

Two Body Lab

Teacher's Guide

Topic:

Newton's Laws of Motion

The following information is provided to the student:

Question:

What is the mathematical relationship between the mass, applied force, internal force and acceleration for a two body system and for the individual objects within the system?

Purpose:

To determine the mathematical relationship between the mass, applied force, the internal force, and the acceleration for a two body system and for the individual objects of the system.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion of Results. The Data section should include an informative and labeled diagram which illustrates how each part of the study was conducted. Collected data should be listed in either table form or on the diagram. Relevant calculations should be shown and tabulated (or somehow organized). The Conclusion/Discussion should identify some mathematical relationships (in the form of equations) which were discovered through the study and provide the necessary references to data trials and calculations in order to logically support such conclusions.

Materials Required:

Two carts; track; masses; mass balance; two computer-interfaced force probes; motion detector.

Description of Procedure:

Two carts are equipped with a computer interfaced force probe. They are placed on a track and the rear cart's probe is secured to the front cart. A motion detector is placed behind the rear cart. Once the computer has been set to collect data, a student pulls on the probe attached to the front cart with as constant of a force as possible. Students analyze the computer's representation of the motion and find a section of the motion in which the accelerations and forces were held relatively constant. On-screen tools are then used to determine the acceleration, force on the rear cart and force on the front cart. Varying amounts of mass can be added to the two carts and the trials can be repeated.

Alternative Materials and Procedure:

Alternative materials and procedures are not recommended.

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

Suggestions, Precautions, Notes:

The Laboratory

1. It should be emphasized to students that they should give forethought to the measurements which they will be making and the manner in which they will tabulate or present their data. Alternatively, to simplify the lab and focus students on the purpose, teachers may desire to provide a data table for students. See Auxiliary Materials section below.
2. This is a complicated lab – both in terms of its procedure and the analysis of results. It is lab reserved for your most able students.
3. As in any two-body situation, both carts will accelerate at the same rate. Measuring the acceleration of the rear cart using a motion detector also provides the acceleration of the front cart.
4. The applied force is the force applied to the front cart. The internal force is the force applied to the rear cart by the front cart.

Auxiliary Materials:

Teachers may want to provide the following data table for student completion and inclusion in the Data section of their lab notebooks.

Mass of Rear Cart (kg)	Mass of Front Cart (kg)	Acceleration (m/s ²)	Internal Force (N)	Applied Force (N)

Scoring Rubric:

NL11. Two Body Lab	Score
<ul style="list-style-type: none">— Included, labeled and organized all parts of the lab report.— Data section includes an informative and labeled diagram. Measured data (with units) are stated clearly. Relevant calculations are conducted; work is clearly shown and organized.— Conclusion/Discussion describes the mathematical relationships and states the equation which expresses the relationship; meaning of symbols are defined. Conclusion is supported by intelligent references to the data and calculations. Discussion reveals a clear and thorough understanding.	___/___

Connections to The Physics Classroom Tutorial:

This lab is a suitable accompaniment to the reading at:

Readings on Two Body situations are not currently available.

Connections to Minds on Physics Internet Modules:

This lab is not ideally coordinated with any of the sublevels of the Minds On Physics Internet Modules.