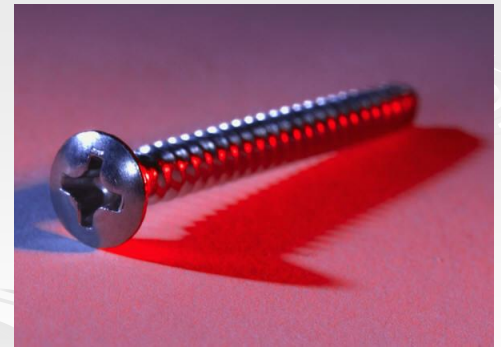


Simple Machines



Simple Machines

Ancient people invented simple machines that would help them overcome resistive forces and allow them to do the desired work against those forces.



Simple Machines

- The six simple machines are:
 - Lever
 - Wheel and Axle
 - Pulley
 - Inclined Plane
 - Wedge
 - Screw

Simple Machines

- A machine is a device that helps make work easier to perform by accomplishing one or more of the following functions:
- transferring a force from one place to another,
 - changing the direction of a force,
 - increasing the magnitude of a force, or
 - increasing the distance or speed of a force.

Mechanical Advantage

- It is useful to think about a machine in terms of the *input force* (the force you apply) and the *output force* (force which is applied to the task).
- When a machine takes a small input force and increases the magnitude of the output force, a *mechanical advantage* has been produced.

Mechanical Advantage

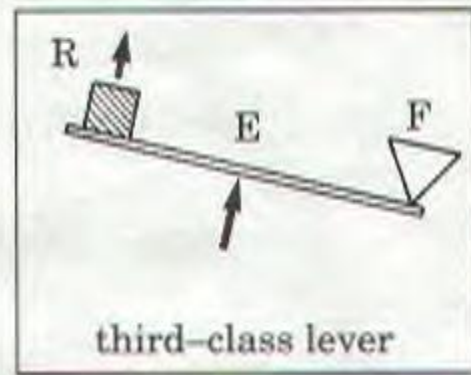
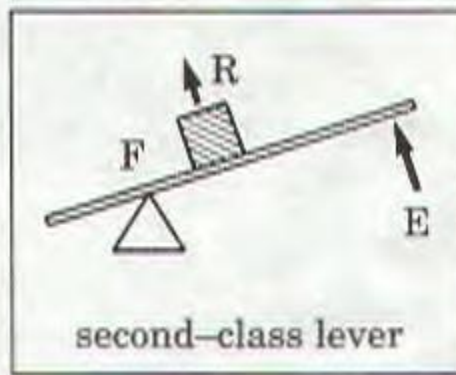
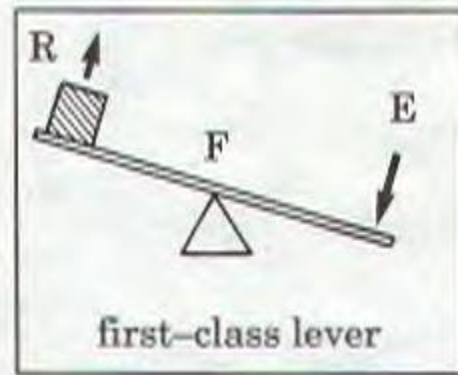
- Mechanical advantage is the ratio of output force divided by input force. If the output force is bigger than the input force, a machine has a mechanical advantage greater than one.
- If a machine increases an input force of 10 pounds to an output force of 100 pounds, the machine has a mechanical advantage (MA) of 10.
- In machines that increase distance instead of force, the MA is the ratio of the output distance and input distance.
- $MA = \text{output}/\text{input}$

The Lever

- A lever is a rigid bar that rotates around a fixed point called the fulcrum.
- The bar may be either straight or curved.
- In use, a lever has both an effort (or applied) force and a load (resistant force).



