THE SIXTEENTH

UBC PHYSICS OLYMPICS

RULE BOOK

FEBRARY 27, 1993

Financial sponsorship is provided by the Rex Boughton Memorial Fund.

The UBC Physics Olympics is organized by the Department of Mathematics and Science Education and the Department of Physics

.

In the Spirit of Physics

The wording of each challenge in this year's rule book has been carefully prepared to define each task as precisely as possible. It is expected that all participants will produce solutions which comply with the task **as defined.** Normal physical interpretations will be applied to all the terminology used in defining the tasks. **Those solutions which, in the opinion of the judges, do not comply with the spirit and intent of the**

challenge, will be disqualified. General questions regarding the challenges may be directed to the coordinators of the Olympics. The coordinators will accept inquiries which may help them to prepare for unusually good solutions to the problem which may require special room conditions and/or measurement equipment.

General Rules

Each school may enter one official team made up of a maximum of five members. If space permits, each school may enter one additional, unofficial team in all events. Gold, silver and bronze medals will be awarded to the official teams scoring the highest, second highest and third highest aggregate scores. Both official and unofficial teams are eligible for these medals. In addition, gold, silver and bronze medals will be awarded to the official teams scoring the highest, second highest and third highest aggregate scores. The official teams must be designated at registration. **All teams must enter all events.** The events are scheduled so that it is possible for all teams to enter all events. All ties will be broken. A trophy will be awarded to the school sponsoring the official team achieving the highest aggregate score. Points scored by unofficial teams will not be included in the school championship aggregate.

TWO of the events require a pre-built structure. These entries must be checked in at the time of registration on the morning of the competition at which time they will be stored in a safe place until the time of the event.

Our Special Thanks to the Event Designers:

Hugh Thompson, Fayaz Khaki, Isaac Leung, Don Witt, Troy Millington, Doug Theissen, Gary Lim

and to

Dr. Brian Turrell, Head UBC Department of Physics and all students of the Physics and Physics Engineering program who assisted in this Physics Olympics**.**

Back to Olympics

The Amazing Electrical Circuit

This event will require teams to race to solve an electrical maze.

Materials: The following equipment will be provided: digital multimeters paper ruler

Rules:

1. Contestants are not allowed to bring or use any other materials or equipment than those provided with the exception of pens or pencils for writing.

2. Teams will be given a fixed circuit consisting of a DC power supply, a light emitting diode and some or all of the following components: resistors, capacitors, switches and diodes. The components may not necessarily be visually identifiable to the contestants; it may be necessary to identify them using their properties and the provided equipment. Recall that a diode is a component which allows the passage of current in only one direction. It is represented in a circuit diagram by where the arrow indicates the allowed direction. A capacitor is a charge storage device

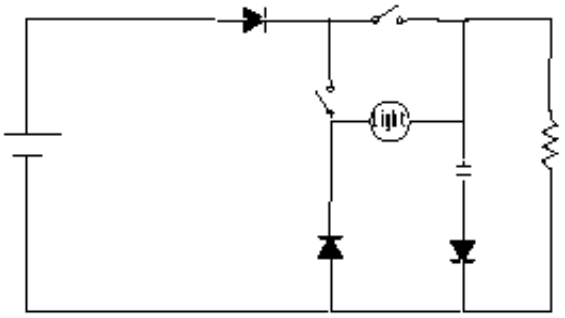
with the property that it does not allow the passage of DC current. It is represented in a circuit diagram by . A switch is a device that allows current to pass in both directions when closed, and does not allow current to pass when open. It is represented by . A resistor changes the voltage across itself according to Ohm's law and is represented by . Finally, a DC power supply is represented by where the current flows from the negative to positive plate and larger plate is positive.

3. Each team will be expected to find a path through the circuit that will successfully cause the light emitting diode to go on. This path will be made by opening and closing switches.

4. Each team will also be expected to draw a circuit diagram of the entire maze. These diagrams will be turned in when the team has successfully solved the maze and will be used in the scoring.

5. Each team will be awarded a time based on the time that their circuit diagram is turned in to the event organizers. The winners of the event will be determined by the least time taken in finding a correct solution to the maze that passes through the least number of components.

6. In the unlikely event of a tie, the clarity and completeness of the circuit diagram will be a deciding factor in determining a winner.



An example of a simple maze

Paper Boat Race

The object of this event is to build a paper sailboat that will sail the racecourse described below in the fastest possible time carrying the largest cargo of loonies.

Materials: The contestants will be required to bring the following three supplies:

1. A stapler with staples.

2. A supply of one dollar Canadian coins as needed.

3. Scissors.

The event organizers will be provided each team with exactly three 8.5 x 11in. sheets of paper. Also, everyone will be provided with access to a small testing tank with water to balance their boat before the race. Please, note that you will only be allowed to use the paper that is given to you by the event organizers. Since you will receive only three sheets of paper it is highly recommended that you practice before coming to the Olympics and bring a "blueprint".

