SPH4C

SIMPLE MACHINES

INTRODUCTION

A machine is a device that helps us perform tasks. It is designed to achieve one of five main functions

1.
2.
3.
4.
5.

Simple machines can be split into two families: the **Lever Family** of machines and the **Inclined Plane Family** of machines.

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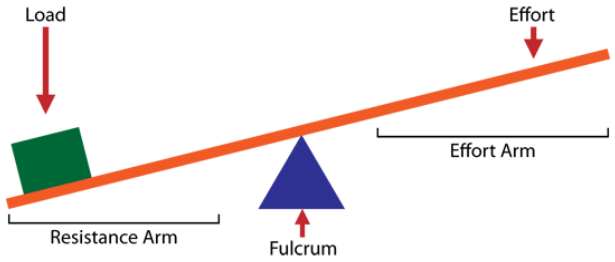
THE LEVER FAMILY OF MACHINES

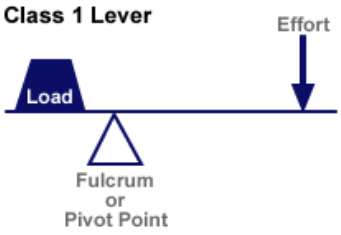
The lever family of machines consists of the **lever**, the **pulley**, the **wheel and axle**, and **gears**.

1. Lever - A rigid bar that can rotate freely around a pivot called the fulcrum. An effort force, F_E, is applied to one part of the lever in order to move the load which exerts a force, F_L, on some other part of the lever.

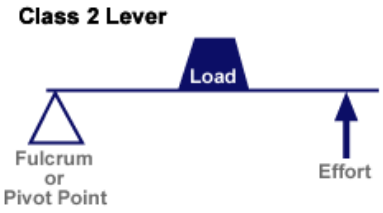


There are three classes of levers:

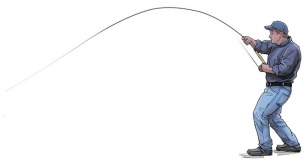
1st class - Fulcrum is in the middle



2nd class - Load is in the middle



3rd class - Effort force is in the middle



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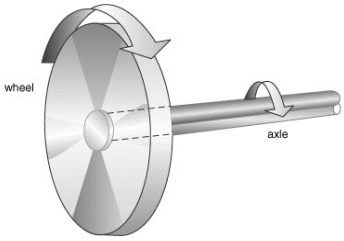
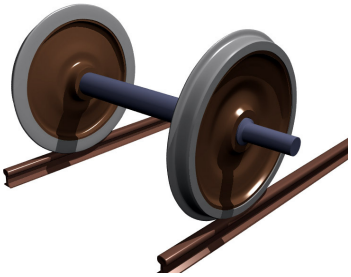
2. Pulley

A wheel with a grooved rim in which a rope runs.

3. Wheel and Axle

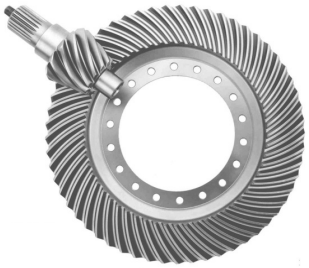
A large diameter disk connected to a small diameter rod.





4. Gears

Toothed wheels of different diameters.



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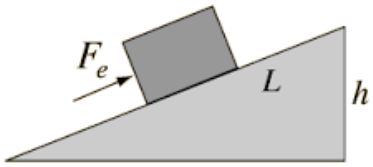
THE INCLINED PLANE FAMILY OF MACHINES

The inclined family of machines consists of the **inclined plane**, the **wedge**, and the **screw**.

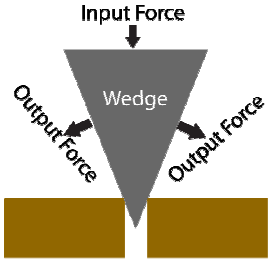
1. Inclined Plane

A ramp. Less force is required to move an object up a ramp then raise it vertically.



2. Wedge

Double inclined plane.



3. Screw

An inclined plane wrapped around a central shaft.

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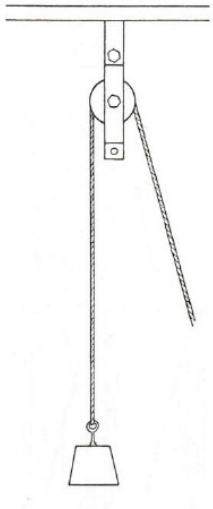
Instructions/Questions

1. What is the measured weight of your object? Load = _____
2. How is the Mechanical Advantage of a pulley system calculated?

A. Set up your pulley, weight and rope as shown at right.



1. What is the theoretical Mechanical Advantage of this system?

   MA = _____

2. What is the required force to raise object higher?

   Effort = _____

3. Calculate the actual Mechanical Advantage of the pulley system using the following equation:

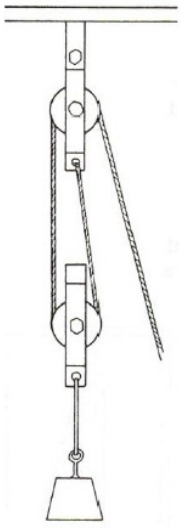
$$MA_{actual} = \frac{Load}{Effort} =$$

4. How does this compare to the theoretical MA from above?

   _____

   _____

B. Support your load according to the pulley setup shown at right.



1. What is the theoretical Mechanical Advantage of this system?

   MA = _____

2. What is the required force to raise object higher?

   Effort = _____

3. Calculate the actual Mechanical Advantage of the pulley system using the following equation:

$$MA_{actual} = \frac{Load}{Effort} =$$

4. How does this compare to the theoretical MA from above?

   _____

   _____

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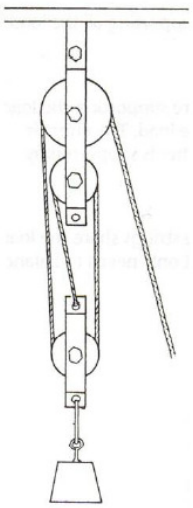
C. Add another pulley to your system as shown to the right.



1. What is the theoretical Mechanical Advantage of this system?

   MA = _____

2. What is the required force to raise object higher?

   Effort = _____

3. Calculate the actual Mechanical Advantage of the pulley system using the following equation:

$$MA_{actual} = \frac{Load}{Effort} =$$

4. How does this compare to the theoretical MA from above?

_____

_____

D. Add another pulley (if time permits). Draw it to the right.

1. What is the theoretical Mechanical Advantage of this system?

   MA = _____

2. What is the required force to raise object higher?

   Effort = _____

3. Calculate the actual Mechanical Advantage of the pulley system using the following equation:

$$MA_{actual} = \frac{Load}{Effort} =$$

4. How does this compare to the theoretical MA from above?

_____

_____

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Results

In general, were the theoretical mechanical advantages similar to the actual ones?

_____

Discussion

1. What were some sources of error in your experimental procedure?

   _____

   _____

2. Calculate the percent error in the mechanical advantage of the actual pulleys compared to the theoretical pulleys.

$$\%\ Error = \left|\frac{Theoretical\ Value - Actual\ Value}{Actual\ Value}\right| * 100$$

Pulley Setup A:

Pulley Setup B:

Pulley Setup C (and D - if attempted):

CONCLUSION - What are your experimental findings?

_____

_____

_____