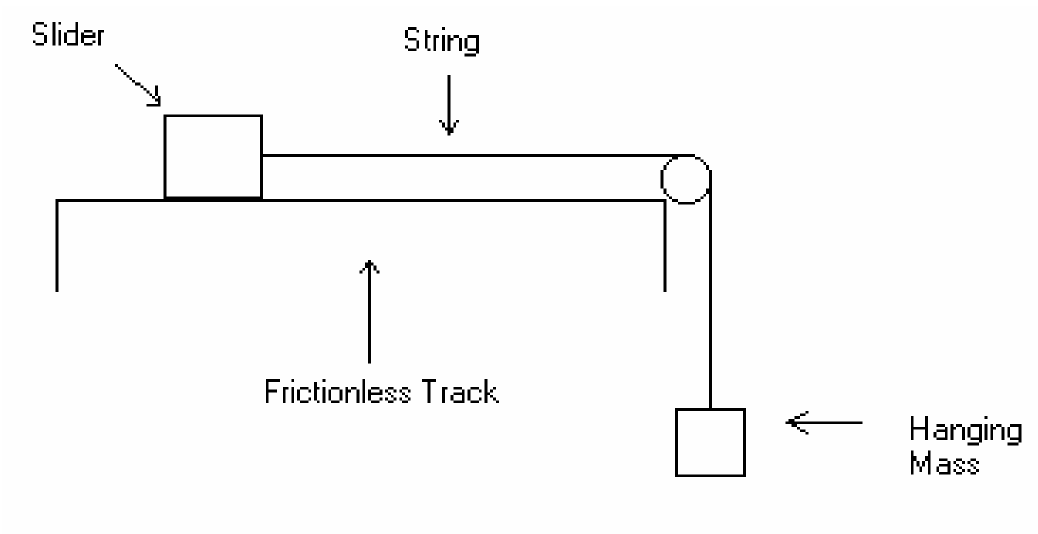
Physics Exploration Homework Supplement   P110-12.pdf

Newton's Second Law Experiment: Hanging Mass on an Airtrack

Go to the Physics Exploration Center. Enter through the resource room 311/312 Thaw Hall. Before you start the exploration, answer the following questions:

(1) In the arrangement shown below, the two masses are connected to each other via a string. If the horizontal surface (on which mass *m2* is sitting) is frictionless, which of the following statements is true:



(a) Mass ml must necessarily be smaller than mass *m2* for there to be an acceleration of the masses.
(b) Mass ml must necessarily be larger than mass *m2* for there to be an acceleration of the masses.
(c) Mass ml must necessarily be equal to mass *m2* for there to be an acceleration of the masses.
(d) Mass ml must be larger than a certain critical mass but not necessarily larger than mass m2 for there to be an acceleration of the masses.
(e) Even for the smallest value of mass ml, there will be an acceleration of the masses.

(2) A student remarks: "In the setup above, if ml < m2, both object will be at rest. If ml = m2, they will both move at a constant speed and if ml > m2 they will both accelerate." Do you agree with the student? If not, how would you convince him/her otherwise?

(3) In the setup above, if the masses accelerate, will the acceleration be constant in magnitude until mass ml hits the ground? Justify your answer.

1/10/05

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This week you will play with an "air track" demonstration. When the air is turned on, objects can slide with negligible friction. Such instruments are useful for understanding Newton's laws. Attached to the air track is a sonar displacement sensor. The sensor is attached to a computer. When triggered, the computer will track the velocity and acceleration of the slider.

Perform the following experiment which is based upon the setup shown in the Figure above: As shown in the Figure, the slider on the air track is attached to a string. You can hang masses at the other end of the string via a hanger as shown in the Figure. The mass of the hanger is 5 grams. Put the 10 gram mass on the hanger and suspend it from the string. Note: Don't forget to add the mass of the hanger to the mass that you put on the hanger to get the total suspended mass for your calculations (15 grams). The total mass of the slider is written on the slider. Ignore the mass of the pulley and the string.

(a) Turn on the air track and plot the acceleration of the hanging mass and the slider using the sonar system. (Print out the graph.)

(b) Is the magnitude of acceleration for the hanging mass and the slider the same? Justify your answer.

(c) Is the magnitude of the tension force in the string the same throughout the string? Justify your answer.

(d) Using Newton's second law and the acceleration you measured from part (a), calculate the magnitude of the tension force in the string and the mass of the slider. Don't forget to draw the free body diagrams for the slider and the hanging mass separately before applying Newton's second law.

(e) Since friction is negligible, do you think there will be acceleration even when an extremely small mass is suspended? Check it by suspending a very small mass and justify your answer using the free body diagram that you drew and Newton's second law. If your observations do not match your prediction in the multiple choice question above, you can reconcile the discrepancy now?