MISSION POSSIBLE

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. DESCRIPTION: Prior to the competition, competitors will design, build, test, and document a Rube Goldberg®-like device that completes a required task through an optional series of simple machines.

**A TEAM OF UP TO:** 2

**SET-UP TIME:** 30 minutes for points

**MAX. RUN TIME:** 3 minute limit

2. EVENT PARAMETERS: Event Supervisors need meter sticks, stopwatches, and measuring tape. All competitors must properly wear eye protection at all times. Competitors without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete. Each device must pass a safety inspection before operation. Uncontrolled flames, as well as hazardous liquids and materials (e.g., rat traps, lead objects, combustible fuses) and unsafe handling of chemicals will not be permitted. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor; otherwise they must receive only participation points.

3. CONSTRUCTION PARAMETERS:
   a. Penalty points will be assessed for Device dimensions during operation greater than 60.0 x 60.0 x 60.0 cm.
   b. The Device must begin with the Start Task and end with the Final Task as listed in Section 4.
   c. After the Starting Task, the device must be designed to operate autonomously. A team must be disqualified if the device is remotely timed or controlled.
   d. The device must be designed and constructed to consecutively execute a sequence of transfers from one Simple Machine to another Simple Machine.
   e. The six Simple Machine Types used in transfers that will count for points are levers, pulleys, wheel and axles, inclined planes, screws, and wedges.
   f. No more than 18 Simple Machine transfers are counted for points between the Starting Task and the Final Task; these may occur in any order.
   g. All scorable actions and transfers must be visible. The top and at least one vertical wall must be open or transparent for viewing all actions and tasks.
   h. Each task in the device must be designed to contribute to the completion of the Final Task. Parallel and/or dead end tasks are not allowed.
   i. Each movable/adjustable physical object in the device can only be utilized by one assigned task.
   j. Other non-scorable tasks may be incorporated into the device but must contribute to the completion of the Final Task, receive no points and be listed on the Task Sequence List (TSL).
   k. Electrical components are not permitted.
   l. A maximum of 3 pre-lit candles may be used in the device. Energy devices (i.e., springs/mousetraps) may be set prior to starting the device.
   m. Students must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org

4. THE COMPETITION:
   a. **Start Task** (100 points) – Drop an unaltered, regulation-sized racquetball into the device to initiate the first action. The racquetball must be dropped from a location higher than the entire device.
   b. **Transfers** – Competitors may have up to 18 scorable unique transfers count for points. (See 4.c.)
   c. Scorable transfers are of one Simple Machine Type to a different Simple Machine Type. The initial type of machine in a transfer is counted for points. (e.g. a Pulley → Lever 1st Class would count as a Pulley Transfer, while a Lever 1st Class → Pulley would count as a Lever Transfer.)
   d. Each Simple Machine Type may be used to score points up to three times using these criteria:
      i. Each Class of Lever (first, second, and third) may only count for points once.
      ii. Pulleys must have an ideal mechanical advantage (IMA) > 1 to count for points.
      iii. Inclined Planes must be stationary and have an object pushed or pulled at least 10cm up the inclined plane to count for points.
      iv. Wedges must be used to separate two touching objects to count for points.
      v. Screws must complete at least one full rotation and must have a clearly visible mark proving that it has moved at least one full rotation to count for points.
      vi. Wheel and Axles must complete at least one full rotation and must have a clearly visible mark proving that it has moved at least one full rotation to count for points.
   e. Each scorable type of transfer must be unique. Unique types of transfers can be repeated, but only one instance of a unique transfer can be scorable (e.g. a device has two instance of Pulley → Screw, only one instance would count for points, the second instance of Pulley → Screw would be ineligible for scoring.)
f. **Final Task** (250 points) – The final action of the device must be ringing or striking a bell to signal the end of the device operation. The bell must be clearly audible to the Event Supervisors and demonstrated prior to operation so the Event Supervisors can accurately measure the operation time.

g. A **Transfer Sequence List (TSL)** must be submitted to the Event Supervisor at impound or check-in, whichever is first. The TSL must be legible, neat, and an accurate documentation of each action of the device’s operation. See www.soinc.org for an example of the format required. Scoring will be based only on the transfers listed in the TSL. Non-scorable transfers must be numbered and documented in the TSL and correspondingly labeled in the device.

h. The Target Operation Time for maximum points is 60 seconds at Regionals, between 61 and 90 seconds at States, and 91 and 120 seconds at Nationals (time announced after impound).

i. Timing and scoring for the device begins when a competitor releases a racquetball into the device. Timing of the device stops when the final bell is first audible to the judges, or when 180.0 seconds elapse, whichever comes first.

j. If the device stops, jams or fails, the competitors must be allowed to “adjust” it to continue operation. Any obvious stalling to gain a time advantage must result in disqualification.

k. If an action inadvertently starts a transfer out of sequence on the TSL, then all transfers skipped in the listed sequence must not earn points even if they are completed.

l. If a competitor completes a scorable transfer or makes an adjustment that leads directly to the completion of the transfer, then that transfer will not count for points (even if it is part of the Final Task).

5. **SCORING:**

   a. Teams that impound a device, but fail to compete, receive participation points.
   b. 25 pts if the TSL is submitted on time as designated by the tournament director.
   c. 25 pts if the TSL uses the format specified on www.soinc.org.
   d. 25 pts if the TSL is 100% accurate of intended scorable and non-scorable actions and transfers.
   e. 25 pts if the scorable transfers within the device are correspondingly labeled as in the TSL.
   f. 50 pts if the competitors use no more than 30 minutes to set up its device.
   g. 0.1 pt for each 0.1 cm that the maximum dimensions of the device (before and during operation) are under 60.0 cm x 60.0 cm x 60.0 cm in each axis. Example: Device measures 40.0 cm x 38.9 cm x 52.4 cm. will receive 20.0 + 21.1 + 7.6 = 48.7 pts.
   h. 100 pts for successfully completing the Start Task.
   i. 250 pts for successfully completing the Final Task.
   j. 2 pts for each full second (rounded down) of operation up to the Target Time.
   k. 25 pts for each unique Simple Machine Transfer successfully completed as described. (450 points max.)

6. **PENALTIES:**

   a. Minus 1 point for each full second (rounded down) that the device operates past the Target Time up to 180.0 seconds (whichever occurs first).
   b. Minus 25 points for each dimension of the device that exceeds 60 cm.
   c. Minus 50 points, one time, for any solid or liquid that detaches and leaves the measured dimensions of the device.
   d. Minus 15 points for each time the device is touched or adjusted during the operation time.

7. **TIERS:** Unsafe devices must not be allowed to run and teams must only receive participation points. Tier 1: Devices without any violations; Tier 2: Devices with construction violations (excluding dimension violations) or competition violations; Tier 3: Devices impounded after the deadline.

8. **TIE-BREAKING CRITERIA:** Ties are broken by this sequence: 1. Fewest penalty points; 2. Number of scorable Simple Machines successfully used; 3. Smallest overall dimension (L+W+H) of the device.

**Recommended Resources:** The Mission Possible DVD and training resources are available at www.soinc.org

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