Physics 112: Roller Coaster Motion Lab

Purpose:

- To study and observe the motion of an object through a vertical circle and around a corner.
- To compare theoretical and experimental conservation of energy.

Materials: Hot Wheels ™ tracks and cars, slow motion camera, Tracker analysis program.

Procedure Part 1 – Making the Loop:

1. Using the components available, construct a track consisting of a loop and a corner (spaced apart using two straight sections). Don't use the slingshot to launch the car, rather attach a few straight sections together and tilt it up to make an incline the car will travel down to gain speed.
    a. Once down the incline the car will hit the loop first, then the corner.
    b. Take a photo of the set up to include in your lab report.
2. Experimentally determine the minimum height to successfully travel the loop:
    a. Record the height of the bottom of the loop from the floor.
    b. Raise the ramp while holding the car, record the height of the car from the floor and the release. Experimentally determine the minimum height *above the base of the loop* the car must start to not crash.
    c. Rearrange the track to that the car goes down the loop, hits two straight sections, then the corner, one straight section, and finally the loop. Then repeat section *b*.
    d. Theoretically, assuming no friction, no matter where the loop is the minimum starting height is given by the formula: $h_o = 1.5r$ where *r* is the radius of the loop. Calculate your theoretical starting height and be sure to compare that result with your experimental results in your discussion section.

Procedure Part 2 – Analyzing the loop and corner with Tracker:

1. Set up the track with a loop and corner (what you have in part 1 will work).
2. Release the car from a height that will result in the just making the loop. Record just the car going through the loop in super slow motion.
3. Video the car going through the corner in super slow motion.
4. Analyze each video with the Tracker program and generate a plot of position vs. time and velocity vs. time for each video.
    a. What was the speed of the car as it entered the loop? ¼ the way up? ½ way (at the top) ¾ the loop?
    b. As the car turned the corner (remember only the middle two sections of track); with what speed did it enter and exit the turn? What was its average velocity?
    c. To take a turn an object must experience what is called a centripetal force. For a mass m, going through a circular turn with radius r and velocity v; the centripetal force is: $F_c = \frac{mv^2}{r}$ Calculate the centripetal force acting on the car. The radius of the turn is 0.165 m.