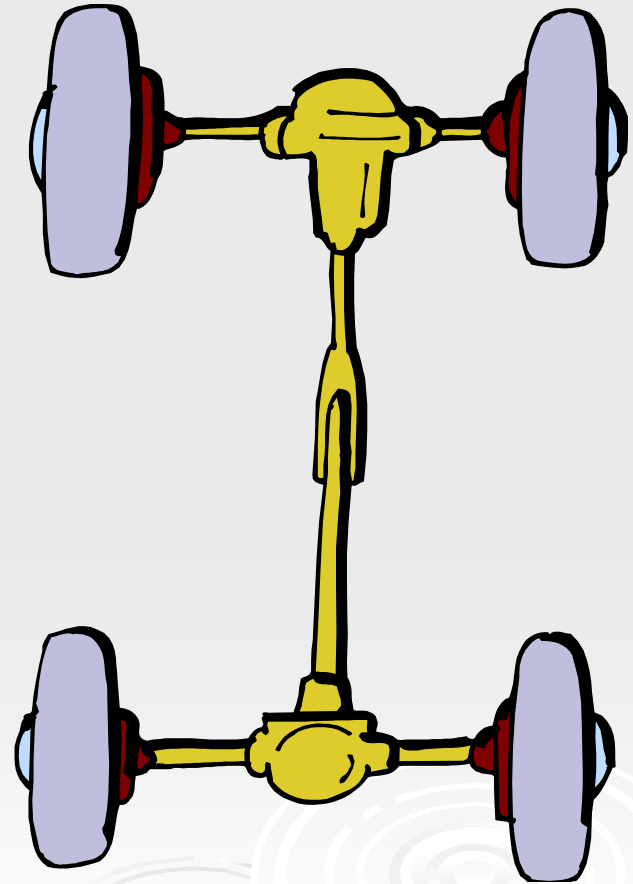
Types of Levers



To find the MA of a lever, divide the output force by the input force, or divide the length of the resistance arm by the length of the effort arm.

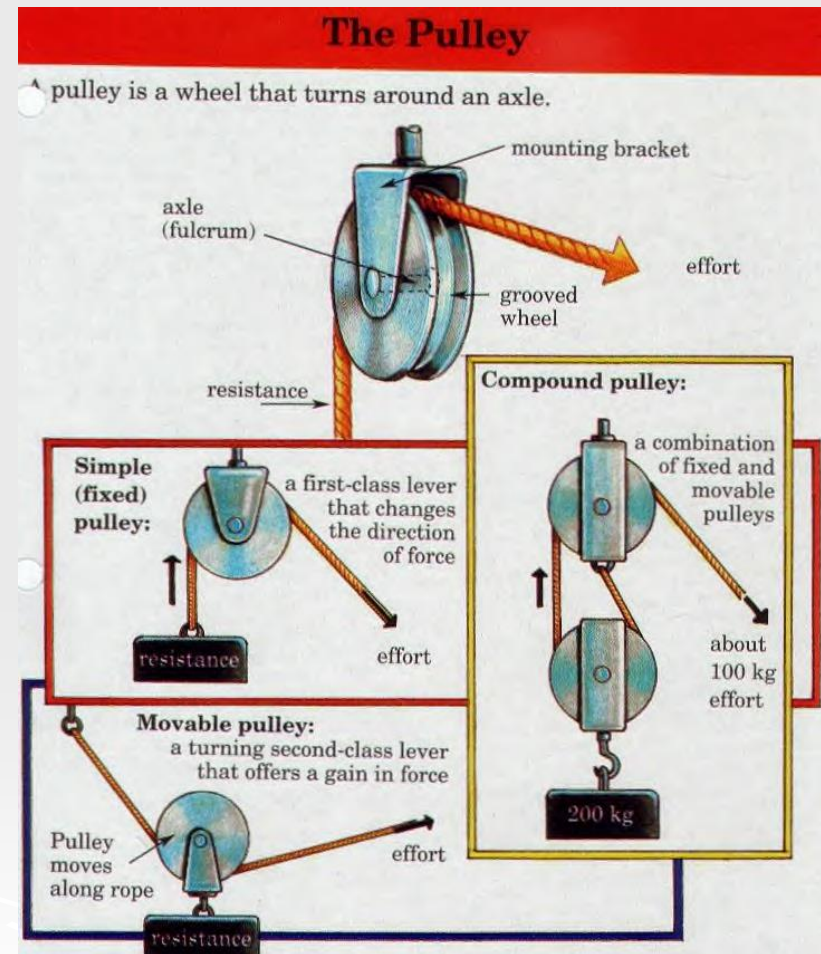
Wheel and Axle

- The wheel and axle is a simple machine consisting of a large wheel rigidly secured to a smaller wheel or shaft, called an axle.
- When either the wheel or axle turns, the other part also turns. One full revolution of either part causes one full revolution of the other part.



