AP Physics Part 1 Lab Handout 09   "Simple Machines: Pulleys"

Your Name:_____ Lab Partner(s):_____

Purpose: To investigate how changing the number of pulleys affects the
     mechanical advantage of a pulley system.

Materials:
     2 meters of string   ring stand & ring   meter stick
     2 double pulleys   spring scale   200 gram mass

Procedure:
1. Find the resistance force (F_r) of the 200. g mass by attaching it
     directly to the spring scale. If the spring scale does not read
     1.96 N then your scale needs adjustment.
2. Set up a Single Fixed Pulley. Pull straight down on the spring scale
     to lift the mass 0.100 m (d_r). Record the effort force (F_e) to the
     nearest 0.01 N by reading the scale while smoothly lifting the
     mass. Measure and record the distance a fixed point on the scale
     has moved to lift the mass (d_e) to the nearest 0.001 m.
3. Repeat step 2 for a Single Movable Pulley, Single Fixed/Single
     Movable Pulley, Double Fixed/Single Movable Pulley and the Double
     Fixed/Double Movable Pulley.
4. Determine the ideal mechanical advantage (IMA) by counting the
     number of upward supporting strands. The string section attached
     to the spring scale only counts when pulling upward.
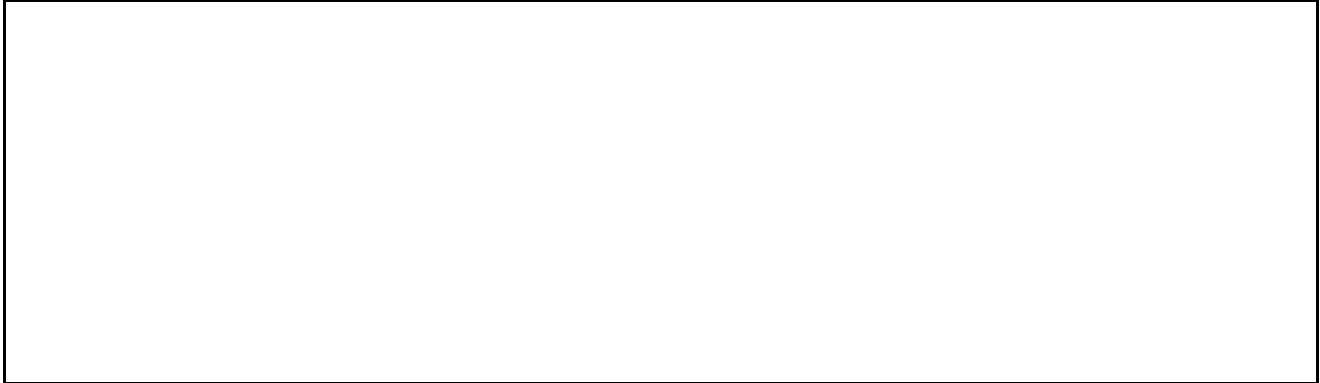
Results:

Observations:

Data:

Pulley Arrangement	F_r	d_r	F_e	d_e	IMA
Single Fixed	1.96 N	0.100 m			
Single Movable	1.96 N	0.100 m			
1 fixed/ 1 movable	1.96 N	0.100 m			
2 fixed/ 1 movable	1.96 N	0.100 m			
2 fixed/ 2 movable	1.96 N	0.100 m			

Data Analysis: (show complete work for one example of each calculation)
1. Calculate the actual mechanical advantage for each pulley using
     AMA = F_r / F_e.
2. Calculate the amount of work input for each pulley using
     W_{in} = F_e · d_e.
3. Calculate the amount of work output for each pulley using
     W_{out} = F_r · d_r.
4. Calculate the percent efficiency for each pulley using
     % efficiency = W_{out}/W_{in} · 100.

Pulley Arrangement	AMA	W_{in}	W_{out}	% efficiency
Single Fixed				
Single Movable				
1 fixed/ 1 movable				
2 fixed/ 1 movable				
2 fixed/ 2 movable				

Diagram:

Error Analysis:

Conclusion: