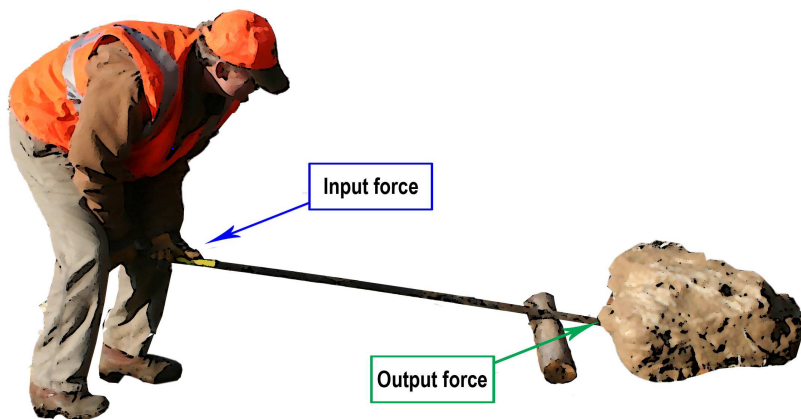


## What is a Machine?

We often think of machines as appliances that run on electrical power or gasoline. But humans have been using machines that run on people power for centuries. We still use them today. A person of average strength can lift a car by hand to change a tire using a jack. The jack does what other machines do. It changes the direction and/or size of the applied force making the work easier or faster. With a jack you press down with a small force to make a heavy car (a large force) move up. A **machine** is a device that changes the direction or magnitude and distance through which a force operates. Sometimes a machine seems to magnify the applied force enabling you to move very heavy things. The apparent change of the applied force is the **mechanical advantage**.

The applied force to a machine is called the **input force**. The resulting force from the machine is called the output force. The **mechanical advantage** is the ratio of the output force to the input force. If the mechanical advantage of a machine is greater than "1," the machine makes work easier.



$$\text{mechanical advantage} = \frac{\text{output force}}{\text{input force}}$$

$$MA = \frac{F_{out}}{F_{in}}$$

$F_{out}$
$MA \mid F_{in}$

**Sample Problem**

How much weight can be lifted with a force of 110 N by a machine with a mechanical advantage of 6?

$$MA = \frac{F_{out}}{F_{in}}; 6 = \frac{F_{out}}{110N}; F_{out} = (6)(110N) = 660N$$

Answer the questions below based on the reading above and on your knowledge of physics.

1. What is the mechanical advantage of a machine that can lift 1,400 N with a force of 175 N?
  
2. What is the maximum weight that can be lifted with a force of 75 N by a machine with a mechanical advantage of 3?
  
3. How much effort is needed to lift a 1,500 N crate using a machine with a mechanical advantage of 12?