



METRIC MASTERY

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Teams will estimate and then measure properties of identical objects including mass, area, volume, density, force, distance, time, and temperature. Teams will also perform metric unit conversions.
A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 Minutes
 2. **EVENT PARAMETERS:** The event will be in one room (or two if needed).
 - a. The event will be divided into 3 Parts. Parts One & Two will have 15-25 stations.
 - b. Competitors will rotate through the stations to make their estimations and then, using the same or identical objects, make their measurements. **Approximately two-thirds of the stations will be Direct Measurement and one-third of the stations will be Calculated.**
 - c. Measuring devices must be kept out of sight during Part One - Estimation.
 - d. The property to be estimated or measured and the units of measurement must be identified in the directions at each station. Prior to the competition supervisors must determine the acceptable measurement value with the same equipment that is to be used at each station.
 - e. Competitors must not bring watches, writing implements, electronic devices, notes, or use any kind of measuring device (e.g., fingers, pieces of paper, pencils, clothing, etc.). Each competitor may bring a non-programmable calculator only for Part Two - Measurement.
 - f. Supervisors must furnish pencils, paper, and all measuring devices needed for the event.
 3. **THE COMPETITION:** For each part Competitors will be given an answer sheet to record their answers. Each answer sheet must be turned in prior to the next Part or the team will lose their score for that Part.
 - a. **Part One - Estimation:**
 - i. Recommended time at each station for the Estimation Part is 30 seconds.
 - ii. Competitors must not touch or feel any of the objects, unless the station directions specifically state the object may be touched. Competitors must be allowed to "heft" an object for estimated masses.
 - b. **Part Two - Measurement:**
 - i. Recommended time at each station for the Measurement Part is 60 seconds.
 - ii. Measurements must be made using the supervisor supplied instruments, expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) plus one estimated digit.
 - iii. To receive points, measurements must be expressed using the proper resolution, estimated digit appropriate for the instrument(s) provided, and the proper unit of measurement. **Example:** Correct answer = 9.0 cm. If the answer given by the team is 9 cm or 9.0, the answer will be marked wrong.
 - c. **Part Three - Metric Unit Conversion:**
 - i. This part must be after the completion of Part One and Part Two.
 - ii. Competitors will have 5 minutes to complete 5 Metric Unit Conversion problems.
 - iii. Competitors will be asked to convert 5 metric numbers to a specific different metric unit and must not be required to convert from one measurement system to another (e.g., metric to standard).
 4. **SCORING:** Final high score wins. **Final Score = Estimation Score + Measurement Score + Metric Unit Conversion Score.**
 - a. **Part One - Estimation:** Scores within 5% of the correct value, as determined by the event supervisor, will be awarded 5 points, within 10% will be awarded 3 points, and within 20% will be awarded 1 point.
 - b. **Part Two - Measurement:**
 - i. **Direct Measurements:** Measurements (not involving calculations) that are within (+/-) 3 of the estimated digit as determined by the event supervisor, expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) receive 5 pts. All others receive zero points. **Example:** The Supervisor measured the width of a page as 209.1 mm using a ruler whose smallest divisions are 1.0 mm, then any value from 208.8 mm - 209.4 mm would be accepted as correct.
 - ii. **Calculated Measurements:** Measurements that require formula calculations (e.g., calculating the density of an object, surface area, velocity, etc.) receive 5 points for answers within the range of the calculated value based on (+/-) 3 of the estimated digit of the direct measurements. All other answers receive zero points. **Example:** Supervisor measured and calculated: 13.45 cm x 22.32 cm = 300.20 cm². Range: within -0.03: 13.42 cm x 22.29 cm = 299.13 cm², within +0.03: 13.48 cm x 22.35 cm = 301.28 cm². Thus any value from 299.13 cm² - 301.28 cm² would be accepted as correct.
 - c. **Part Three - Metric Unit Conversions:** Answers must be with the correct unit written to receive 5 pts. All other answers receive zero points. **Example:** Convert 14.56 mm to hm. Correct answer = 0.0001456 hm.
 - d. **Penalties:** A 10 point penalty will be given for each of the following team violations:
 - i. Does not return measuring devices to their original location or does not clean up any spills.
 - ii. Alters the equipment (e.g., such as un-zeroing a balance). Altering equipment may also result in DQ.
 - e. Ties will be broken using tiebreaker stations designated prior to the start of the event.
- Recommended Resources:** The Problem Solving/Technology CD and resources are available at www.soinc.org