# Machines

**Lesson 12: The Advantage Is All Yours**
Mechanical advantage is a measure of the useful work a machine offers. The ideal mechanical advantage (IMA) provides an estimate of this work in a perfect, frictionless world. The actual mechanical advantage (AMA) accounts for friction and air resistance. A machine's efficiency is defined as the AMA divided by the IMA expressed as a percentage. Are you ready for some calculating?

**Doing the Science**
1.    Enter your data from Lesson 11 or Lessons 4 – 10 into Table 1.
2.    The Ideal Mechanical Advantage (IMA) is calculated by dividing the input distance (Distance Force Device Moved String) by the output distance (Height Mass Lifted). Calculate the IMA for each pulley system and record in Table 2.
3.    The Actual Mechanical Advantage (AMA) is calculated by dividing the output force (Force on Mass Due to Gravity) by the effort force (Applied Force of the Force Device). Calculate the AMA for each pulley system and record in Table 2.
4.    Calculate and record in Table 2 the efficiency of each pulley system.

**Table 1. Force and Distance Moved**

| Pulley | Mass (kg) | Force on Mass Due to Gravity (N) | Height Mass Lifted (m) | Applied Force (N) | Distance Force Device Moved String (m) |
|---|---|---|---|---|---|
|  | 1 | | | | |
| | 2 | | | | |
|  | 1 | | | | |
| | 2 | | | | |
|  | 1 | | | | |
| | 2 | | | | |
|  | 1 | | | | |
| | 2 | | | | |

**Table 2. Mechanical Advantage and Efficiency**

| Pulley | Mass (kg) | Ideal Mechanical Advantage (IMA) | Actual Mechanical Advantage (AMA) | Efficiency (%) |
|---|---|---|---|---|
|  | 1 | | | |
| | 2 | | | |
|  | 1 | | | |
| | 2 | | | |
|  | 1 | | | |
| | 2 | | | |
|  | 1 | | | |
| | 2 | | | |

**Do You Understand?**

1. Which pulley system was the *most* efficient? Provide a reason for this pulley system's high efficiency.

2. Which pulley system was the *least* efficient? Provide a reason for this pulley system's low efficiency.

3. A different pulley system consists of eight single pulleys all connected together. Discuss how the efficiency of this new pulley system would compare to the pulley systems you investigated in this experiment.