



Physics Field Day 2006

The Physics of Amusement Parks

This spring, the Creighton University Society of Physics Students (CUSPS) will again sponsor *Physics Field Day*, a day of activities and excitement for high school students. The day is filled with competitions that require understanding and application of basic physical principles. We in the CUSPS believe that physics can be enjoyed in a hands-on, competitive spirit. There is an event for everyone! It is our hope that the diversity of the Physics Field Day events will encourage many students to participate and challenge themselves.

Physics is a part of our everyday lives, in ways that are often unexpected and fun. From roller coasters to Ferris wheels and several things in between, physical forces are harnessed at amusement parks to thrill us in unexpected ways. The topic of this year's field day is the physics of Amusement Parks.

In the following pages are descriptions and a full set of rules for the events that we have chosen for this year's Field Day. Please read these rules carefully and prepare well for the flurry of events and excitement that make Field Day an educational, and more importantly, fun experience. If you have any questions regarding the rules or operation of any event, please e-mail cusps@creighton.edu or call 402.280.5559 or 402.280.2835 and leave a message for Steve Hansen or Dr. Mike Nichols.

Chalk Talk

Topic: *The Physics of Amusement Parks.*

I.) Procedure:

One contestant per team. Each contestant is allowed to bring colored chalk and no more than two five-by-seven inch index cards with notes. No contestant will be allowed to sit in on other speakers' talks until the final round. Each speaker will present his/her talk to three judges and the room will be closed to all others at that time. The speakers will be given no more than five minutes to present the talk. The judges will give the speaker a warning at four minutes in order to let the speaker finish within the time limit. After all the talks have been given, the top four participants will be selected to present in the final round of the Chalk Talks. The names of the four finalists will be announced just prior to the beginning of the final round. If a finalist is not present at the time of the announcement, his/her eligibility will be forfeited, and the next highest rated contestant will be selected.

II.) Judging:

A.) Delivery:

In the delivery of the talk, the contestant should use smooth, concise English and maintain eye contact with the judges. A contestant's poise during his/her presentation is also part of the judging criteria.

B.) Content:

During talk itself, the following will be considered:

1. The amount of material covered.
2. The logical flow of ideas.
3. The quality of material covered.
4. The creativity of the talk (originality).

C.) Questioning: After the talk the judges will take five minutes to ask the contestant relevant questions pertaining to the topic. The speaker's answers will be judged on the following criteria:

1. The accuracy of the answer.
2. The relevance of the answer to the question.
3. The ability to think about the questions in unfamiliar areas of the topic.

III.) Suggestions:

A.) The talk should concentrate on the physics of Amusement Parks. Do not dwell on material not related to physics. In the presentation of your material, do not attempt to explain phenomena that are beyond your mathematical and physical comprehension. Know your ideas with as much depth as possible.

B.) In preparation for the question period, familiarize yourself with the basic physical principles that relate to the physics of amusement parks.

D.) Remember that the judges are trying to evaluate your speech fairly. They are not trying to exploit the speech or the speaker.

Quiz bowl

Purpose: This game is used to test the subtle points of physics and the individual's ability to deal with physics problems of various levels.

I.) Teams:

Each team will consist of three individuals.

II.) The Game:

Depending on attendance the rounds will either be made up of two or four teams. The game consists of three rounds. The first round will have 10 questions worth 25 points. There will be an 8 second time limit to buzz in and a 5 second time limit to answer. The second round will have 4 questions worth 50 points. There will be a 15 second time limit to buzz in and a 5 second time limit to answer. The third round will have 1 questions worth 100 points. Each team will have 2 minutes to work to problem and write down an answer. More then one team can score on the last question. Each team should have a captain who will give the answers.

III.) Equipment:

Students may not bring anything into the exam except a pen, pencil, scratch, paper and calculator. Programmable calculators may be used, but their memory will be erased at the start of the exam. Books, or notes are not permitted.

IV.) Scoring:

There will be a penalty of 10 points for a wrong answer in round one, and 20 points for wrong answers in round two.

V.) General Information:

Commonly used formulas and constants will be given and a cheat sheet. Proper use of these formulas should enable the team members to solve all of the problems.

Boat Building

Purpose: Using a knowledge of buoyancy each team will construct a boat out of the provided materials. The boat will be built on the day of the competition. Each boat will be tested to see how much weight it can hold before sinking. The boat that holds the most sand will win.

