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Equipment:

Lab Pro	ring stand
C clamp	hanging masses
2 right angle clamps	string and scissors
photogate	pendulum clamp
balance	

DATAGATE program
available for download from
http://www.vernier.com/calc/software/index.html

References: ***Physics with Computers, Vernier***

Title: **Is Pendulum Motion Like the Swing Set of Old?**

Purpose:

To observe the relationship between the period of a pendulum swing and:

a. length of pendulum
b. mass of pendulum
c. angle of deflection

Discussion:

Consider for a few minutes the knowledge of practical physics you acquired when you were in primary grades. Any time you went to the playground at the local park, you experienced what Newton's Laws of Motion looked like (and felt like, too!)

The Law of Inertia is easily observed. No matter what piece of equipment you sat upon, an object at rest (you), stayed at rest unless… an outside force was applied! Now remember the swing set experience. The swing at rest has a deflection angle of zero.
Consider the diagram on the following page, once you were on a swing, for example, what caused you to swing back and forth?

We can consider the chain (or the string) that supports the swing to represent the y axis. If the swinger pumps (or someone from behind pushes) and allows the swing to more forward by 30°, how far does the chain move in the reverse direction?

Consider the back and forth motion. Does the chain/rope always stay taught? Why or why not?

On the gal on the swing set, draw a free body diagram and label ALL forces.

Remember your own experience on the swing. Use an X to mark the landing spot if each of the gals below were to jump off the swing.

Does each gal land straight down from the swing position? Why or why not?

Set a ball swinging at a 45° angle. Sketch a picture of the ball, string, and the probable landing position of the ball.

Consider two children on adjacent swings.
Child A has a mass of 20 kg.
Child B has a mass of 60 kg.
Which child can swing higher? Child A? Child B? Neither? Both?
Explain your answer again remembering your playground experience.

Is it possible for both child A and child B to swing side by side? Yes or not?
Explain your answer again remembering your playground experience.

Procedure:

1. Use the C clamp to fasten the ring stand to the table so the pole is closest to the end of the table.
2. Fasten the pendulum clamp to the ring stand so it hags over the base of the ring stand.
3. Fasten the photogate to the bottom of the ring stand so the opening of the photogate faces up.
4. Record the mass of each available bob in the data table.
5. Use string to suspend a 1.00 meter long pendulum bob so the center of the mass goes through the beam of light emitted by the photogate.
6. Attach a calculator to the LabPro using the black connecting cable. Attach the photogate to the LabPro on DIG/SONIC 1.
7. Turn on the calculator. From PRGM select the DATAGATE program.
8. Press 1 for SETUP. Press 3 for PENDULUM settings.
9. Pull the mass to the appropriate angle. Press START. After Trial 10

(10 revolutions), pres STO to stop the data collection process. Record the average period in the data table. Repeat the measurement at the same angle, pendulum length, and mass. Record the average mass for in the data table and calculate the average of these two experiments.
10. Repeat the experiment changing each variable one at a time until all three data tables are complete.
N.B. When you change the masses or pendulum lengths, you may have to raise or lower the photogate so the middle of the mass always passes through the light sensor.

Data:

Table 1: Period as a function of amplitude

Mass used _____ pendulum length _____

Angle	Period		
	Trial 1	Trial 2	Average
15			
30			
45			
60			

Table 2: Period as a function of pendulum mass

Angle _____ pendulum length _____

Mass (g)	Period		
	Trial 1	Trial 2	Average
50			
100			
200			
400			

Table 3: Period as a function of pendulum length

Mass used _____ angle used _____

Length (meters)	Period		
	Trial 1	Trial 2	Average
1.00			
0.75			
0.50			
0.25			

Analysis:

1. Use Logger Pro to construct graph depicting the relationships between:
   a. angle vs. average period
   b. pendulum mass vs. average period
   c. pendulum length vs. average period

2. Which of these graphs represents a valid mathematical model and hence scientific dependency on the period of pendulum motion?
Justify your answer.

Write the equation for this function.