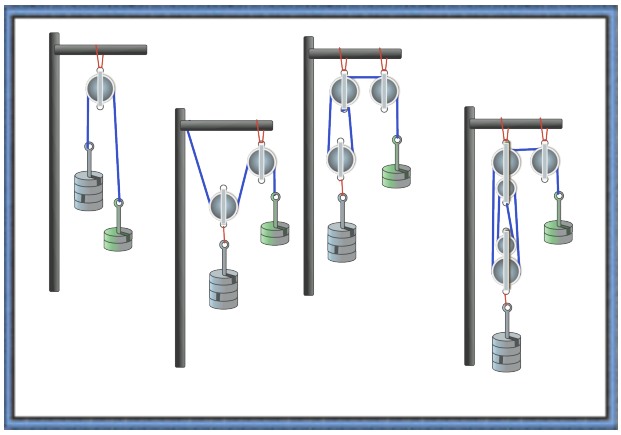
Simple Machines - Pulleys Name _____

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 force times the distance that the force moves (FeDe). The work output equals the output force (load) times the distance it is moved, (FeDe). 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 = De / Dr 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:

Data:		**Draw the pulley arrangement**	**Calculations:**	
mass lifted			Number of lifting strings	
Weight Lifted			Work input **F x D**	
Height lifted			Work output **W x H**	
mass needed			Efficiency W_o / W_i	
Force applied				
Distance				

-Mass lifted, weight lifted and height lifted all refer to the output side of the machine.
- Mass needed, Force applied, and Distance all refer to the input side of the machine.

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Name ____________________

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mass lifted			Number of lifting strings	
Weight Lifted			Work input **F x D**	
Height lifted			Work output **W x H**	
mass needed			Efficiency W_o / W_i	
Force applied				
Distance				

Data:		**Draw the pulley arrangement**	**Calculations:**	
mass lifted			Number of lifting strings	
Weight Lifted			Work input **F x D**	
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mass needed			Efficiency W_o / W_i	
Force applied				
Distance				

Data:		**Draw the pulley arrangement**	**Calculations:**	
mass lifted			Number of lifting strings	
Weight Lifted			Work input **F x D**	
Height lifted			Work output **W x H**	
mass needed			Efficiency W_o / W_i	
Force applied				
Distance				

Simple Machines - Pulleys **Name** _____

Data:		**Draw the pulley arrangement**	**Calculations:**	
mass lifted			Number of lifting strings	
Weight Lifted				
Height lifted			Work input **F x D**	
mass needed			Work output **W x H**	
Force applied			Efficiency $\mathbf{W_o / W_i}$	
Distance				

1. How does increasing the load **affect** the ideal 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.