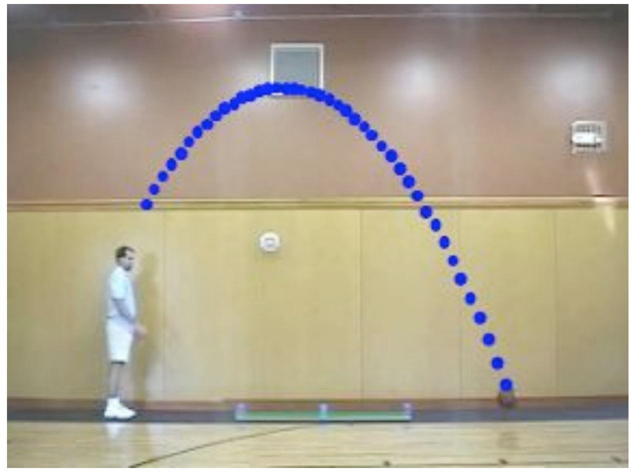
Energy with Video Analysis



This document will detail how you can add an energy component to the video analysis of the basketball shot described elsewhere. It assumes you have followed steps 1 through 11 of the Video Analysis document, and have marked the positions of the basketball for all of the frames from launch to just before hitting the floor as shown on the right. (Of course you could mark all frames up to and after the bounce.)

1. Save your work to this point with a distinctive name such as your group's designation:

   File > Save As…

2. Calculate Gravitational Potential Energy:

   Data > New Calculated Column
   Name: ***Potential Energy***
   Short Name: ***PE***
   Units: ***J***
   Equation: ***0.6*9.8*"Y".*** In order to get the "Y", use the drop-down menu labeled "Variables". The mass of a basketball can vary from just over 500 grams to over 600 grams when new, so the 0.6 kg figure is a good average.

   Click on the Options tab and select a color for your data points. Then click [Done]. At this point you should have a new column in your data table for Potential Energy. Click on the y-axis label and select Potential Energy to graph this quantity.

3. Calculate Kinetic Energy:

   Data > New Calculated Column
   Name: ***Kinetic Energy***
   Short Name: ***KE***
   Units: ***J***
   Equation: ***0.5*0.6*("X Velocity"^2+"Y Velocity"^2).*** In order to get "X Velocity", use the drop-down menu labeled "Variables". **^2** represents squaring the quantity, raising it to the second power.

   Click on the Options tab and select a color for your data points. Then click [Done]. At this point you should have a new column in your data table for Kinetic Energy. Click on the y-axis label and select Kinetic Energy to graph this quantity.

4. In a similar manner, calculate the total mechanical energy, **TE**, the sum of the potential and kinetic energies.

ANALYSIS

Plot each of the energy forms, one at a time. For each, write a brief description of how that energy varies over the time the basketball is in the air.

Plot all three energy forms at the same time on the same axes.

Click on the y-axis label. Choose "More…" from the menu.

In the resulting menu, check all three of your calculated energies then click [OK].

Describe the resulting graph and what it says about the forms of mechanical energy involved in the projectile motion of the basketball.

EXTENSIONS

The motion of the basketball is typical of any number of objects that are launched near the earth's surface. Their motion is due to two factors: Inertia and Gravity. Such objects are collectively called Projectiles, although they may be as different as baseballs and shot putts, golf balls and water balloons. Other objects experience a third phenomenon, air resistance. What is an example of a common object that would incorporate Inertia, Gravity and Air Resistance in its motion? Set up an experiment where you video the motion and carry out the analysis above. Compare and contrast the results you get with the basketball results.

Use the same technique for an object moving down an inclined plane. Use dynamics carts, balls (hollow and solid), cylinders (hollow and solid) and other objects that you might locate. Discuss how well each illustrates conservation of energy or illustrates another form of energy that must be considered.

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November 2007