

Metric Mastery

Division B

Georgia Tech Event Workshop Series
2024-25



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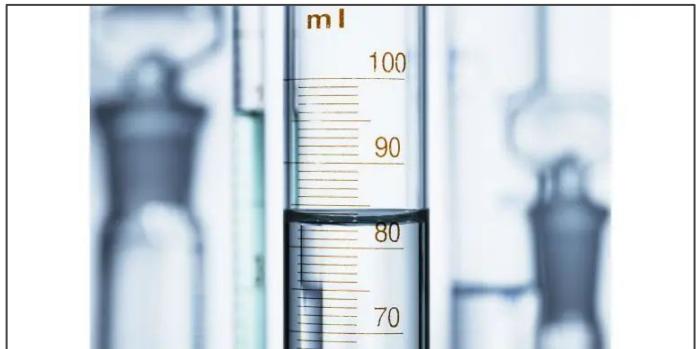
RULES SHEET

DIFFICULT TOPICS

COMMON QUESTIONS

TIPS FROM A VETERAN

OTHER FREE RESOURCES



The Rules Sheet

Event has 3 parts:

- 1. Estimation:** Have 30 seconds at 15-25 stations to estimate measurements of objects
- 2. Metric Unit Conversion:** Have 5 minutes to convert 5 numbers to different units
- 3. Measurement:** Have 60 seconds at 15-25 stations to actually calculate measurements of objects

What is a measurement? Density, surface area, velocity, ect...

METRIC MASTERY B
See General Rules, Eye Protection & other Policies 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.
TEAM OF UP TO: 2
CALCULATOR: Class II **APPROXIMATE TIME:** 50 minutes

2. EVENT PARTS:

- The event will be divided into 3 sections. Sections One & Three combined will involve estimating and measuring properties of objects at stations.
- Participants will route through 15 - 25 stations to make their estimations in Section One - Estimation and then measure the objects at stations in Section Three - Measurement. Participants will use measuring devices to measure the mass, area, volume, density, force, distance, time, and temperature of identical objects at the stations. Some of the stations will ask for calculated measurements - measurements that require formula calculations (e.g., calculating the density of an object, surface area, velocity, etc.). The measurement devices must be used to measure the objects at the stations per the following:
 - No more than 20% of the stations at the Regional level
 - At least 20% but not more than 40% of the stations at the State level
 - At least 40% but not more than 60% of the stations at the National level
- Measuring devices must be kept out of sight during Section One - Estimation.
- Participants will be given a list of acceptable measurement devices to use 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.
- Participants may use any of the following items: electronic devices (with the exception of a calculator for Section Three), notes, or use any kind of measuring device (e.g., fingers, pieces of paper, pencils, clothing, etc.). Each team may bring two stand-alone non-programmable, non-graphing calculators.
- Supervisors must furnish writing implements, paper, and all measuring devices needed for the event.

3. THE COMPETITION: For each part participants will be given an answer sheet to record their answers.

- Section One - Estimation:**
 - Recommended time at each station for the Estimation Section is 30 seconds.
 - Participants must not touch or feel any of the objects, unless the station directions specifically state that they may touch or feel the object. Participants will be allowed to feel the object for estimated masses.
- Section Two - Metric Unit Conversion:**
 - Participants will have 5 minutes to complete 5 Metric Unit Conversion problems.
 - Participants will be asked to convert 5 metric numbers to a specific different metric unit and must use the conversion factor given in the metric conversion table (e.g., 1000 mm = 1 m).
- Section Three - Measurement:**
 - Recommended time at each station for the Measurement Section is 60 seconds.
 - Measuring devices must be used using the supervisor-supplied instruments, expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) plus one estimated digit (if appropriate/analogy).
 - Estimated measurements must be expressed using the proper resolution and 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.

4. SCORING: First high score wins. Final Score = Estimation Score + Measurement Score + Metric Unit Conversion Score.

- Section One - Estimation:** Participants receive 50% of the points for each correct answer. Participants receive zero points for each answer that is within 10% of the marked 1 point, and within 20% will be awarded 1 point.
- Section Two - 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.

METRIC MASTERY B (CONT.)
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

c. Section Three - Measurements:

- 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.
- 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: If the answer to a problem is calculated: $13.45 \text{ cm} \times 13.45 \text{ cm} \times 22.35 \text{ cm} = 300.20 \text{ cm}^3$. Participants with 13.42 cm x 13.42 cm x 22.29 cm = 299.12 cm 3 will receive 5 pts. 13.48 cm x 13.48 cm x 22.35 cm = 301.28 cm 3 . Thus any value from 299.13 cm 3 - 301.28 cm 3 would be accepted as correct.
- Penalties:** Penalties may be applied to teams who do not return measuring devices to their original locations, do not clean up spills, and/or intentionally alter or damage equipment or objects.
- Ties will be broken using tiebreaker stations designated prior to the start of the event.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase; other resources are on the Event Pages at soinc.org.