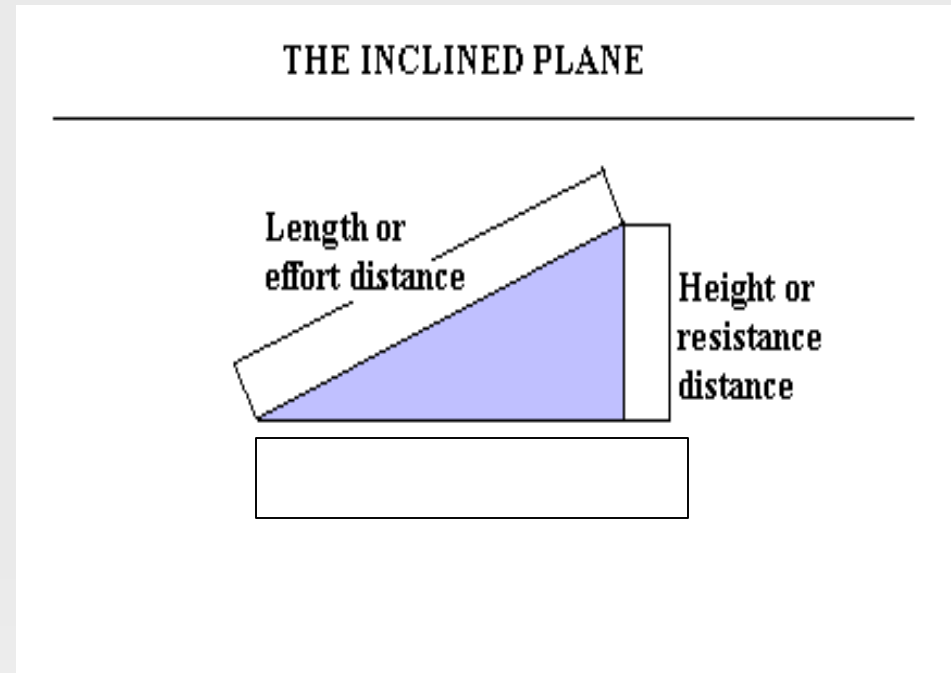
Pulley

- A pulley consists of a grooved wheel that turns freely in a frame called a block.
- A pulley can be used to simply change the direction of a force or to gain a mechanical advantage, depending on how the pulley is arranged.
- A pulley is said to be a fixed pulley if it does not rise or fall with the load being moved. A fixed pulley changes the direction of a force; however, it does not create a mechanical advantage.
- A moveable pulley rises and falls with the load that is being moved. A single moveable pulley creates a mechanical advantage; however, it does not change the direction of a force.
- The mechanical advantage of a moveable pulley is equal to the number of ropes that support the moveable pulley.



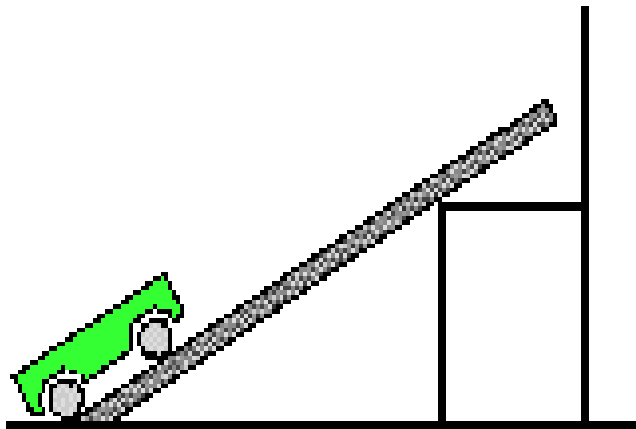
Inclined Plane

- An inclined plane is an even sloping surface. The inclined plane makes it easier to move a weight from a lower to higher elevation.

