COMPILATION: unit 7 - gravitational potential energy lab

Date: Wed, 1 Mar 2000
From: Andrew Kartsounes <kartsoun@HARTLAND.K12.MI.US>
Does anyone have a good gravitational potential energy lab that they could share? I tried the Pasco cart projecting itself up the incline but I get large errors and I have found it difficult to use different spring compressions due to the rather rough nature of the plunger spring.

Date: Wed, 1 Mar 2000
From: "Richard J. McNamara"
Have you done projectile motion yet? If you have, try putting a large steel ball on a ramp onto a table. Let the ball roll across the table some distance and then off the table into the air. I use old computer printer paper and carbon paper on the floor to mark the landing spot of the ball. From those horizontal distances and the height of the table, the students can calculate speed of the ball at the bottom of the ramp. If you make the height, above the table, the independent variable and the speed at the bottom of the ramp the dependent variable, you'll get a linear relationship between release height and speed squared. The slope will come out to be less than g/2 because of the rotational kinetic energy the ball has, due to rolling. In my AP classes, we incorporate the rotational kinetic energy and verify the actual value of the slope.
The results are usually very good even if the ramp is curved.

LATER SUGGESTIONS on the above question:

Date: Tue, 7 Jan 2003
From: WILLIAM JAMESON <WJAMESON@DEFOREST.K12.WI.US>
On yesterday's list, there was a mention of trouble with the PASCO plunger carts giving reproducible energy for determining GPE and KE. I learned several years ago of a somewhat more reliable method, from the Modeling Mentors of Madison:
Stretch a hefty rubber band across the track (I have a picture of the brackets I use for this, email me and I'll send it to you) at a level where it will come across the end of a cart. Mount a force probe on a cart. Using the force probe, calibrate the rubber band Force vs Stretch (pulling the cart back onto the band.) Use GA or LoggerPro, integrate the F vs stretch graph to obtain the energy stored in the rubber band. Then use the calibrated rubber band to shoot the cart up an incline (for GPE) or horizontally (for KE).
I just finished the KE lab yesterday. All 4 lab groups (small AP class) got nice E vs v^2. The slope is not 1/2Mass because not all the energy transfers to the cart. However, by testing 3 or more cart masses, the students can show that the slope is linear w/r/t mass. To get to the 1/2 takes a little theoretical appeal: 2 a x = vf^2, and
W=Fx = (ma)x = m (1/2 vf^2).
Again, if you want pictures of my lab set up, email me directly.

Date: Wed, 08 Jan 2003
From: Matt Greenwolfe <matt_greenwolfe@CARYACADEMY.ORG>
I've also had good success using a level spring and attaching a spring to one bumper, and then attaching the cart to the spring using about 50cm of light string. The students determine the spring constant, calculate energy as area under force vs. stretch graph for the spring, and then stretch the spring and let the cart go. The cart's velocity is measured by a photogate placed just a couple centimeters after the cart's location when the spring goes slack. This gives nice graphs for both KE vs. v and KE vs. m. However, the graphs of KE vs. mv^2 don't have slopes of exactly 1/2.
