

Simple Machines - Pulleys

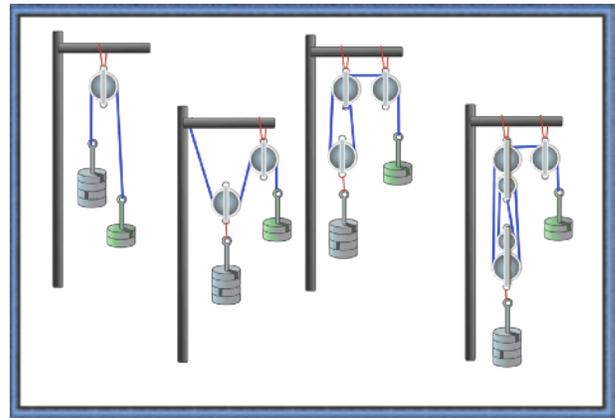
Name _____ Date _____

Purpose:

Find the mechanical advantage and the efficiency of several different pulley systems.

Concepts:

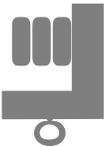
Pulleys are simple machines that can be used to change the direction of a force, to reduce the force needed to move a load through a distance, or to increase the speed at which the load is moving, but that do not change the amount of work done. However, if the required effort force is reduced, the distance the load moves is decreased in proportion to the distance the force moves. Pulley systems may contain a single pulley or a combination of fixed and movable pulleys.



In an ideal machine, one lacking friction, all the energy is transferred, and the work input of the system equals the work output. The work input equals the effort force times the distance that the force moves ($F_e D_e$). The work output equals the resistance force (load) times the distance it is moved, ($F_r D_r$). The ideal mechanical advantage, IMA, of the pulley system can be found by dividing the distance the force moves by the distance the load moves. Thus $IMA = D_e / D_r$. The ideal machine has a 100% efficiency. In the real world, however, the measured efficiencies are less than 100%. Efficiency is found by the dividing work output by the work input.

Complete the following tables for 5 pulley arrangements:

For Each trial, use a different number of lifting strands.

Data:		Draw the strings	Calculations:	
mass lifted		  Number of Lifting Strands _____	Work input	
Weight Lifted			F x D	
Height lifted			Work output	
Force applied			W x H	
Distance			Efficiency	
			W_o / W_i	

-Mass lifted, weight lifted and height lifted all refer to the output side of the machine.

-Force applied, and Distance all refer to the input side of the machine.

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Height lifted			Work output	
Force applied			$W \times H$	
Distance			Efficiency	
			W_o / W_i	

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1. How does increasing the load affect the actual mechanical advantage and efficiency of a pulley system?
2. How does increasing the number of pulleys affect the efficiency of a pulley system?
3. Explain why the following statement is false. (Describe what a machine actually does)
“A machine reduces the amount of work you have to do.”
4. In the space provided below, sketch a pulley system that can be used to lift a boat from its trailer to the rafters of a garage, such that the effort force would move a distance of 50 m while the load will move 10 m.