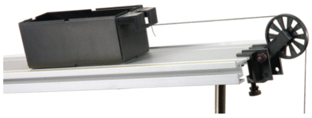

PASCO ME-9448 Standard Dynamics Systems Instructions

Contents

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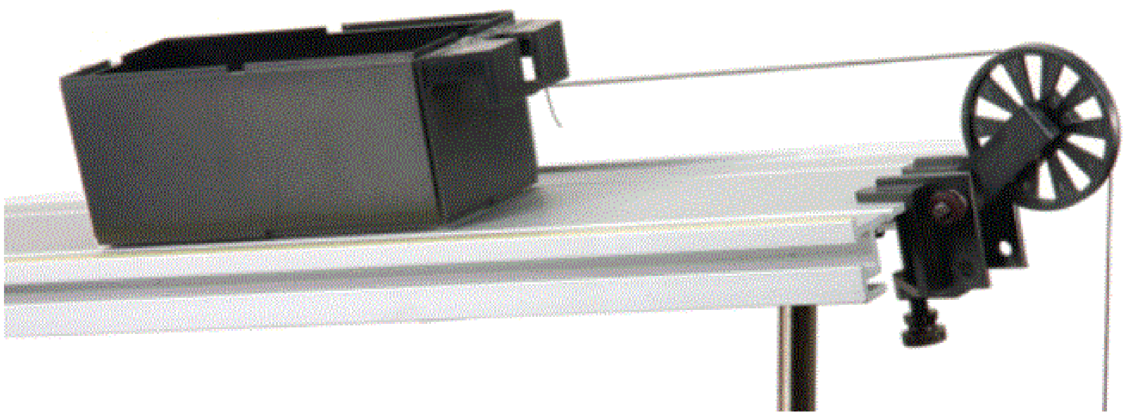
PASCO ME-9448 Standard Dynamics Systems



Product Information

The product being discussed in this user manual is Standard Dynamics Systems. It is a system used for conducting experiments related to Newton's Second Law.

Required Equipment

- Track with Feet and End Stop
- Cart Masses
- PASCO Cart
- Super Pulley with Clamp (Model Number: ME-9448)
- Stopwatch (Model Number: ME-1234)
- Mass and Hanger Set (Model Number: ME-8979)
- Mass balance (Model Number: SE-8723)
- String (about 2 m) (Model Number: SE-8050)

Purpose
The purpose of this experiment is to verify Newton's Second Law, which states that F = ma, where F is the net force acting on the object of mass m, and a is the resulting acceleration of the object.

Theory
According to Newton's Second Law, the net force on a system consisting of a cart of mass m1 and a hanging mass m2 connected by a string over a pulley should be equal to ma, where m is the total mass being accelerated (m1 + m2).

Procedure

1. Install the feet on the track and level it.
2. Install one end stop on the track near one end with the magnets facing away from the track.
3. Measure the mass of the cart and record it.
4. Attach the pulley and end stop to the track. Place the cart on the track and tie a string to the lower tie point of the cart. Tie a mass hanger on the other end of the string. Run the string under the end stop and over the pulley. Adjust the pulley so that the string runs parallel to the track.
5. Pull the cart back until the mass hanger reaches the pulley. Record this initial release position.
6. Make a test run to determine the hanging mass required for the cart to complete the run in about 2 seconds. Record the hanging mass.
7. Place the cart against the end stop on the pulley end of the track and record the final position of the cart.
8. Pull the cart back to the initial release position, release it, and time how long it takes to reach the end stop. Record the time.
9. Measure the time at least 5 times with the same mass and record these values.
10. Add a 500 g mass to the cart and repeat the procedure.

Data Analysis

1. Calculate the average times for each trial and record them.
2. Record the distance traveled (from initial to final position) in Table 4.1.
3. Calculate the accelerations for each trial and record them in Table 4.2.
4. For each case, calculate (m1 + m2)a and record in Table 4.2.
5. For each case, calculate the net force, FNET, and record in Table 4.2.
6. For each case, calculate the percent difference between FNET and (m1 + m2)a and record in Table 4.2.

Experiment 4: Newton's Second Law

Required Equipment from Dynamics System

- Track with Feet and End Stop
- PASCO Cart
- Cart Masses

Other Required Equipment	Suggested Model Number
Super Pulley with Clamp	ME-9448
Stopwatch	ME-1234
Mass and Hanger Set	ME-8979
Mass balance	SE-8723
String (about 2 m)	SE-8050

Purpose

- In this experiment, you will verify Newton's Second Law, $F = ma$.

Theory

- According to Newton's Second Law, $F = ma$, where F is the net force acting on the object of mass m, and a is the resulting acceleration of the object.
- For a cart of mass m_1 on a horizontal track with a string attached over a pulley to a hanging mass m_2 (see Figure 4.1), the net force F on the entire system (cart and hanging mass) is the weight of hanging mass, $F = m_2 g$, (assuming that friction is negligible).
- According to Newton's Second Law, this net force should be equal to ma, where m is the total mass that is being accelerated, which in this case is $m_1 + m_2$. You will check to see if $m_1 g = (m_1 + m_2)a$ as predicted by theory.
- To determine the acceleration, you will release the cart from rest and measure the time (t) for it to travel a certain distance (d). Since $d = (1/2)at^2$, the acceleration can be calculated using $a = 2 dt^2$.

Procedure

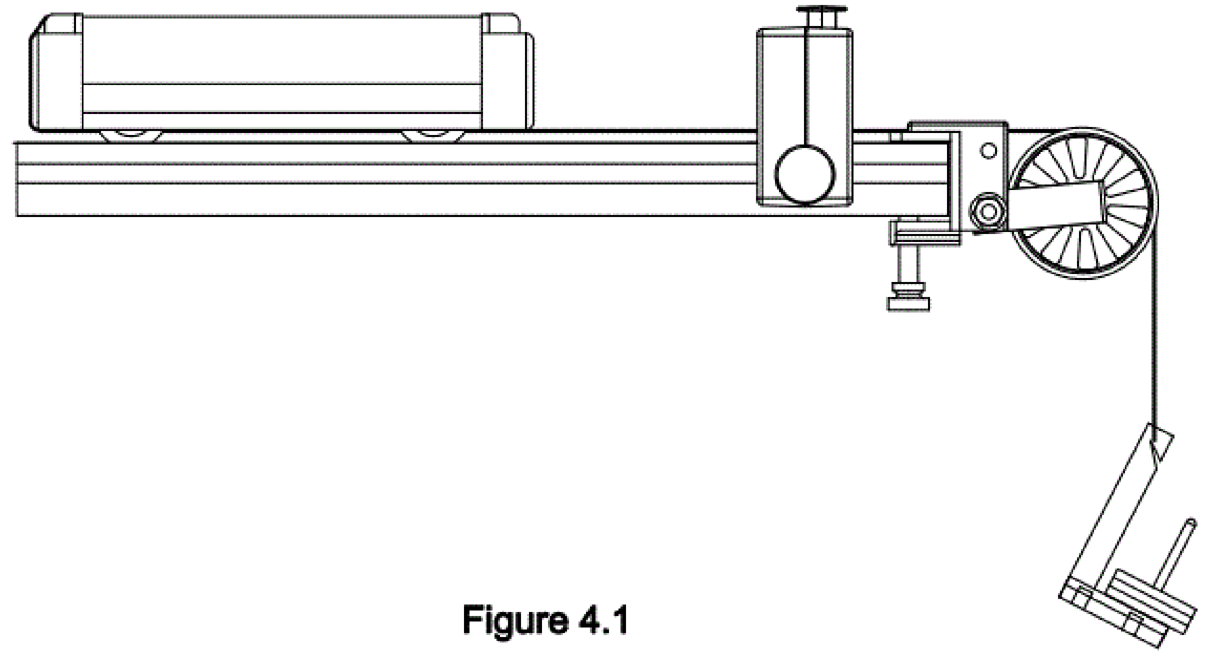


Figure 4.1

1. Install the feet on the track and level it.
2. Install one end stop on the track near one end with the magnets facing away from the track.
3. Measure the mass of the cart and record it in Table 4.1.
4. Attach the pulley and end stop to the track as shown in Figure 4.1. Place the cart on the track. Tie a string to the lower tie point of the cart. Tie a mass hanger on the other end of the string. Run the string under the end stop and over the pulley. Adjust the pulley so that the string runs parallel to the track. The string must be just long enough so the cart reaches the end stop before the mass hanger reaches the floor.
5. Pull the cart back until the mass hanger reaches the pulley. Record this initial release position in Table 4.1. This will be the release position for all the trials. Make a test run to determine how much mass is required on the mass hanger so that the cart takes about 2 seconds to complete the run. Because of reaction time, too short of a total time will cause too much error. However, if the cart moves too slowly, friction causes too much error. Record the hanging mass in Table 4.1.
6. Place the cart against the end stop on the pulley end of the track and record the final position of the cart in Table 4.1.
7. Pull the cart back to the initial release position. Release it and time how long it takes to reach the end stop. Record the time in Table 4.1.
8. Measure the time at least 5 times with the same mass and record these values in Table 4.1. **Table 4.1: Experimental Period**

Initial release position = ___________ Final position = ___________ Distance traveled (*d*) = ___________							
Cart Mass	Hanging Mass	Time					Average Ti me
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	

9. Add a 500 g mass to the cart and repeat the procedure.

Data Analysis

1. Calculate the average times and record them in Table 4.1.
2. Record the distance traveled (from initial to final position) in Table 4.1.
3. Calculate the accelerations and record them in Table 4.2.
4. For each case, calculate (m 1 + m 2)a and record in Table 4.2.
5. For each case, calculate the net force, F NET, and record in Table 4.2.
6. For each case, calculate the percent difference between F NET and (m 1 + m 2)a and record in Table 4.2.

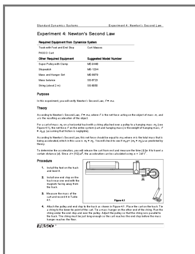
Table 4.2

Cart Mass	Acceleration	$(m1 + m2)a$	FNET= $m2g$	% Difference

Questions

1. Did the results of this experiment verify that F = ma?
2. Why must the mass in F = ma include the hanging mass as well as the mass of the cart?

Documents / Resources

	[PASCO ME-9448 Standard Dynamics Systems] [pdf] Instructions 711, ME-5716, ME-9448, ME-1234, ME-8979, SE-8723, SE-8050, ME-9448 Standard Dynamic s Systems, ME-9448, Standard Dynamics Systems, Dynamics Systems, Systems

References

- [User Manual]