

# Physics 201 Lab 4

## Simple Machines

Feb 11, 2013

### Equipment

- Meter sticks
- Air carts
- Physics string
- Scissors
- Meter stick holders
- Meter stick stands
- Air tracks
- Slotted weights
- Wood stacking blocks

### Inclined Plane

Set up the air track with one end tilted up under two blocks of wood. Measure the horizontal distance from the leg on the table to the raised leg. Measure the vertical distance on the track between these two points. Measure the diagonal distance along the track. Confirm your measurements by plugging them into the Pythagorean Theorem. Which of two of the three measurements are most reliable? Use them to calculate the angle of incline. What is the theoretical mechanical advantage of this inclined plane?

Measure the mass of the air cart. What hanging mass is required to just lift the cart up the track? Confirm by setting up the masses and turning on the air. Explain any discrepancies.

Now turn off the air. How much hanging mass is required to lift the cart? What is the mechanical advantage of this system? What is the efficiency of this machine?

### Feynman's Lever

Using a meter stick and one stand as a pivot, set up the lever system in Figure 1. Place the pivot at 20 centimeters, a 100 gram mass at 40 centimeters, a 60 gram mass at 60 centimeters, and attach the pulley at 100 centimeters.

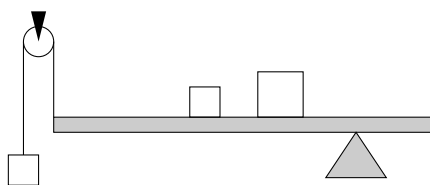


Figure 1: Feynman's problem in virtual work

Using the principle of virtual work, one can show that the amount of hanging mass to support the system ought to be 55 grams. Place that amount on the hanger (remember that the mass of the hanger counts in the 55 grams). This will probably *not* balance the system. What mass does balance the system? What has been not taken into account that explains this discrepancy?

## Block and Tackle

Set up the block and tackle system drawn in Figure 2. Can a 50 gram mass can support twice its mass as shown? If not, why not? What is the efficiency of the system?

Now set up the block and tackle system drawn in Figure 3. Can a 50 gram mass can support four times its mass as shown? If not, why not? What is the efficiency of the system? Is this value consistent with the previous result?

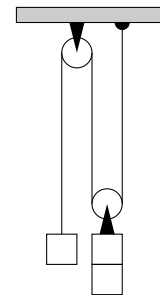


Figure 2: A simple block and tackle with  $MA = 2$

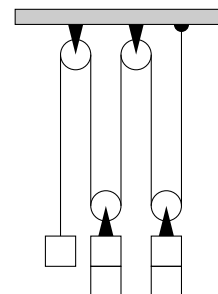


Figure 3: A simple block and tackle with  $MA = 4$