Example of physics report

Health & Medicine, Body

Experiment 6

Introduction:

Newton’s laws of motion are very fundamental topic in physics. Motions of a body and force acting on the body to create motion are justified by these laws. In this experiment property of spring is also discussed. Spring is an interesting device which is widely used in daily life. In physics or any experiment related to physics, spring is utilized for its property of storing elastic potential energy.

Objective:

Purpose of this experiment is to be familiar with Newton’s laws of motion.

Theory:

Newton’s second law states that the vector sum of all individual forces acting on an object is equivalent to the object’s mass multiplied by its acceleration. According to third law of motion, whenever something exerts a force on a body, it exerts a reaction force on that something.

Procedure:

Figure 1 indicates two different masses hanging from two pulleys. A photogate mounted around one pulley (not shown) was used to measure the acceleration of the string connecting the masses. Since string did not stretch, this acceleration was also the acceleration of the system as a whole. This arrangement was called an Atwood's machine.

Assuming massless and frictionless pulleys, Newton’s Second Law predicts the acceleration to be g multiplied by the difference in the masses divided by their sum. In Part 1, you will use the computer, the LabPro interface, the LoggerPro software and a photogate to measure this acceleration.

Main experimental procedure consists of three parts –

Part 1 The Atwood's Machine

At first the apparatus was so arranged that the heavy table clamp was near the edge of the table a threaded rod was screwed into each pulley. In one case the threaded rod was used to mount a photogate around the pulley. Both pulleys were so clumped to the cross bar that a string passing over them moved free and cleared of the edge of the table. Then the software was set up by clicking several commands and an image of the LabPro was appeared with a photogate visible as the sensor. After selecting several commands finally the option labeled Smart Pulley (10spoke) In Groove was chosen.

A total collection time was used more than the time it actually took for the weight hanger to fall. The data rate was set to at least 100 points per second and a foam pad was placed beneath the hanger. The weight hangers were made steady before each run to minimize swinging. The alignment of the pulleys was checked to reduce friction. Small mass is generally added to balance the hanger. Then slotted masses were placed on one of the weight hangers and it was noted that all the small masses, needed for balancing the hunger, were removed. One of the hanging masses was made 50 to 80 grams greater than the other. Using Logger Pro, the green color button was pressed and masses were released. It was made sure that masses fell vertically and did not swing from side to side. Also it was noted that the string rode in the pulley groove and did not slip out of the groove. Then the distance, velocity and acceleration graphs were examined. The acceleration graph displayed a fairly flat constant value for a short time period. The Examine command in the Analyze menu was used to highlight this constant acceleration. The Statistics command in the Analyze menu was used to compute an average acceleration over this time interval. An average and a standard deviation were recorded. A second trial was performed to ensure repeatability of the result. Then after writing name one copy of the best acceleration graph was printed. The percent error in this “ experimental' acceleration computed. A triple beam balance was used to measure each mass and these values were substituted into the derived expression and a ‘ theoretical’ value was computed. The experimental and theoretical values were compared by calculating a percent difference between them.

Part 2 Springs in Series

At first a mass hanger, some slotted masses and two different springs were obtained. Each spring was pulled on to qualitatively determine which spring was stronger i. e. had the larger spring constant. The stiffer spring was mentally labeled as #1 and the weaker spring as #2. The mass of the springs and hanger were measured and recorded. Each spring was placed flat on the lab table and its unstretched length was measured. The weight connected to a spring was called the load. Each spring was hanged vertically with zero loads. It was measured that how far each spring stretches under its own weight. Also an uncertainty was estimated in your length measurements. The equipment was assembled as in Fig. 2 except only hang spring #1 from its rod. A mass was hung vertically from spring #1. Then a mass was so chosen that the mass could stretch spring #1 by a little more than half of its unstretched length. The mass of the load was recorded. Then a meterstick was used to measure how far the spring stretches. The stiffness constant of the spring was calculated. Then springs were exchanged and spring constant of #2 was evaluated in the same manner. Then two springs were connected in series and hang them vertically from the same rod. Spring #1 was placed above spring #2. Using a meterstick mounted behind the spring, the position of the bottom of spring #2 was measured. The same load was connected to the bottom of spring #2 and allowed to stretch both springs simultaneously. Oscillation was dampened so the load hung motionless. The position of the bottom of spring #2 was measured. It was calculated how far the bottom of spring #2 stretched and it was labeled Δxi. A table was completed using the bottom entry as a guide. When the load was motionless, the free body diagram for pints A, B and L were drawn. Each force was labeled using the established convention for naming forces. After this, the relationship between Δx1, Δx2, Δxt was expressed as an equation. Hook’s Law was used to rewrite each term as a fraction involving F and keff, k1 and k2, keff was the effective spring constant of both springs. Using the earlier measured values for k1 and k2, the effective spring constant of the two springs in series was calculated. It was verified that calculated value gave the correct force when multiplied by Δxi.

Part 3 Springs in Parallel

At first the two springs were arranged in parallel as in Fig. 2 and the same load was hung as before from both springs simultaneously. Then the springs stretched the same distance, Δx, but the forces exerted by each spring were unequal. An equation was developed relating the total force exerted by both springs in parallel, Ft, the forces exerted by each spring individually (F1 and F2). This equation was rewritten in terms of keff, k1, k2, and Δx. Using the earlier measured values for k1 and k2, the effective spring constant of the two springs in parallel were calculated and verified.

Result: