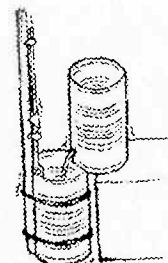


1. **DESCRIPTION:** Students will use a non-electrical device, which they have constructed prior to the tournament, to measure time intervals between 10 and 300 seconds. They will also be asked to answer questions about issues such as the concept of time, timekeeping, astronomy, physics, and mechanics.

A TEAM OF UP TO: 2 EYE PROTECTION: #2 IMPOUND: Yes APPROX. TIME: 50 minutes

2. **EVENT PARAMETERS:**

- a. Students may bring for use during both parts of the competition one 3-ring binder (any size) containing information in any form, from any source (the materials must be 3-hole punched and inserted into the rings, sheet protectors are allowed) and writing utensils.
- b. Students may bring for use only during Part I of the competition items such as stopwatches, water, sand, tools and supplies needed to set up, calibrate, operate, and clean up their device.
- c. Student may bring calculators for use only during Part II of the competition. **Items needed only for Part II of the competition do NOT need to be impounded.**
- d. Students may not bring watches, cell phones, or other time-keeping devices into the competition room (except for those used for the calibration step outlined below). No other resources are allowed.
- e. The event supervisor will provide all formulas, constants, or basic equations needed for Part II, provide scratch paper to the teams and hide from view any clocks present in the competition room.
- f. Eye protection must be worn during Part I, but does NOT need to be impounded.
- g. Devices and all components needed to operate and calibrate the device, including items such as stopwatches, water, sand, tools, and clean-up supplies, must be impounded prior to the beginning of competition. Each team may impound only one device that will be used for all time trials.
- h. The impounded device should be clearly marked with the team school name and competition number. Any storage box for tools or individual items must be marked.



3. **CONSTRUCTION:**

- a. Prior to competition students are to build their own device. Some examples of acceptable devices include water or sand glasses, simple or torsional pendulums, or oscillating springs.
- b. Commercial counters, timepieces or parts of either are not allowed. **Commercial balances / scales / test tubes / beakers / graduated cylinders / etc. are not considered counters and are allowed.**
- c. The device may NOT utilize any electrical components or chemical reactions in order to operate **except for a battery-operated electronic balance or scale used solely to determine mass.**
- d. The device must be constructed to contain spillage.
- e. At impound, the device and all components must be able to fit into an 80cm cube (except for clean-up supplies, tools, stopwatch, etc.) and be able to be moved by the competing team members without outside assistance. **The device may become larger than an 80cm cube once setup for Part I.**
- f. **Devices must be constructed to minimize possible impacts on other teams when running (e.g., as quiet as possible, occupies a reasonable amount of space when setup, etc.).**

4. **COMPETITION:**

Part I:

- a. The event supervisor will pre-select a different target time (as described under SCORING) for each of 5 Time Trials. The same times will be used for all teams. Teams will not be informed of the selected intervals. **Time Trials will run in the order listed under the SCORING section.**

- b. Teams will be given five minutes to setup and calibrate their device against a stopwatch or other timing device (provided by the students). All timing devices used for this calibration must then be impounded with the event supervisor prior to the start of the timing trials.
- c. Prior to the start of each Time Trial the event supervisor will give the teams a short verbal notification that the trial is about to start.
- d. To prevent human error, the event supervisor will use a timing device that produces a tone or sound indicating the starting and stopping points. A stopwatch is not acceptable for this task. A computer with a program that can produce a beep at the start and end of a given time, or a prerecorded audio file that contains two beeps with a given time interval and is played to the teams is suggested. **Such audio files are available on the National Science Olympiad website for all possible time intervals.**
- e. Teams will then have at least one minute to **determine / calculate /** record the time from their device (to the nearest 0.1 second) and prepare for the next time trial.
- f. **Teams are allowed to interact with their devices during and between the time trials if so desired**

Part II:

- g. Teams will be given a set amount of time (20-30 minutes is suggested) to complete a written test
- h. Questions may be multiple choice, true-false, completion, or problem solving calculation type.

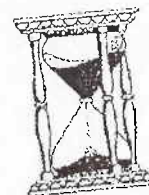
4. SAMPLE QUESTIONS:

- a. If the time in New York City is 9:30 AM EDT on June 21st, **2009** what is the sidereal time?
- b. What is the longitudinal time difference between St. Louis, Mo. (longitude 90° W approx.) and Kansas City, Mo. (longitude 94° W approx.) if 15° longitude = 1 hour i.) no difference, ii.) 4 minutes, iii.) 16 minutes, iv.) 20 minutes, v.) none of these.
- c. A pendulum has a period of 1.5 seconds. If we take the period of a simple pendulum to be $2\pi\sqrt{L/g}$ and the gravitational field strength at a given location is 980 cm/sec², what is the length of the pendulum?

5. SCORING

- a. Teams will start with 10 points per Time Trial (for a total of 50 possible points for Part I).
- b. Penalty points will be deducted from the initial 10 points as described below. The score for a trial can NOT be less than zero. There will be no carry-over of penalty points between trials. The trial interval ranges and penalty points are:

| Time Trial # | Time Interval Range | Points Deducted / ± 0.1 sec error |
|--------------|---------------------|---------------------------------------|
| Trial 1 | 10 to 30 sec | 0.4pts per 0.1 sec |
| Trial 2 | 30 to 90 sec | 0.3pts per 0.1 sec |
| Trial 3 | 90 to 180 sec | 0.2pts per 0.1 sec |
| Trial 4 | 180 to 300 sec | 0.1pts per 0.1 sec |
| Trial 5 | any of the above | 0.1pts per 0.1 sec |



- c. The Part II written test will be worth a total of 50 points.
- d. The total of the scores from Part I and Part II, minus any penalties, will determine the winner (which is the highest scoring team).
- e. Event supervisors may disqualify any device that is operated in an unsafe manner or does not comply with the rules, resulting in 0 points for Part I.
- f. If any material or substance splashes, spills or falls on a table or floor the team will be assessed a penalty of up to 10 points. A penalty of 15 points will be deducted from the total score if a team does not completely clean up after their competition period. The event supervisor will make every effort to inform the team of such a situation and give them an opportunity to correct it prior to assessing the penalty.
- g. Ties will be broken first by the highest score from Time Trial 5, with the second tiebreaker on a designated question from the Part II test. The event supervisor will announce further tiebreakers prior to the competition.