Rules for construction of boat:

1. The boat must be constructed during a 10 minute period during the beginning of the event from no more than three 8.5 by 11 sheets of paper and staples. This paper will be 20 lb. long grain white copy paper of type typically used in copiers and will be provided by event organizers. An unlimited number of staples are allowed. The paper may be cut into any shape and as many pieces as desired. Contestants may bring a "blueprint" of their boat design to aid in the construction, but no piece of the blueprint may be incorporated into the boat itself.

2. The boat must not be longer than 9 inches and must have a sail that reaches a minimum height of 4 inches above the water line. The profile of the sail must be at least 1 inch wide at the height of 4 inches to ensure triggering of the timer.

3. The boat must be designed so that it will carry at least two Canadian one dollar coins (loonies). These loonies must be in normal circulating condition; i.e. loonies with holes in them or otherwise modified to make them lighter then their mint issue weight will be disallowed. All loonies used must be supplied by the contestants. As scoring will be based on a combination of the number of loonies carried and time, contestants may wish to design their boats to carry more than two loonies.

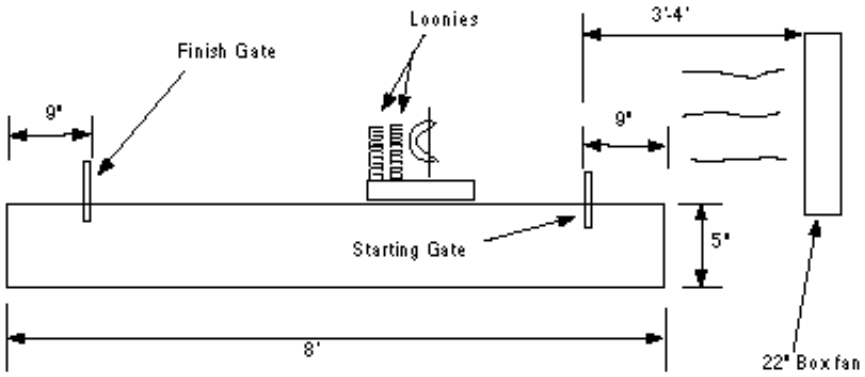
Racecourse: The course will consist of an 8 foot long by 3 foot wide by 5 inch deep trough filled with water. The starting gate will be placed 9 inches from one end of the trough and the finish gate will be placed 9 inches from the other end of the trough. There will be a source of wind power provided; it will be produced by a standard 22 inch by 22 inch box fan on low setting. The fan will be placed 3 to 4 feet away from the starting end of the trough.

Rules: For racing and scoring:

4. The back end of the boat will be placed against the end of the trough nearest to the starting gate and released by a member of the school team.

5. The timer will start when the sail crosses the starting gate and stop when the sail crosses the finish gate. The score will be proportional to this time.

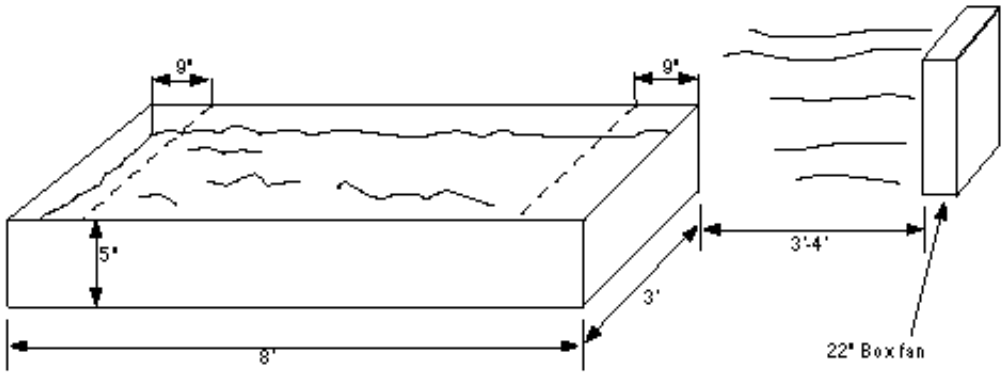
6. The boats are allowed to hit the sides of the trough and will not be disqualified if they take on water, assuming that they finish.



Side view of trough

7. The score will be computed by the formula t - (n-2)/4 where t is the time in seconds and n is the number of loonies transported by the boat across the finish line. After the race, contestants may fish any of their loonies lost overboard out of the trough.

8. Should there be a tie for best score, another set of time trials will be run to break the tie. The judge's decisions will be final.



Perspective view of trough

Mystery Event

This event will involve solving a simple experimentally oriented problem or problems using logic and knowledge of basic principles of physics.

Springy Thingy

The goal of this event is to determine the spring constant of one of the two springs provided.

Materials:

- 2 springs
- 1 simple massive object (for example a steel ball)

- 1 bolt
- 2 nuts
- 1 washer
- 1 ruler
- 1 tubular object (not that its cross section may not be circular)
- 1 Magical Sheet of Information several mystery items

Using the above items, it*is* possible to determine the spring constant for one of the springs! You may find the following information helpful:

1. This is not an impossible exercise. The Magical Sheet of Information will be very helpful. So don't despair if you do not know how to solve it before you get to the event.

