2018 SCIENCE OLYMPIAD HOVERCRAFT EVENT

DESCRIPTION

- Focus of the event is on classical mechanics and related topics. Teams will construct a self-propelled air-levitated vehicle that moves down a track.

- Team Members: 2
- Eye Protections: B
- Impound: Yes
- Approx. Event Time: 50 minutes

EVENT PARAMETERS

What to Bring:

- 3-Ring binder with all forms, and information sources which were used in the project. (Information may be removed during the written portion of the event, so bring something to stash notes in during the exam portion).
- Writing utensils, preferably the type that erase, two calculators of anytime fit for computations for use during the event.
- Eye Protection. This will be used in the second half of the event. Both team members will need it, so please bring two.
- The vehicle--with all or any graphs/tables, must be labeled with the team name and tournament specific number—must be "impounded" (boxed). (Tools, supplies, and 3-ring binders do not need to be impounded).
    - **The box you use for impounding must be 40 cubic centimeters (40 cm wide, 40 cm long, 40 cm tall/deep). BONUS POINTS are awarded to teams that impound their own vehicle in an appropriately sized (40 cubic cm) box.**

PARAMETERS CONT.

- **BEFORE the competition**, teams must calibrate their device by preparing graphs and/or tables showing the relationship between time and distance for various device configurations. A labeled device picture or diagram should be included.
  - Any number of graphs and/or data tables may be submitted but the team must indicate up to four to be used for the Chart Score, otherwise the first four provided are scored. (TIP: The little details count the most, so make sure your tables and charts are snazzy!)
  - Graphs and/or tables may be computer generated or drawn by hand on graph paper. Each must be on a separate sheet of paper. A template is available at www.soinc.org.
  - Teams are encouraged to have a duplicate set to use as those submitted may not be returned. (Tip: Make copies ahead of time, facilities for copies at the event cannot be gauranteed).

CONSTRUCTION

- Materials: Any
- Mass: Any
- Size: Any size that fits within a 40cmx40cmx40cm box while levitated and with any inflated skirt. (See the impounding instructions on slide 3).
  - The vehicle must levitate on a cushion of air as it moves down the track. Participants may be asked to demonstrate levitation by pushing the vehicle slightly down. If it then rises, it is levitating. Continuous contact of the inflated skirt with the base surface, occasional contact of other vehicle components with the base surface, or **any contact** with the inside edge of the side rails is permitted.

CONSTRUCTION, CONT.

- The vehicle may have up to two motors each rotating one **propeller/impeller. All propellers/impellers, including under the device,** must have shielding **which prevents a 3/8" dowel from touching them.**
- **For timing purposes,** the vehicle must have a 1/4" or larger dowel vertically attached within 5.0 cm of its front edge such that the top end is **at least 20.0 cm** above the lowest vehicle surface.
- **The vehicle may carry a mass consisting of up to 16 standard, unopened rolls of U.S. pennies provided by the event supervisor (50 pennies per roll, mass ≅ 125 g; 16 rolls ≅ 2 kg).**

CONSTRUCTION, CONT.

- Commercial batteries, **including rechargeable**, not exceeding 9.0 V as labeled, may be used to energize the motors on the vehicle. Multiple batteries may be connected together as long as the expected voltage across any points does not exceed 9.0 V as calculated by their labels. The vehicle must not have any other energy sources. **Batteries containing lithium or lead are prohibited. Battery use must follow the Battery Policy.**
- **Electrical components shall be limited to batteries, wires, motors, switches, resistors, potentiometers, capacitors, mechanical relays, fans, and blowers.** Brushless motors and integrated circuits are **not permitted unless they are an integral part of or embedded into commercially available fans used for cooling electronics or computers.**
- Vehicles must have a switch to permit safe starting. **Relying on inserting batteries or twisting wires together to start is not allowed. A stopping system is recommended.**

CONSTRUCTION TIPS:

- Watch as many tutorials with your teams as necessary to put a picture to the above specification.
- Examples:
  - https://www.youtube.com/watch?v=7mpH_Vn4aGM
  - https://www.youtube.com/watch?v=4_0V88akJJM

COMPETITION: WRITTEN TEST PORTION

- Timed test of 20 minutes
- Mult. Choice, True/False, and Calculation questions/problems.
- The**writtentestwill**consistofatleastfivequestionsfromeachofthefollowingareas:
- i. Newton's Laws of Motion: inertia, force, impulse, action-reaction
  ii. Kinematics: projectile velocity, speed, acceleration, position
  iii. Kinetic energy: calculation, momentum, non-relativistic
  iv. ***Division C only - Fluid mechanics: density, buoyancy, viscosity, Bernoulli's principle, Pascal's law***
- c. Unless otherwise requested, answers must be in metric units with appropriate significant figures.

