Trial/Pilot Event

Contact the organizers of your tournament to find out what trial/pilot events will be held.

KEEP THE HEAT

DESCRIPTION: Teams will construct an insulated structure prior to the tournament, hereafter called the device, which will fit **within** a **20** cm cube. The **purpose of the device is to minimize** the heat **transfer from** approximately 100 ml of water in a standard, unaltered **aluminum beverage can** (supplied by students) **within the device to the ambient room.**

A TEAM OF UP TO: 2 APPROXIMATE TIME: 45 minutes

THE COMPETITION: 1. The **judges will inspect, weigh, and impound the complete** device a minimum of one hour before the **start of the first round of the competition. The device must meet the requirements stated herein by the close of the weigh-in period in order to compete. The inside of the device must contain a standard empty unaltered 355 ml aluminum soft drink can, completely intact except for the pull ring and tab. The accepted standard dimensions of the soft drink can are 65 mm diameter and 125 mm high. The main portion of the top closure must be intact on the can. The can must be in its original shape; it cannot be cut, crushed, bent, or otherwise deformed.** The **soft drink can** must be removable from the device, and **the construction of the device must allow** easy loading, rapid temperature measurement of the water sample at the end of the **cool down** period**, and water removal when the competition is over**. **All** fiberglass **insulation** must be **completely** covered. **The device must allow for measuring the water temperature by the means the judges select. At least one student from the competing team must be present during the entire testing including the weigh-in, loading, cooling, temperature measurement, and emptying of the device.**

2. At the designated competition time, the judges will add approximately 100 ml of heated water to each of the devices at approximately 30 second intervals. The heated water will come from a constant temperature source.

3. At the end of a 20 to 30 minute time period, **as** determined by the judges, **the judges will measure and record** the temperature of the water in the device **in degrees Celsius,** in the same order in which they were loaded at approximately thirty-second intervals. The devices may be opened or not, depending on the method the judges **use to measure temperatures**. **The** judges will supply the **temperature measuring device, such as a** digital **thermometer** or a thermocouple.

4. Prior to the tournament, **the team** will develop a set of temperature vs. cooling time curves **to predict the temperature loss of the device. The curves must show, for starting water** temperatures in the range of 50oC-90oC**, and time up to 30 minutes.** These curves will be used by the students to predict **at weigh-in, the ending water temperature based on the starting water temperature and the cooling time the judges establish for the competition.**

5. The event **supervisor will** give a short quiz on heat and temperature **or engage students in some other structured activity** during the time the devices are under test. The quiz scores may be used to reduce the score by up to 10%. Questions could include temperature conversions; definitions of heat units, thermal conductivity, heat capacity and/or specific heat; or simple calculations of heat capacity and/or specific heat. Teams should be notified in advance of the range of questions if different than the above.

SCORING: 1. The team with the lowest score wins. The judges will score the devices based on the formula:

SCORE = [(**20** x ΔT) + (mass of device in grams) + (5 x $\Delta T_{prediction}$)] x [1 - (0.1x(quiz score if used)]

WHERE: ΔT = | Final water temperature **minus** the initial water temperature |

$\Delta T_{prediction}$ = | Actual final temperature minus the predicted final temperature |

Example: **if** the mass of device = **150** grams, the water temperature change ΔT = **25**oC and $\Delta T_{prediction}$= 1.5oC, then the

Score is: = [(**20x25**oC) + **150** grams + (5 x 1.5oC)] = [500 + 150 + 7.5] = 657.5

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If a quiz score of 80% were included: Score = [657.5][1- (0.1 x .80)] =[657.5][0.92] = 604.9

2. **The judges will rank the scores of the device in ascending order, awarding least score the maximum competition points.** In case of ties, the device with the smallest ΔT will **rank before the larger ΔT**. The second tie breaker will be the smallest ΔTprediction.

3. The winning devices will be **inspected at the end of the competition period** to assure that **the competing team did not use another** source of energy other than the hot water. If accurate instrumentation and data collection is available, the judges may correct the heat loss values for variations in cooling time, water start temperature, and/or room ambient temperature over the course of the competition.

Keep the Heat NOTES TO JUDGES:

Large coffee makers do not maintain a constant temperature, although they do make good container for the hot water, as long as some other method is available to assure that the water temperature is constant for all devices. to minimize heat loss between the filling of the graduated cylinder and the pouring of the water into the device, have several graduated cylinders available, and fill them and store filled cylinders in the hot water source. Warm the cylinders to the source temperature by filling them several times and pouring the water back into the source. Nylon or polypropylene are a good choice over glass since the thermal conductivity is less, resulting in less heat losses from the time the filled cylinder is removed from the source until the water is poured in the device.

Note the accuracy of the temperature measuring equipment. If the equipment only reads to, say, 0.3, this is equivalent to 6 points in the raw score.

Have alternate methods immediately available in case of failure of the primary timing and temperature measuring devices.

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