# It's All Uphill Interactive

**Background**:

In this Interactive, you will analyze the motion of a cart being pulled up an inclined plane at a constant speed. The angle of the incline can be modified by 10° increments between the values of 30° and 90°. Three different masses can be selected – 2.0 kg, 3.0 kg, and 4.0 kg. In each simulation, the cart is pulled to the same height – 1.0 meter above the original starting position. For each simulation, the force that must be applied is reported on the screen. The displacement of the cart can be measured using the cm-ruler that is displayed for each trial.

**Purpose:**

To determine the effect of the angle of an inclined plane upon the amount of force and the amount of work done when pulling a cart up an inclined plane at a constant speed and to the same height.

**Discussion of Procedure:**

Select a mass from one of the three choices. Tap the **Run Trial** button. The force required to pull the cart at a constant speed is displayed on the screen; record in the Data Table. The displacement from the starting position to the final position can be measured using the cm-ruler; record in the Data Table. (Note that the table lists meters as the unit.) The force and the displacement vectors are both directed parallel to the inclined plane. Use the force and displacement to calculate the work done. Repeat the procedure for all angles.

Data tables are provided for a single cart mass. Additional tables can be made if necessary.

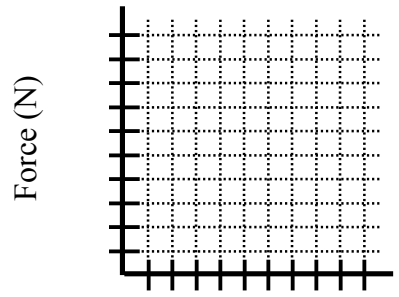
**Data:**

Mass: _____ kg

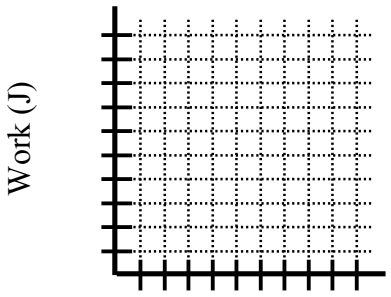
| Angle (°) | Force (N) | Displacement (m) | Work (J) |
|---|---|---|---|
| 30.0 | | | |
| 40.0 | | | |
| 50.0 | | | |
| 60.0 | | | |
| 70.0 | | | |
| 80.0 | | | |
| 90.0 | | | |

**Analysis:**

1. In the space below, construct plots of force and work as a function of the incline angle. Label the divisions along the axes. Construct the best-fit line through the data.




Angle (°)




Angle (°)

2. Describe how varying the incline angle affects the force (if at all).

3. Describe how varying the incline angle affects the work (if at all).

4. When work is done by an applied force, the object's energy will change. In this Interactive, does the work cause a kinetic energy change or a potential energy change? _____ Explain your logic.

5. Assuming the starting height is 0.0 m, calculate the potential energy of the cart after it has been elevated to a height of 1.0 m above the starting location. **Please Show Your Work.**

6. How does your answer to question #5 compare to the work values in the data table?

**Conclusion:**

State a two-part conclusion in which you describe the effect of the inclined angle upon the …

- amount of force required to pull the cart up the hill at a constant speed.
- amount of work done when pulling the cart up the hill at a constant speed.