

COMPOUND MACHINES

Read the General Rules in the manuals and on [www .soinc.org](http://www.soinc.org) as they apply to every event.

DESCRIPTION: This event includes activities and questions related to simple and compound machines.

A TEAM OF UP TO: 2 EYE PROTECTION: None IMPOUND: Yes APPROX. TIME: 50 Mins.

1. EVENT PARAMETERS:

- a. Competitors may bring a single pre-made device, tools, supplies, reference materials, writing utensils and any type of calculators for use during Part 1. Calculators do not need to be impounded.
- b. The device and any tools and/or supplies must fit inside a box no larger than 100.0cm x 100.0cm x 50.0 cm (at impound) and must be impounded prior to the start of the competition.
- c. All reference materials to be used during all parts of the competition must be secured in a 3-ring binder, so that regardless of orientation nothing can fall out. **Reference materials do not need to be impounded.**
- d. Event supervisors provide **three masses labeled A, B, and C. A flexible loop, large enough to pass a standard golf ball through, must be tied to the top of each mass. The loops may be made from fishing line, zip ties, strings, etc.** The masses, including the fully stretched out flexible loop, must be able to fit inside a 15.0 cm x 15.0 cm x 20.0 cm box. **Masses A, B, and C must be between 20.0g and 800.0g.** The ratio of the **largest** mass to the **smallest** mass must not exceed **8:1**.

2. CONSTRUCTION:

- a. The device must be a class 1 lever connected directly in series to a class 2 lever, each with a single beam of length less than or equal to 40.0cm.
- b. The device may be made out of any materials. Elastic or electronic components are prohibited.
- c. The device must be constructed to accommodate the masses.
- d. **The device must not include springs.**
- e. **Competitors must not bring masses or include them in devices except when fixed in place prior to impound to obtain static equilibrium.**

3. THE COMPETITION: All teams must be given the same total amount of time to complete the competition.

- a. Device Testing
 - i. The objective is to quickly determine the **ratios or three** unknown masses using a **compound** lever,
 - ii. The event supervisor will individually call each team to a station. Multiple identical stations may be used, but all teams must use identical masses.
 - iii. Supervisions must verify that devices meet construction specifications. Devices that do not meet construction specifications must not be tested until the devices comply with event specifications via modification with the tools and supplies brought by the team. Teams must not interfere with the device testing of other teams.
 - iv. Timing (**up to 10 minutes**) begins when the event supervisor provides **the masses** to the competitors. The supervisor must ensure that the **mass values** are not revealed to **any** teams. **Teams must not touch the masses until time begins.**
 - v. Using the basic mathematical principles of a lever and adjusting only the relative positions along the lever beams of the masses and fulcrums, competitors must calculate the ratios of the masses. **Teams may work with either two or three masses at a time.** Teams may use

- their resources, calculators and tools to determine mass ratios.
- vi. Competitors must not mark on, attach anything to, or modify the masses.
 - vii. Timing stops when the competitors provide the supervisor with the calculated **mass ratios A/B and B/C** or 10 minutes has elapsed. Event supervisors must record the elapsed time to the nearest whole second. No changes are allowed to the calculated values once timing stops.

4. SCORING:

- a. Scoring will be based upon closeness of student answer to actual value of masses and time needed to do calculations.

Students should work as quickly as possible, however, they will be allowed as much time as needed to complete each division event. Final team positions will be given point values of a school's best team, on the following scale:

1st=8
2nd=7
3rd=6
4th=5
5th=4
6th=3
7th=2
8th=1

The following are possible subjects for questions in the fourth and final Science event, the Jeopardy Match held on Saturday:

- Simple/Compound machine concepts (e.g. types/terminology)
- Simple/compound machine calculations (e.g. ideal/actual mechanical advantage, efficiency, load, effort, potential/kinetic energy, coefficient of friction)
- Static equilibrium simple machines including
 - Lever (all three classes)
 - Inclined plane
 - Wedge
 - Pulley (up to two double pulleys in a single system, also including belts)
 - Wheel and axle (including gears)
 - Screw

Prohibited topics include: dynamic calculations, strengths of materials, and angle of repose.

Recommended Resources: All reference and training resources including the Chem/Phy Sci CD are available on the Official Science Olympiad Store of Website at <http://www.soinc.org>

