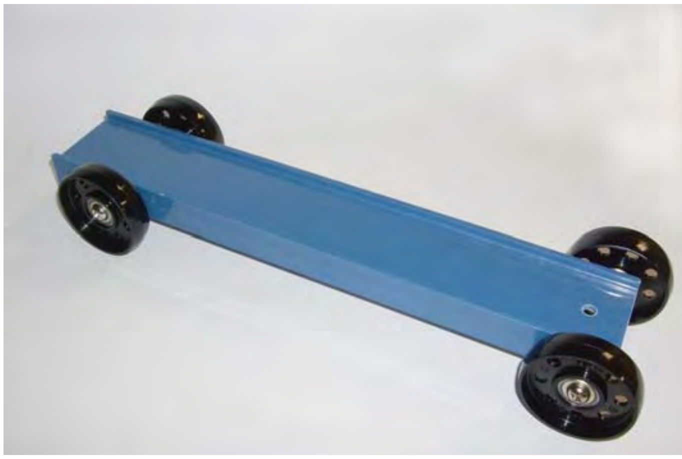
32280 ECONOMY CART



Purpose:

This kit is designed for use in the ISCS curriculum. It may also be used for independent study to allow students to experimentally determine work, power and many other variables involved with simple machines, static forces, or laws of motion.

Material Needed, Not Included:

Spring Scale
Incline Plane
Meter stick
Hooked Weights
Pulley*
Stopwatch
Books
String
Protractor

Assembly:

Insert the screws, from the inside toward the outside, through the holes in the side of the cart body. Place wheels onto the screws and secure in place with wing nuts.

Experiment:

Work and Power: Place an incline plane onto a stack of books creating an angle between it and the table. <u>Attach a pulley* to the incline plane in the center of the raised end.</u> Attach one end of a string to the small hole located on the cart. Tie the free end of string into a loop and set the string over the pulley. Position the cart at the upper end of plane. The string should now be long enough to allow the hanging weights to just touch the table top or the floor as appropriate. Add enough weight to the string to achieve equilibrium. Equilibrium is achieved when the cart can rest anywhere on the plane and not move in either direction. Position the cart at the lower end of the plane. Mark this as the starting point, using a temporary marker or a piece of tape on the cart.

While holding the cart in place at the lower end of the plane, add more weight to the other end of the string. This will be your Force (F) in grams. Simultaneously have one partner release the cart as another starts a stopwatch. Measure and record the Time (T) in seconds needed for the cart to stop. The cart will stop when the weights hit the table top or floor, as before. Be careful that the cart does not fly off the end of the inclined plane. Place a second mark where the cart stopped, referencing from the same place on the cart as used for the start point. Using a meter stick, measure and record the Distance (D) in meters between the cart's start and stop point.

Calculations:

Using the data collected, we may now calculate the power used to pull the cart up the incline. Power is defined as the rate at which work is performed. Work is defined by a force acting over a known displacement.
Force must first be converted to Newtons using the above formula:
A Newton is the mass in kilograms multiplied by acceleration of gravity (9.8 m/s^2). Now power may be calculated using the following formula:
P = Power calculated (N m/s)
F = Total amount of force used to pull cart (Newtons)
D = The distance through which the cart moved (meters)
T = Time needed for the cart to move the measured distance (seconds)

The units in the numerator above match the definition of a joule. Therefore, the units for power are joules/second which are the same as watts. Another familiar unit for power is horsepower. To convert watts to horsepower, divide the number of watts by 746. Repeat the above experiment several times to get an average value. Repeat the experiment, changing the additional weight hanging on the string. Try this again for different angles, establishing equilibrium first, as before.

Questions:
Is all the power needed to pull the cart up the incline due to its weight?
Is any work being performed while the cart is in equilibrium?
What are the English units used in determining power?
Can horsepower be applied to anything other than mechanical devices?

Time Allocation:
This is one of many experiments that can be performed with this device. To prepare this product for an experimental trial should take less than ten minutes. Actual experiments will vary with needs of students and the method of instruction, but most investigations are easily concluded within one class period.

Feedback:
If you have a question, a comment, or a suggestion that would improve this product, you may call our toll free number.