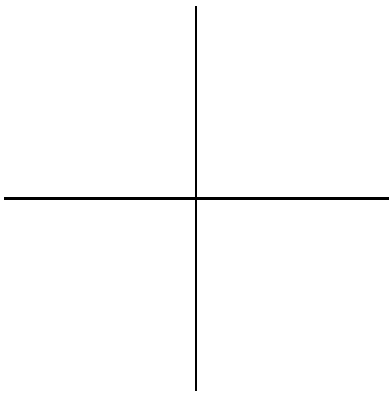
Name: _____ Last five digits of ID Number: _____

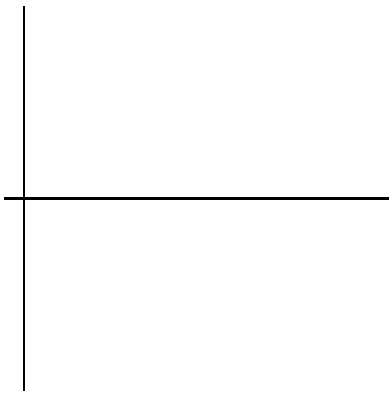
Date: _____ Start Time: _____ End Time: _____ Monitor: _____

Goals: To understand the effects of periodic forcing in second-order, linear equations.

The `Damped Forced Vibrations` tool: This tool illustrates the solutions of a forced, linear equation in terms of a mass-spring system with a dashpot.

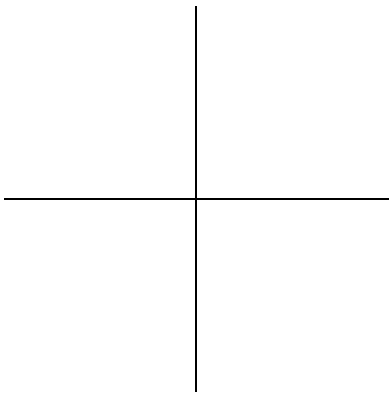
1. Start this worksheet with the default parameter values of $m = 1.5$, $b = 1$, $k = 1$, $F = 2$, and $\omega = 1$. Turn off the transient and steady state graphs, and plot the graph of the solution with initial condition $(x_0, \dot{x_0}) = (3, -3)$ (as close as you can get). You should also plot the corresponding solution curve in the phase plane.

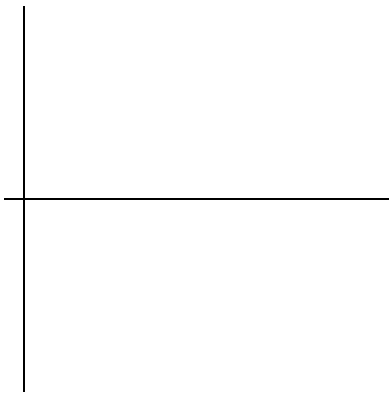




Give a brief description of the long-term behavior of this solution. How does this behavior manifest itself in both plots?

2. Change the damping coefficient to 0.5 and turn on graphing of the transient. Plot the solution corresponding to the initial condition $(x_0, \dot{x_0}) = (3.0, -3.0)$ (as close as you can get).

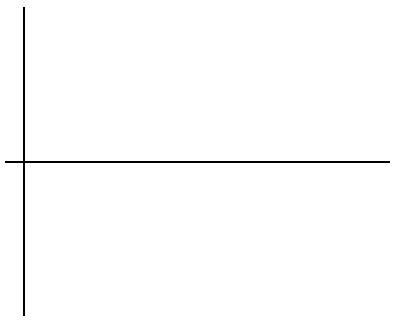




How do you know that this system is nonautonomous from these graphs alone?

3. Turn off the forcing and compute the solution with the initial condition $(x_0, \dot{x_0}) = (2.8, 0.0)$. What happened to the graph of the transient? What calculation can you make that predicts the behavior of this solution?

4. Turn off graphing the transient and return the value of the forcing to 2.0. Set the damping coefficient to 0, and plot the graph of the solution that corresponds to the initial condition $(x_0, \dot{x_0}) = (0, 0)$.



Note that this solution is commonly described as a "beating phenomenon."

5. Turn on graphing the steady state and set the value of ω to 0.0. Plot the graph of the solution that corresponds to the initial condition $(x_0, \dot{x_0}) = (1, 0)$.

Give a brief explanation of the resulting graphs.

Those of you who are studying circuits may profit from a little experience with the `series circuits` tool. Note the similarity between the behaviors of the solutions in that tool and the behaviors that you observed on this worksheet.