2. You will be allowed to bring a non-scientific calculator. Don't try to be sneaky, or we just might exercise the right to disqualify your calculator!

3. You may bring in as much blank paper and as many pencils and pens as you wish.

4. Your score will be based on your method of finding the spring constant and on the correctness of your answer. In case you finish quickly, there may also be bonus questions which may increase your score.

5. The invigilators are a really fun bunch of people, so don't be afraid to ask questions.

6. Since this event has to do with springs, the equations of motion to know are obvious. However, it wouldn't hurt to review other equations of motion.

And just to make life hard for you, here is a bonus hint: *You are sitting in a dark room, panting from your running. You're darn out of shape. holding the lamp close to your eyes, you carefully look it over. You notice a dark stain on the lamp, smelling suspiciously like A&W Cream Soda. You pull up you purple, long sleeved (size Medium) shirt and rub the stain off. As you rub it, I suddenly appear from the lamp. "Aha!" I cry, " You have released the Invigilator of the Physics Olympics. OOOH! Just wait and see what goodies I have for you!*"

Wind Powered Crane

This event is a pre-built. Contestants will build a wind powered crane which will lift a mass. The only source of power for the lifting of the mass will be provided by a fan. Any materials can be used to constructed the crane: some suggested materials are popsicle sticks, balsa wood, cardboard, monofila-ment fishing line and paper.

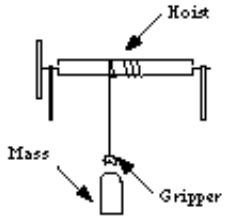
Apparatus:

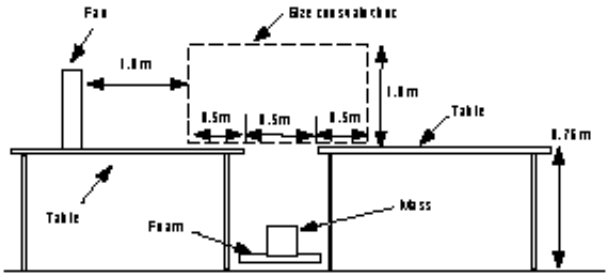
1. The crane must be pre-built and checked in upon registration.

2. Before you start to set up your crane for the event, you must present the judge with a diagram of your crane which clearly labels all of its parts. Namely, the diagram must explicitly label the hoist, the gripper, and the mass as shown in the diagram to the right. The definitions of these parts are as follows:

- The crane is your whole machine.
- The mass is the object which your crane lifts and drops.

- The hoist is the lifting part of your crane.
- The gripper is the device which holds the mass during the lift and drops the mass. It will be attached to the hoist.





3. Everyone one will provide all three parts of the crane. Specifically note that everyone will provide their own mass. This mass can be constructed out any material or can be standard lab weights. It can be any shape so long as it fits in a box of dimension 20cm x 20cm x 20cm. You should bring several different masses so that you can try a lighter lift if your first one fails. Mass

4. The maximum size of the hoist is such that the part above the table will fit in a box of dimension 1.0m high x 1.5m wide x 1.0m deep as indicated in the diagram.

Rules:

5. The set-up for the event is illustrated in the diagram below. Please note that the table is only approximately 60cm wide even though the allowed width of the crane is 1.0m.

6. A wind will be provided by a 60cm by 60cm box fan set on high. The running time of the fan will be controlled by an automatic timer set at 1.0 minute.

7. The fan will be a minimum distance of 1.0m from the crane and will be 1.5m from the end of the table as indicated in the testing configuration diagram.

8. Only the power of the fan can be used for lifting. No other power sources or forms of energy can be used to lift the mass. However, note that other forms of energy such as potential energy may be utilized by the gripper.

9. Each team will be allowed two trials. A trial consist of a lift and a drop. Each trial can take no longer than of 1 minute. In each trial, different masses may be used. Teams will be given a total time of 10 minutes to set up and run the two trials.

10.The crane will start with the mass sitting on a foam crash pad and the gripper attached to the mass. The crane must lift the mass a minimum of 38cm as measured from the bottom of the mass to foam pad **and then drop it**. *It is important to note that no external intervention is allowed to control the crane nor is anyone allowed to touch the crane once a trial starts.*

11. The gripper is not counted as part of the mass lifted and must not be dropped.

12. The score will be given by the formula 100 WM / WH+G where WM is the weight of the largest mass lifted in a successful trial and WH+G is he weight of the hoist and gripper. Thus the lightest hoist and gripper that lifts the largest mass in a successful trial will win.

Intuitive Physics Problems

Each team will be presented with a set of 5-10 problems. These problems can be solved either by using basic physics principles or by the application of simple logic. Some problems may require a minimal amount of calculations. A team leader will be responsible for recording the answers arrived at by the group. Solving all problems correctly should be your main objective (no team obtained 100% last year). However, time will be used as a basis for breaking ties.

Back to cover page