Trial/Pilot Event

Contact the organizers of your tournament to find out what trial/pilot events will be held.

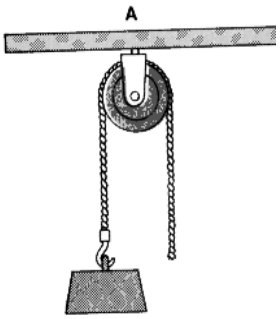
SIMPLE MACHINES

1. **DESCRIPTION:** Teams will **be expected to determine the** IMA, AMA and/or Efficiency of simple machines.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 45 minutes

2. **EVENT PARAMETERS & DEFINITIONS:**

   a. Only non-programmable calculators may be used.

   b. Simple machines are devices that multiply or divide force (i.e., makes a force large or smaller) or, are used to change the direction of a force. They are described in terms of their mechanical advantage (MA) and efficiency (E). The mechanical advantage is a measure of the amount of force multiplication or division, which the machine can do. There are two types of mechanical advantage: ideal (IMA, sometimes called theoretical TMA) and actual (AMA).

   c. The IMA is defined as the distance the input force of the machine moves divided by the distance the output force moves. This ratio considers only distances moved and ignores actual forces. The IMA is the force multiplication the machine could do if there was no energy loss within the machine due to friction. For example, the distance moved is the vertical distance moved as the force (input or output) moves along the inclined plane.

   d. The AMA is the force at the output of the machine **(often the weight of the object being moved)** divided by the force delivered to the input of the machine. The AMA is a measure of what the machine can actually do when energy losses within the machine due to friction are included.

   e. The Efficiency is a measure of how much of the energy delivered to the machine is used for useful work and is **measured in %**. In an ideal simple machine the amount of work produced would be equal to the amount of work or energy delivered to the machine. In this case, the machine would have an efficiency of 100%. However, in a real machine, the efficiency is never 100% because of the energy needed to overcome the friction of moving parts within the machine itself. The Efficiency of a simple machine **is defined as the AMA divided by IMA times 100%.**

3. **THE COMPETITION**:

   a. Students will be asked to determine the IMA, AMA, and/or efficiency **for each of 4 simple machines which include**: a Lever **(first, second, or third class)**, an Inclined Plane, a Pulley System, or a Wheel and Axle System**. The competition will consist of 4 stations of which 3 will be single simple machines and the fourth will be a compound machine. A lever may be used in more than one station, but each lever should be a different class. One of the stations will be a combination of machines used in series where students will determine the *overall* IMA, AMA, and efficiency.**

   b. After the IMA, AMA and the efficiency of a machine are determined, students may also be asked to use the information to solve a problem using the machine in specific way. Any or all of the machines may be enclosed or hidden from the student's view as long as the student has reasonable access to the input and the output connections of the machines.

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3. **THE COMPETITION**: (CONT.)

   c. THE NATIONAL COMPETITION

   i. Teams will be required to construct the simple machines from the materials provided by the judges at each station so that their simple machine achieves the target value IMA, AMA, or efficiency indicated by the judges.

   ii. Teams will be required to then measure and calculate the IMA, AMA, and efficiency of their simple machine.

   iii. Teams will be required to draw and label their set-up.

   iv. For the combination station, teams will only be required to determine the IMA, AMA and efficiency. No construction is required. This station will be set-up by the judge. Application and extension questions may be asked as part of any or all stations.

4. **SAMPLE QUESTIONS**: (**for all levels of competition)** After experimentally determining the IMA and AMA of a simple machine station, students **may be** asked to calculate and complete **questions similar to the following**:

   a. If the input force of this machine were equal to the "weight of a mass" of 250 gm, the maximum mass that could be lifted by the output force would be ____ gm.?

   b. How much mass could be lifted if the machine's efficiency was 80%? ____ gm.?

5. **SCORING**:

   a. **Thirty** points are possible for each of the four stations.

   b. The supervisor will establish the distribution of points.

   c. Winners will be ranked based on the **greatest** number of points.

   d. Ties **will** be broken by a series of designated questions within the test.