Pivot Interactives Playground Ball Two Dimensional Energy Measurement

Purpose: To determine whether energy is conserved in the flight of a playground ball.

Access the Pivot Interactives lab "Three Views of Projectile Ball". For this lesson we will be using the video and measurement tools, but we will be using an Excel spreadsheet for the analysis.

We used this video module early in the semester. But just to review how it works:

The video begins like this:

In the side view, you can watch the flight of the playground ball from the usual perspective. But we will use the top view to analyze the horizontal motion of the ball and the front view to analyze the vertical motion.

Run the video through once. You will see the familiar parabolic path in the side view. The top view and front view are something else altogether.

Now open the toolbox in the upper right hand corner of the screen. Click on the stopwatch, the vertical ruler and the horizontal ruler.

Return to the beginning of the video and advance the video frame by frame until the moment when the ball leaves hands of the thrower. Now do three things. First, RESET the stopwatch so your measurement starts at 0.000 seconds. Second, move the horizontal ruler over the top view so that the ball has position zero at this moment. Third, move the vertical ruler over the side view so that the ball has position zero in this view as well.

In a spreadsheet, tabulate the time, the horizontal position and the vertical position as columns. Your first entry will be time 0.000 seconds, horizontal position 0.000 m and vertical position 0.000 m. Then advance the video five frames and enter the time, and horizontal and vertical positions again.

For each time you have tabulated, determine a horizontal velocity component and a vertical velocity component. You can't determine an instantaneous velocity from your data, but you can determine an average velocity over a short time interval. For each time you tabulated, subtract the horizontal position from the preceding time (that is, five frames earlier) from the following time (that is, five frames later) and divide that difference by the time difference corresponding to ten frames. Do the same for the vertical positions. Now for each time add the horizontal and vertical velocities in quadrature to get the speed, from which you can calculate the kinetic energy (the mass of the ball is 377 g).

Then calculate the gravitational potential energy from the height for each time.

Plot the gravitational potential energy, the kinetic energy and the total energy (potential plus kinetic) as a function of time. Copy that plot into a Word document.

Would you expect the total energy to be constant? Is it? If not, what might account for the difference? Answer these questions in your Word document and submit via Canvas.