

2006 Hammond Coach's Clinic  
October 6, 2006  
October 7, 2006

## Metric Mastery Division B:

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This will usually be a station based event. Students have to estimate the mass, volume, area, force, distance, time or temperature of a unit in about 30 seconds and move on when they are given directions to do so. In the second part, they will have to make measurements quickly and accurately.

### Part One: Estimate

- 30 seconds is recommended for each estimation.
- Students will use a pencil provided by the supervisor.
- Students can not use any tools to help them estimate.
  - Can not use fingernails, watches, knuckles, or anything else to help gauge measurements.
- Use correct units. The supervisor will identify which units to use.
- Follow the correct rotation order.
- Make sure students understand that their first station will not necessarily be number one on their paper. They might be starting at any number.
- No calculators are allowed.
- Quick conversion: if students can estimate mass well but are weak on estimating force, they can divide grams by 100 or multiply kg by 10 to get Newtons. They will automatically be off by 2%; however, if their mass estimate is very accurate, they may still be within 10% of the correct measurement of force.
  
- Score for each estimation:
  - +5 points if within 10% of measured value
  - +3 points if within 20% of measured value
  - +1 points if within 30% of measured value

### Part Two: Measure

- 60 seconds is recommended for each measurement.
- Use correct units. The supervisor will identify which units to use.
- Measure to the precision of the instrument plus one estimated digit.
- Follow the correct rotation order.

- Make sure students understand that their first station will not necessarily be number one on their paper. They might be starting at any number.
  - Students must realize that all graduated cylinders are not the same, nor are all rulers, or any other measurement instrument. They should practice determining what degree of precision to include in their measurements.
  - Students should practice using a variety of measuring instruments.
    - Practice using a vernier scale such as seen on calipers.
    - Practice using a vernier caliper to find internal diameter (ID), outside diameter (OD) and depth.
    - Practice using micrometers.
    - Practice using instruments with a reversed scale such as on some pipettes and burettes.
    - Practice using double pan or Harvard Trip balances.
    - Practice calculating mass by using tare mass.
  - Although we teach students to calibrate instruments before they make measurements, DO NOT ASSUME that is acceptable at competition. Check with supervisor before adjusting any instrument!
  - Evaluate rulers and meter sticks carefully before you begin measurement, if there isn't a true 0, start measurement at 1 and then subtract 1 from the measurement.
  - Score for each measurement:
    - +5 points if within the instrument's range of precision plus one estimated digit.
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Estimation practice game:

<http://teachers.net/lessons/posts/1275.html>

Have students look through science catalogs at pictures of measuring instruments to determine what degree of precision they should use with that instrument. Cut pictures out of old catalogs to make flashcards.

Plastic vernier calipers can be picked up at many hardware stores.

Instrument help online: There are many sites available to learning how to use tools such as a micrometer or a vernier caliper. If you do a google search for vernier scale, you will find many usable sites.

How to use a micrometer:

<http://www.upscale.utoronto.ca/PVB/Harrison/Micrometer/Micrometer.html>

How to read a vernier caliper and micrometer:

<http://www.phy.uct.ac.za/courses/c1lab/vernier1.html>