THE THIRTIETH-FIRST UBC PHYSICS OLYMPICS RULE BOOK

March 7, 2009

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The UBC Physics Olympics is organized by the Department of Physics and Astronomy with assistance from the Department of Curriculum & Pedagogy (Science Education).

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General Rules

Each school may enter one team of students, which participates in all 6 events. A team may have a maximum of 10 registered students, of which at most 5 participate in a given event. Events are designed so undersized teams are not penalized. Each event is run in 6 heats lasting about 1 hour each, with approximately 10 schools participating in each heat. There is a break for lunch (not provided, but the Student Union Building is across the street from Hennings). Gold, Silver, and Bronze medals will be awarded to the members of the top teams in each event. A trophy will be awarded to the school sponsoring the team with the best combined score.

The combined score of a team is the sum of their decibel scores in the 6 events. The schools are sorted by score in each event, and the decibel score of each school is $\mathrm{dB} = 10 \times \log_{10}(\mathrm{rank})$. Thus a first place ranking in an event is 0 dB, second is 3.01 dB, fifth is 6.99 dB, tenth is 10 dB, twentieth is 13.01 dB. The overall winner is the school with the lowest total decibels.

Interpretation of Rules

Normal physical interpretations will be applied to all the terminology used in defining the challenges. Those solutions which, in the opinion of the event judges, do not comply with the spirit and intent of the challenge will be disqualified from the event (and thus ranked last). The ruling of the event judges is final.

Pre-Built Events

There are two events which require teams to design and build structures before the event. It is the responsibility of each team to package their structure for transportation to the competition without damage. Pre-built structures will be checked in on arrival and safely stored until required for a heat. Modifications are not allowed after arrival, except repairs for damage in transit.

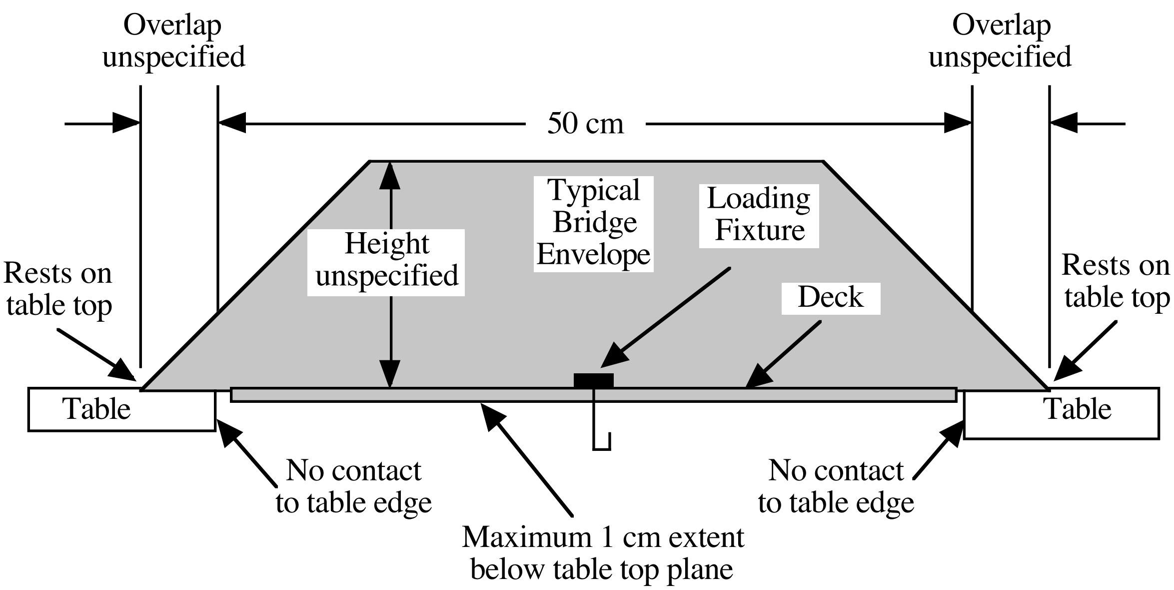
The pre-built events are intended to be learning experiences for the students, so we ask that team coaches resist the urge to overly involve themselves in the design and construction.

Winning solutions will typically push up against the limits of the rules, but violating the rules will result in disqualification. To avoid this disappointment, teams are encouraged to contact the Physics Olympics organizers at any time for a preliminary evaluation about whether their design is within the rules. However, the ruling of the event judge about the legality of a pre-built structure at the time of the competition is final, and overrides any preliminary evaluation.

Please direct inquiries about the rules to Prof. Thomas Mattison, preferably by email to mattison@physics.ubc.ca or telephone 604-882-9690 (day) 604-224-3049 (evening).