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DIFFICULT TOPICS

Topic 1: How to use...

- Calipers - [Wikihow](#)
- Micrometers - [Home Depot Guide](#)
- Pipettes - [Youtube Video](#)
- Double Pan Balance - [Website Guide](#)
- Tare Mass - [EUREKA!](#)
- Ruler
- Stopwatch
- Spring Scale
- Graduated Cylinder - [Read the Meniscus](#)
- Thermometer

**MEASURE the
SMALLEST graduation
or markings on the
instrument plus one
estimated digit**

Topic 2: How to estimate?

Use reference points and logic!

- Boiling, freezing, room temperature

Per rules:

~~the same equipment that is to be used at each station.~~

- e. Participants must not bring watches, writing implements, electronic devices (with the exception of a calculator for Section Three), notes, or use any kind of measuring device (e.g., fingers, pieces of paper, pencils, clothing, etc.). Each team may bring two stand-alone non-programmable, non-graphing calculators (Class II) for use during Section Three.

What are “things” that you can visually see and “secretly” use as reference points?

- Size of letter paper
- Sizes of tables and chairs

Topic 3: Doing Math

- Converting metric unit to metric unit
- Use **Dimensional Analysis**
 - Write the units as fractions
 - Cancel same units
 - Keep remaining units in final solution

Ex. "Convert 3.598×10^3 picometers to kilometers."

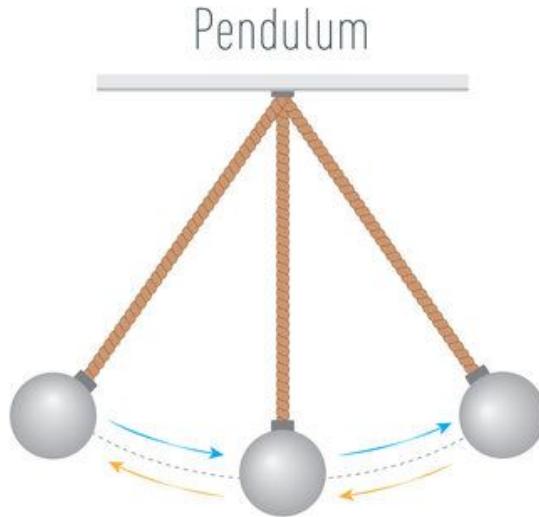
COMMON QUESTIONS

A detailed 3D rendering of a DNA double helix. The structure is composed of two interlocking spiral chains, each made of a series of light blue and white rectangular segments. The overall color palette is a gradient of blues, purples, and pinks. A solid dark blue rectangular box is positioned in the upper left area, partially overlapping the DNA structure. Inside this box, the words 'COMMON QUESTIONS' are written in a large, white, sans-serif font.

All of the following questions have been pulled from past YJI exams (which can be found on our website) or the Text Exchange on SciOly Wiki

Question 1

- Measure the period of the pendulum



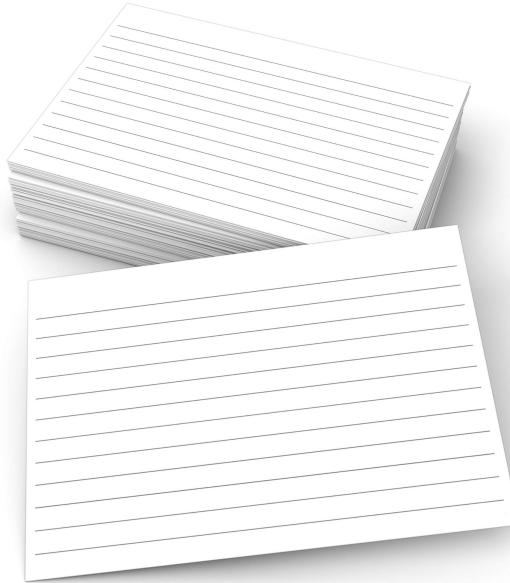
Question 2

- Measure the mass of the Godzilla figure



Question 3

- Area of a notecard in giga meters²



Tips from a Veteran

- Make quizlets to study and test your partner!
 - What are things you need to memorize? (Metric prefixes, formulas)
 - What are things you need to practice? (Getting a feel for estimations)
- Go through “practice rounds” of the event
 - How will you and your partner work together?
 - Could you work more efficiently if one person was responsible for measuring, while the other for doing math?
 - Who will study for which topic?
- Precision is key!

Additional Resources

[Sci Oly Metric
Mastery Wiki](#)

[Metric Units of
Measurement](#)

[Example Metric
Mastery Quizlet](#)

[CueMath Website
on Metric System](#)

[Example Metric
Mastery Exam](#)

[Formulas](#)

THANKS!

