

Metric Mastery

Division B

Georgia Tech Event Workshop Series
2024-25



01

RULES SHEET

02

DIFFICULT TOPICS

03

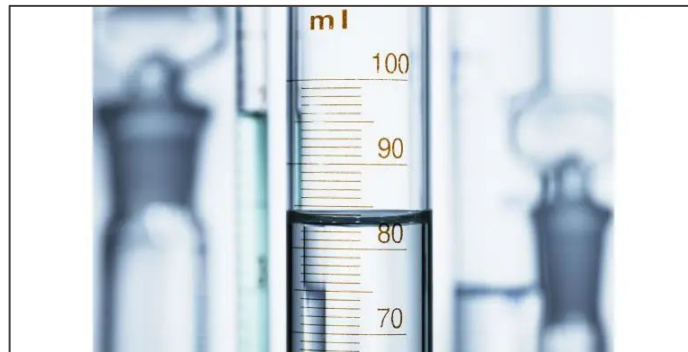
COMMON QUESTIONS

04

TIPS FROM A VETERAN

05

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.



- 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. CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes
- EVENT PARAMETERS:**
 - The event will be divided into 3 sections. Sections One & Three combined will involve estimating and measuring properties of objects at stations.
 - Participants will rotate through 15-25 stations to make their estimations in Section One - Estimation, and then in Section Three - Measurement, they will use measuring devices to measure the same or 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 number of calculated measurements will be based on the level of competition 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.
 - 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.
 - 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.
 - Supervisors must furnish writing implements, paper, and all measuring devices needed for the event.
- THE COMPETITION:** For each part participants will be given an answer sheet to record their answers. Each answer sheet must be turned in prior to the next section or the team will lose their score for that section.
 - 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 the object may be touched; Participants must be allowed to "hold" an object for estimated masses.
 - Section Two - Metric Unit Conversion:**
 - This part must be after the completion of Section One and before beginning Section Three.
 - 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 not be required to convert from one measurement system to another (e.g., metric to standard).
 - Section Three - Measurement:**
 - Recommended time at each station for the Measurement Section is 60 seconds.
 - 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 (if appropriate/analog).
 - To receive points, 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.
- SCORING:** Final high score wins. Final Score = Estimation Score + Measurement Score + Metric Unit Conversion Score.
 - Section 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.
 - Section Two - Metric Unit Conversion:** Answers must be with the correct unit written to receive 5 pts. All other answers receive zero points. **Example:** Convert 14.56 mm to km. Correct answer = 0.0001456 km.




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



- 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. **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 208.5 mm - 209.4 mm would be accepted as correct.
 - 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: $13.45 \text{ cm} \times 22.32 \text{ cm} = 300.20 \text{ cm}^2$. Range: within -0.03: $13.42 \text{ cm} \times 22.29 \text{ cm} = 299.13 \text{ cm}^2$, within +0.03: $13.48 \text{ cm} \times 22.35 \text{ cm} = 301.28 \text{ cm}^2$. Thus any value from 299.13 cm² - 301.28 cm² 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.



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:

- ~~with 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."

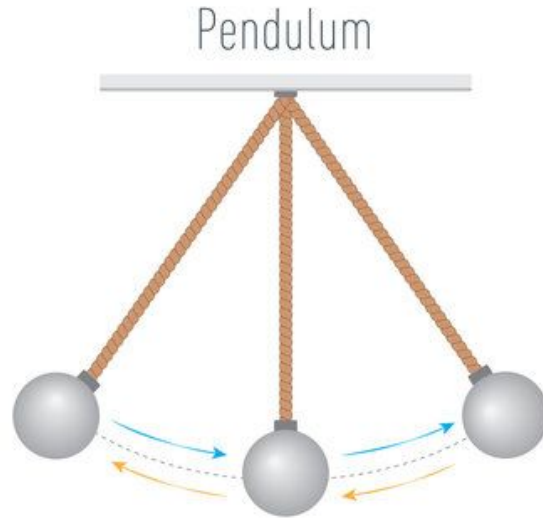


COMMON QUESTIONS

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



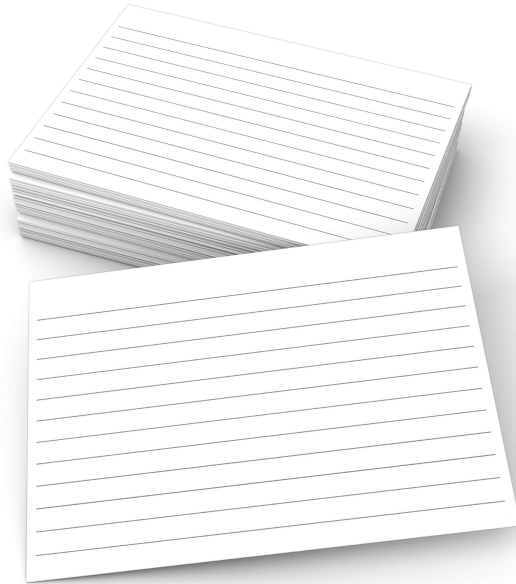
Question 2

- 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](#)

[CueMath Website
on Metric System](#)

[Example Metric
Mastery Quizlet](#)

[Example Metric
Mastery Exam](#)

[Formulas](#)

THANKS!