White Bridge

Design and build the lightest bridge with a horizontal free span of 50 cm that can support a load of 5 kg at mid-span, using only white paper, cotton string/thread, and water-based glue



No wood, metal, plastic, cloth, fiberglass, carbon-fiber, nylon, kevlar, or other material except 20 lb white copier paper, white cotton string or thread, or white or clear water-based glue (e.g. Elmer's) may be used. To facilitate inspection of materials, the bridge may not be painted or decorated.

The bridge must contact only the top surfaces of the support tables on either side, and apply only vertical forces. The bridge may not be anchored to either support table except by gravity. The bridge may not contact any other surface of the support tables, or the floor, ceiling, walls, or other object. Note that the total length of the bridge will necessarily be more than 50 cm. The deck must have a 1 cm diameter hole in the center at mid-span for the loading fixture that we supply, which is a 5 cm by 5 cm block with a hook underneath. To facilitate the load test, the bridge structure must not extend more than 1 cm below the plane of the support tables.

The bridge must have a continuous horizontal deck at least 5 cm wide, able to support a 5 cm wide, 5 cm long, 2 cm tall aluminum deck-verification block (135 grams) pulled slowly across the 50 cm span by a string. Note that the deck may require side walls to guide the verification block.

You will first pull the deck-verification block slowly from one support table to the other with a string (the bridge may be anchored manually at one end during this test). You will then insert the loading fixture that we supply into the deck and attach test weights that we supply. A weight must be supported for 60 seconds with a deflection of less than 1 cm. The first test weight will be 2 kg (including loading fixture), and the second test weight will be 5 kg (including loading fixture). A total of 5 minutes is allowed for deck verification and load testing.

The ranking is: bridges that support 5 kg (lightest first), bridges that support 2 kg (lightest first), bridges that pass only deck verification (lightest first), and all other bridges (lightest first).

Efficient Electromagnet

Design and build a battery-powered electromagnet, and a weight for it to support, with the largest ratio of weight supported to weight of the electromagnet (including the batteries, holder, and switch).

For scoring, the electromagnet will be placed on top of a 1.2 mm thick horizontal plastic sheet (the thickness of a CD). The weight will be put in contact with the plastic sheet from below. No direct mechanical or electrical contact between the magnet and weight is allowed. The weight must be supported for 10 seconds, then released by turning off the electromagnet. Three trials with different amounts of weight may be attempted, and batteries may be changed between trials. A total of 5 minutes is allowed for setup and all trials. The score will be the ratio of largest weight supported to weight of electromagnet plus batteries.

The electromagnet, battery holder, and weight must be designed and built by the students, not purchased as a unit or kit. The construction and/or decoration of the electromagnet, battery holder, and weight must allow inspection to ensure that the rules have been followed. The electromagnet and weight must fit within a cylinder of diameter 100 mm. The length of the weight (including any added weights) must be less than 50 cm. The magnet, battery, and weight combined may be at most 5 kg. No permanent magnetic materials (except for unavoidable remnant magnetization) may be employed in either the electromagnet or the weight. Power must be provided exclusively by AAA, AA, C, or D size non-rechargable consumer-labelled alkaline flashlight batteries. Total voltage must be less than 30 volts. Lithium, nickel-cadmium, or nickel-metal-hydride batteries may not be used, from any source. No parts of the magnet or batteries may exceed a temperature of 50°C at any time during or after a 10 second run. Caution and a fire extinguisher is recommended during testing!

Mystery Event

Teams will solve a problem using knowledge of physics principles, logic, and/or experiment. Details of the problem and scoring scheme will be announced at the time of competition. To preserve the mystery, the heats are closed to all except participants.

Experimental Triathlon

Teams attempt 3 challenges, in which they answer a multiple-choice question that requires an experimental measurement. The winning team is the one that answers the questions in the least total time, with a 300 second penalty for each incorrect answer.

Unreal Physics

This event will require the team to operate a computer simulation based on principles of physics. It may require design and simulated construction of a configuration of components that satisfies some design criterion within some constraints. It may require performing some task in a simulated situation in real time for the highest score or fastest time. It may require ... nearly anything! After all, it's unreal!

Quizzics!

Team members will work together to answer questions about physics and astronomy. Questions may involve famous scientists, history of science, mechanics, waves, electricity and magnetism, fluids, and “modern” physics. Some questions may involve short calculations.

All teams will participate in the preliminary Quizzics! heats. Questions are in multiple-choice format and each team will answer using an electronic “clicker.” Consultation between team members is allowed. The same questions will be used in each preliminary heat, so these heats are closed to all except participants. The three teams with the highest scores in the preliminary heats will meet in the public medal-round of Final Quizzics!

In Final Quizzics! the first person to buzz gets to answer for her team without consultation. An incorrect answer (or failing to promptly answer after buzzing) loses 5 team points, and allows the next team to buzz a chance to answer the same question (also without consultation). Correct answers score 5 team points, and a chance for the team to answer a 10 point bonus question (with 1 minute for consultation).