I) Teams:

Each team may consist of up to three people, and only one entry will be accepted from each team.

II) Construction

A) Construction materials:

One square of aluminum foil 1/2meter by 1/2meter

8 paper clips

B) Dimensions

The boat may be any shape, size or design.

C) Boats must be constructed on the day of the event, with materials provided.

D) Students will have 25 minutes to construct the boats.

III) Judging

A) In order to be considered the boat must be able to float on the water before the weight is added.

Optical Slalom

Purpose: Using the principles of geometric optics, participants will maneuver a beam of light to hit a specified target by reflecting the beam off and through a series of optical elements.

I.) Team:

Each team will consist of two members.

II.) Rules:

A.) Each team will aim the beam blindly (with the laser shutter closed) except for three optional wild card shots of 5 seconds in duration.

B.) Once the team has signified that they are satisfied with the placement of all the optical devices, the shutter is opened for scoring. At that time no optical elements may be moved, added, or subtracted.

C.) Contestants are allowed to choose any appropriate path for the beam.

D.) The path of the beam must be continuous. It must avoid touching anything other than optical elements. Support structures for apertures and previously positioned optical elements are considered immovable obstructions and must be maneuvered around.

E.) The beam may strike any part of the optical element.

F.) There will be a time limit in which to hit the target. Be ready to start on time!

III.) Equipment:

Teams may bring in relevant texts, tables, calculators and pencils. Optical elements (lasers, mirrors, and prisms), meter sticks, protractors, and scratch paper will be provided. Contestants must bring all other equipment they deem necessary.

IV.) Scoring:

Scoring will be based upon how many optical elements are successfully used as well as the radial distance from the beam to the center of the target.

Mouse trap

Purpose: *To build a car prior to field day using a mousetrap as the source of propulsion.*

I.) **Team:**

Each team will consist of two members.

II.) **Rules:**

Part I- Building:

1. The mousetrap must be the sole source of propulsion. You may connect the lever arm by a string to the axle of the car (no other springs, rubber, bands, etc. are allowed, unless the rubber bands are used for traction on the wheels).
2. The car must have wheels
3. The car must remain on the ground
4. Participants must use a mousetrap. No rattraps will be allowed.

Part II- Competition:

1. Two trials with three minutes in between each trial to reset the trap.
2. The car must travel down a long hall
3. If the car hits the wall it is dead
4. The distance will be measured from the starting point to the end point.

III.) **Scoring:**

Scoring will be based upon how far the car traveled (70%) and the creativity of the design (30%).

IV.) **Suggestions:**

1. Parts of Lego or toy cars work well as additions to the mousetrap.
2. A long lever arm allows for slow release of the car.

Catapult

Purpose: *To build, prior to Field Day, a catapult to fling raw Grade A large chicken eggs at targets a distance 25 and 50 meters away.*

I.) **Team:**

Each team may consist of up to three people, and there is only one entry per team.

II.) **Rules:**

A.) *Construction:*

The catapult may be any size, built of any material, and must operate solely off of gravity power.

B.) *Competition:*

1. The catapult will be fired from behind a line to targets of 25 and 50 meters away. The entire catapult must be behind the line before and after the launch.
2. Each device will have two trials at each distance. There will be a reasonable amount of time given to reset the catapult. Modifications of the device will be allowed for each distance.
3. Eggs will be provided

III.) **Scoring:**

1. The scoring will be the sum of the radial distance from the targets on the better of the two tries. Creativity of design will break any ties.

Egg Drop

Purpose: *To construct a device that will prevent an egg from breaking after being drop from set heights.*

I.) Team:

Each team will consist of up to 3 members.

II.) Rules:

- A) The team may only use the materials provided.
- B) The teams will have 25 minutes to construct their device.
- C) After 25 minutes the devices will be drop from heights of one story, two stories, and upward until the egg is broken.
- D) Teams will be awarded points by how high their device can safely transport the egg to the ground compared to device weight.

III.) Equipment:

- one egg carton
- rubber bands
- several pieces of 5'' by 5'' cardboard
- duct tape
- one Styrofoam cup
- string
- more materials can be requested prior to Field Day, but these are subject to approval and all teams will be notified of added equipment

IV.) Scoring:

The team's score will be the largest distance they obtained.