Student Name: _____

Student Resource 3.1.6
Mechanical Advantage Worksheet

Simple machines (lever, pulley, wedge, screw, inclined plane, wheel and axle) often are combined to create complex mechanical machines. Simple machines apply mechanical advantage to typically move an output force (load) with an input force (effort), less than that of the output force. The general equation for mechanical advantage is shown below:

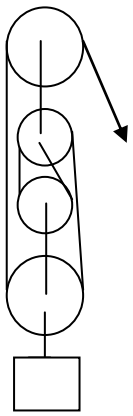
Mechanical Advantage (MA) = Load (R)/Effort (E)

Each simple machine possesses its own equation for mechanical advantage. The formula for mechanical advantage for each simple machine is represented below:

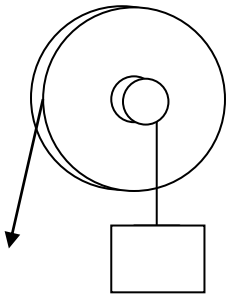
Lever	**Inclined Plane**
MA = Length to Effort (LE)/Length to Load (LR)	MA = Length of Plane (L)/Height of Plane (H)
Wheel and Axle	**Pulley**
MA = Radius of Effort (LE)/Radius of Load (LR)	MA = number of ropes that support the pulley
Wedge	**Screw**
MA = Length of slope (L)/thickness of wedge (H)	MA = Circumference (C) / pitch (p)

Practice
Using the equations above, calculate mechanical advantage for the following examples. Be sure to show your work.

1. What is the mechanical advantage of the system pictured on the right?



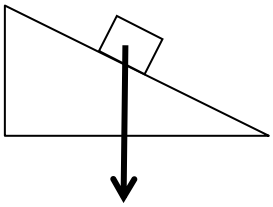
2. If the load is 100 pounds, how much effort is required to pick up the load?



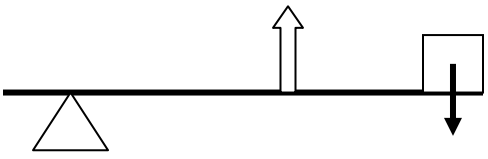
3. What is the mechanical advantage of the system pictured on the left if the diameter of the wheel is 15 feet and the diameter of the axle is 3 feet?

4. If Mrs. Jones can only pull with 25 lbs of force, how much weight can she lift using the wheel and axle system from question 3?

5. If we build a ramp in Tech Ed class that is 2 feet high and the length of the ramp is 30 feet, what is the mechanical advantage?

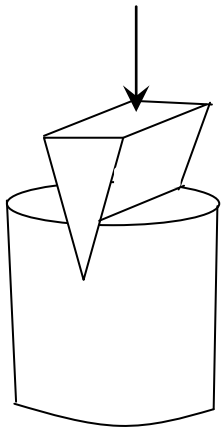


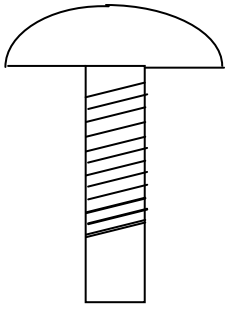
6. How much effort force would someone need to push a 45 pound box up the ramp from question 5?



7. Jose and Suzette construct an arm where the effort is located 10 inches from the fulcrum and the load is 25 inches from the fulcrum, what is the mechanical advantage of the arm?

8. Find the mechanical advantage and the maximum separation load for a wedge used to split the object shown. The wedge has an incline length of 8 inches, an overall height of 2 inches. The effort load applied is 60 pounds.





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9. Using a 1-inch diameter screwdriver, students in the lab used the screw shown to fasten two objects together. What is the mechanical advantage of the screw?

Application
One student group has decided to design a device where a toy car (10 grams) must apply a force to lift a 50 gram weight 2 inches in the air. What simple machine could the group use and what mechanical advantage would they need to achieve their goal? Place your answer, including a sketch of the device, in the space below.

Reflection on the Design Problem
Write your response in the space below using complete sentences.
8. How could simple machines and mechanical advantage help me in designing my device for the "Rube Goldberg activity?

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Formula Sheet

Mechanical Advantage = Load/Effort

Mechanical Advantage of a Pulley = number of strands

Mechanical Advantage of a Wheel and Axle = Radius of Effort/Radius of Load

Mechanical Advantage of a Wheel and Axle = Radius of Wheel/Radius of Axle

Mechanical Advantage of an Inclined Plane = Length of Plane/Height of Plane

Mechanical Advantage of a Lever = Length to Effort/Length to Load

Circumference of Wheel (C) = (pi) * (wheel diameter) = πd

S = Distance traveled in one revolution

Pitch = 1/ # of threads per inch