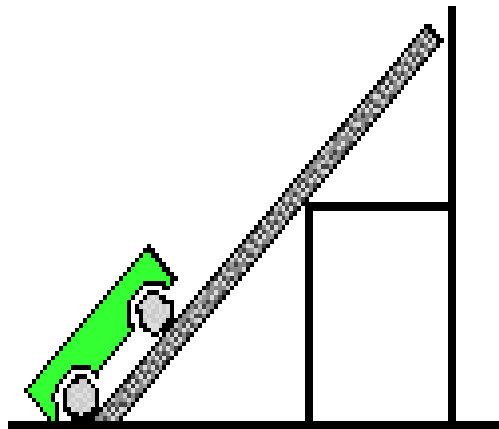


Although it takes less force for car A to get to the top of the ramp, all the cars do the same amount of work.

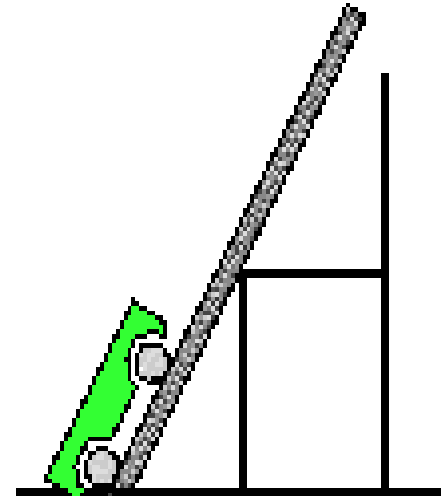
30°



45°



60°



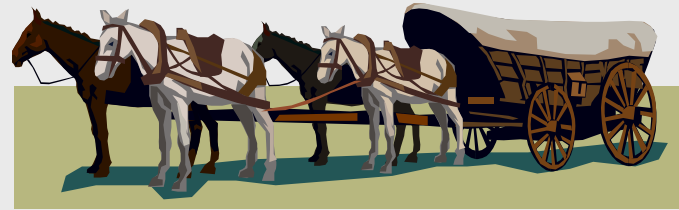
A

B

C

Inclined Plane

- A wagon trail on a steep hill will often traverse back and forth to reduce the slope experienced by a team pulling a heavily loaded wagon.
- This same technique is used today in modern freeways which travel winding paths through steep mountain passes.



Wedge

- The wedge is a modification of the inclined plane. Wedges are used as either separating or holding devices.
- A wedge can either be composed of one or two inclined planes. A double wedge can be thought of as two inclined planes joined together with their sloping surfaces outward.

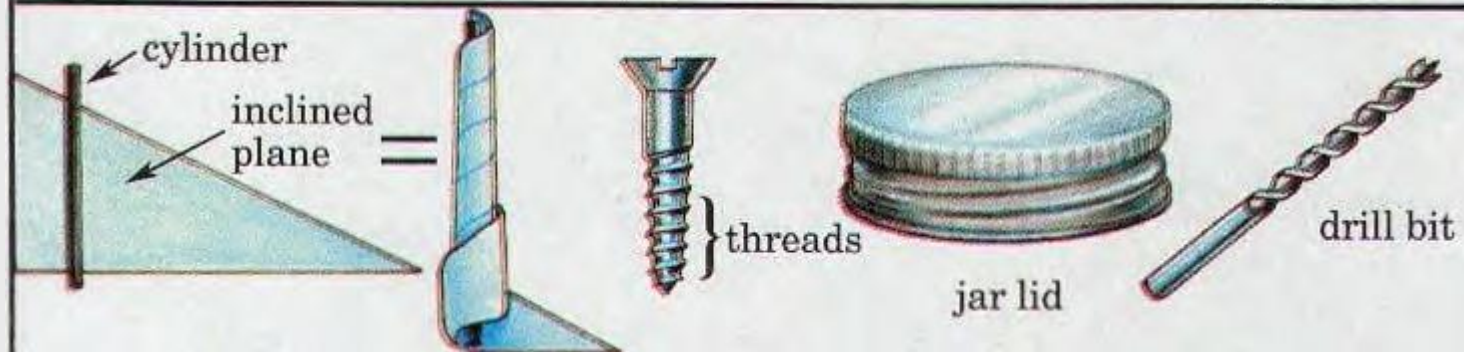


Screw

- The screw is also a modified version of the inclined plane.
- While this may be somewhat difficult to visualize, it may help to think of the threads of the screw as a type of circular ramp (or inclined plane).



The screw is an inclined plane wound around a central cylinder.



MA of an screw can be calculated by dividing the number of turns per inch.

