

## Predicting the oscillation of a mechanical system. AP Physics with Barton Clark

Items to include in your report.

1. **Introductory paragraph** describing when and why Simple Harmonic Motion can be exhibited.
2. **Determination of the Spring Constant.** You can pull real time force and position data directly from the Smart Car as it oscillates.. .. recall that you don't need to know the exact 'rest' length of the spring because the 'true value' can be determined by extrapolation. (the X intercept in the linear function  $y = mx + b$ ).  
  
Graph the data, determine the 'offset' from your original zero point and the extrapolated data point. Show the linear function and present the Spring Constant.
3. Set up the ramp and determine the ramp angle. **Draw a diagram of the apparatus** illustrating the both the range of motion of the oscillator.. and the angle the ramp makes with the horizontal.
4. **Determination of Restoring forces.** Note: draw a representative sketch showing both the free body diagrams of forces acting on the car and the Net forces acting as 'restoring' forces. (please draw vectors to some kind of scale). (Top, 'rest position' and bottom of range).
5. Place the system at its natural 'rest' position. (place a mark on the ramp). Start recording data slightly before you perturb the system (lift it and 'let 'er rip!"). Continue recording data until the motion has been brought to rest by damping forces.
6. **Graph the forces** measured by the force sensor, write a function which calculates the net forces acting on the mass. Graph both the measured forces and the net forces acting on the car during the oscillation event. (superimpose these two graphs)
7. **Graph the velocity** of the car throughout the oscillation event
8. **Graph the acceleration** of the car throughout the oscillation event.
  - a. **Note: Stack the graphs so the time axis line up.. (and you can see WHEN things are happening in parallel).**
9. Section showing the prediction of the period and frequency..
10. **Draw a line on your velocity graph** showing the length of time for one, complete period of oscillation..
11. **Compare (percent error) the predicted** period of oscillation with the measured period of oscillation.
12. **Show how the energy is moving between** energy stored in the Spring, the kinetic energy of the car and the gravitational potential energy. (note the SUM TOTAL of these should add to a fixe value. Graph each of these forms of energy and include a 'summation' function (these are all 'series' on the same, energy graphic).
13. Discussion of how changing the angle of the ramp affected the experiment (would increasing or decreasing the angle affect the period? What other factors are affected by changing the angle of the ramp? Can you do a quick experiment to determine this?