Your team will need to be able to answer questions regarding design, operation, and construction of the vehicle, per the Building Policy found here.

COMPETITION: VEHICLE TESTING PORTION

The Basics:

- Teams have a total of 8 minutes to adjust and repair their vehicle and make 5 failed or 2 successful runs; whichever comes first. Supervisors will give a warning at 7 minutes. **Practice runs are not allowed.**
- A failed run occurs if a vehicle does not meet construction specifications when timing for that run starts, fails to move for 3 seconds at any time, fails to cross the finish line within **45 seconds**, or any part of the vehicle, **including pennies**, falls off. **Teams are not allowed to declare a run a failed run.**
- A run will count as long as it is started before the 8-minute period has elapsed.

COMPETITION: VEHICLE TESTING, CONT.

DIVISION B

- Distance: Fixed @ 165cm +\- 5cm
- Target time: 15.0 seconds
- Load: 0-16 Rolls of Pennies*

DIVISION C

- Distance: Variable between 165-260 cm (The distance specified at time of contest and will be constant for all teams).
- Target Time: 15 Seconds
- Load: 0-16 Rolls of Pennies*

*Pennies are provided by event manager. **The rolls of pennies must be placed on the vehicle so that they may not fall off during a run. The number of rolls used may be changed between runs. Participants are not allowed to unroll, break, or alter the packaging of the pennies nor are they allowed to use any adhesives (e.g.; glue, tape) to affix the penny rolls to the vehicle.**

COMPETITION: VEHICLE TESTING, CONT.

- To begin a run, a team will place their vehicle, **including the penny load**, on the track at the start line **against the wood block placed by the supervisor.* A team then activates their vehicle's motor(s).**
- The team will give a countdown of "3, 2, 1, launch"; then the supervisor **will remove the wood block.***
- Timing **starts** when the vehicle's dowel crosses the start line and **stops** when it crosses the finish line.
- The team must not touch a vehicle **after the dowel crosses the starting line** until **it** passes the finish line or the supervisor declares a failed run**. If touched, the run is successful with a TS and a MS of 0.**
- The supervisor will review with the team the Part II data recorded on their scoresheet.
- **A team** filing an appeal regarding Part II must leave their vehicle in the competition area.

*This year's track will be on display at the workshop on Saturday, and may be somewhat different that described here as the goal is to automate the track with gates instead of wooden blocks and laser tracking at the finish line to get more exact times.

SCORING

- Final Score (FS) = **best run** MS + best run TS + ES **+ CS + IB;** maximum FS = 100. High score wins. **The MS and TS may come from different successful runs.**

  Division B Scoring Rubric

  Division C Scoring Rubric

SCORING, CONT.

- Mass Score (MS) = **(# of penny rolls/maximum # of penny rolls used in a successful run across ALL teams)** x **21** points.
- Time Score (TS) = **21 - (0.7)(abs(runtime - 15))** points. The smallest possible TS is 0.
- ExamScore(ES):(Part I score/Highest Part I score for all teams)x**45**points.
- **One of the submitted graphs and/or tables, selected by the event supervisor, must be scored as follows for the Chart Score (CS, max of 10 points). Partial credit may be given.**
  - **2 points for including data spanning at least one variable range (e.g. distance, load)2 points for including at least 10 data points**
  - **2 points for proper labeling (e.g. title, team name, units)**
  - **0.5 points for each graph or table turned in (up to 2 points total as long as they are not the same)**
  - **2 points for a labeled device picture or diagram**

Impound Bonus (IB) = 3 points if vehicle is impounded in a box labeled with team name & number.

SCORING, CONT.

- Teams without successful runs or disqualified for unsafe operation receive a TS and MS of 0. Teams still compete in Part I.
- The number of penny rolls must be multiplied by 0.7 when calculating the MS if any CONSTRUCTION violation(s) are corrected during the Part II testing period or if the team misses impound.
- **A team violating any COMPETITION rules during a successful run will have their TS multiplied by**
- **0.9 when calculating the Final Score.** Rule violations during failed runs do not result in this penalty.

Tie Breakers: 1st - Best ES; 2nd - Best MS; 3rd - Best other successful run TS; 4th - specific test questions.

RECOMMENDED RESOURCES

The Science Olympiad Store (store.soinc.org) carries the Hovercraft Video and Chem/Phy Science CD; other resources are on the event page at soinc.org

Google "Hovercraft Science Olympiad" and watch some of the examples and tutorials for hovercrafts used in competition.

Come to the workshop on Saturday where teams may come and attempt to build their crafts and use the tracks to test them!

Location: South Lake High School

Hovercraft B/C: 12:30-3PM