Jr. High/Middle School Schedule of Events

Thursday, March 8, 2012
8:00am – 6:00pm

Collage Competition
"Inertia"
9:00am to 1:00pm – Inside Lobby of Boardwalk Ballroom
(Please pick up your collages by 2:00pm. Collages left after 2:00pm become property of Knott's)

Workshop
Dr. Flubber Paper Airplane
9:00am to 11:00am – Inside Boardwalk Ballroom

Game
Paper Power Tower
9:00am to 9:45am – Inside Boardwalk Ballroom
30 Teams of up to 4 Students

Game
Conversion Conundrums
10:00am to 10:45am – Inside Boardwalk Ballroom
30 Teams of up to 4 Students

Game
Paper Airplanes for Accuracy
12:15pm to 1:00pm - Inside Boardwalk Ballroom
Limited to First 75 Individuals

Game
Buoyancy Challenge
1:00pm to 2:00pm – Outside Boardwalk Ballroom
100 Teams of up to 3 Students

Guest Speaker
Mr. Thomas Unfried – "Inertia"
2:00pm – at Xcelerator in the Boardwalk area

All Events are First Come, First Serve
A School may have a maximum of 2 teams per competition (Space Available)

(Events & Times Subject To Change)

Knott's
BERRY FARM

Physics FUN Day

2012

Presented by

Knott's Berry Farm
and local Physics Teachers

Descriptive Version

Physics Fun Day
at Knott's Berry Farm

Welcome to the Annual Physics Fun Day at Knott's Berry Farm.
The planners hope you have both an enjoyable and educational day.
To make the day safe for all we ask you to keep the following rules in mind:

1. Only hand-held equipment of the type found in Amusement Park Physics Kits (sold by science vendors) has been approved by Knott's officials for use on the rides this day. Wristbands provided with kits must be used.
2. Follow the directions of Knott's employees. Do not distract ride operators. They need to pay attention to the safe operation of the rides.
3. Check in with your teacher and team on a regular basis.
4. Wear appropriate clothing.

To make the most of your day of physics, the following pieces of equipment would be helpful:

Pencil | **Stop watch 0.01 sec.**
Vertical Accelerometer | **Horizontal accelerometer**
Inclinometer
Soft linear measuring device (knotted string, cloth measuring tape)

When making measurements at Knott's, work in a team of two, three, or four. One team member should plan to keep track of the "stuff" while others stand in line for a ride.

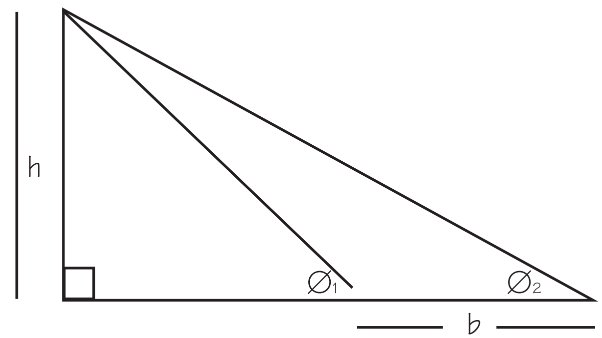
Before coming to Knott's you should discuss the measurements you will need to make and calibrate your equipment. Measurement suggestions and useful equations are included in this guide. Plan your day to include the Physics competitions and presentations in outside of the Boardwalk Ballroom. Several thousand physics students are expected to attend Physics Day at Knott's. Knott's will open at 8am exclusively for physics students. There are many rides demonstrating numerous physics concepts. If a line for one ride is too long, go to another ride. When you finish with your measurements, store your equipment in a locker and continue to explore the park in a less quantitative manner.

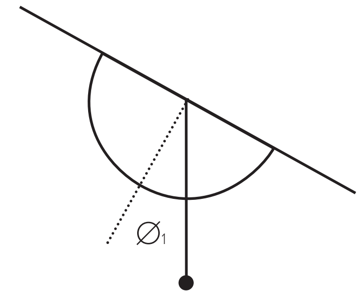
Drawings and Notations

To measure height:

Use an inclinometer

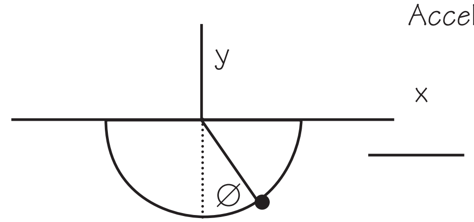
$$h = \left[\frac{\sin\varnothing_1 \sin\varnothing_2}{\sin(\varnothing_1-\varnothing_2)}\right]b + \text{observer height}$$





$$a_x = -g \tan\varnothing$$

To measure Horizontal Acceleration use bb in tube



Measure from 90º

1. Count the number of complete revolutions made by the riders in sixty seconds.

2. Describe the path made by the water issuing from the wet riders as they revolve.

3. What useful purpose is served by the large masses located at the ends of each rotating arm of Rip Tide?

4. What is the ratio of water jets on Rip Tide to passengers on Rip Tide? (Show your math.)

Measurement Suggestions and Useful Formulae

Knott's Berry Farm is compact, so you will need to explore areas appropriate for making measurements, which do not interfere with the operations of the park.

To find distances use string knotted at known intervals, cloth measuring tapes or your known pace length.

To find heights you will measure the angles from your eye to the height at two locations in line of sight along a measured distance between the two angles. Have someone help you read the angle on the inclinometer because very slight errors in reading angles cause major errors in calculations. (See Diagram on next page) The height can then be determined by making a scale drawing back in your classroom.

When measuring speeds find a location that parallels the tracks and take several readings to find the average value.

When using accelerometers, be sure to have them secured around your wrist so there is no possibility that they may come loose to hurt yourself or others. (See Diagram on next page) A lift is the portion of the track where the ride is "pulled" to a height from which it "falls".

Useful Formulae:

$KE = 1/2\, mv^2$

$a = \frac{V_f - V_i}{t}$

$PE = mgh$

height = $\{[\sin\varnothing_1 \sin\varnothing_2 / (\sin(\varnothing_1 - \varnothing_2)] \bullet b\}$ + observer's height

$v = d/t$

$g = 10\ m/s^2$

$J = kg \bullet m^2/s^2$

$v = 2\pi r/T$

freefall: $d = 1/2gt^2$

$v = gt$

$a_c = v^2/r$

$T = 2\pi(L/g)^{1/2}$

TIMBER MOUNTAIN LOG RIDE

1. While on the ride, determine the time during which the log moves in the **flume**. Use a stopwatch to record the time to the nearest tenth of a second. *(Do not count the time from when the log reaches the top of the last hill to when it returns to the loading area.)*

2. Knott's reports that the water's path in the **flume** is 670 meters in length. Calculate your average velocity during that time.

3. As the log moves from the top of the last hill down the chute where it splashes in the water, does it float or roll?

4. At the bottom of the chute the combined large mass of the log and passagers is moving with great velocity. What physical property does it possess as it enters the water?

5. What physical characteristic of the log is responsible for making such a large splash and slowing the log so rapidly?

PERILOUS PLUNGE

1. From the choices given below, circle your best estimation for the angle made between the tracks and the ground on the drop.

   25º 40º 55º 60º 75º 90º

2. How many seconds are needed for the car to travel down the down?

3. Use the following comparisons to estimate the height of the drop. Circle the letter of your best estimation.
   A. A 2 story building is about 6 meters high.
   B. A 4 story building is about 12 meters high.
   C. A 6 story building is about 18 meters high.
   D. A 8 story building is about 24 meters high.
   E. The drop is more than 8 stories (24 meters).

4. Name two forces acting on the car as it begins to move through the drop.

Silver Bullet

1. Count the number of vertical steps required to reach the loading platform? Report that number below.

2. Determine the approximate height of each step and then report the overall change in elevation attained by riders as they move from ground level to the loading platform.

3. What kind of energy increases for a 45.4 kilogram (100 pounds) student who climbs these steps to the loading platform?

4. What is the direction of the net force on the riders as they move through the elevated spiral?

Ghostrider℠

1. Estimate the height of the tunnel at the top of the first hill. See the hint given in Perilous Plunge question #2.

2. How many seconds do the riders accelerate down the first hill?

3. Since energy is conserved, give three reasons why the roller coaster slows down during the course of the ride.

JAGUAR!

1. Time the Jaguar as it travels between post #98 and #104. Use a stopwatch to record the time to the nearest tenth of a second.

2. Time the Jaguar as it travels between post #124 and #130. Use a stopwatch to record the time to the nearest tenth of a second.

3. Assume the distance from posts #98 to #104 is about equal to the distance from posts #124 to #130. Are the times you recorded in the first two questions also equal?

4. Explain your answer to question #3 above.

LA REVOLUCION

1. Which of the following rides is most like La Revolucion. Circle the best choice from below:
   A. GhostRider B. Wave Swinger C. Dragon Swing

2. What is the period for La Revolucion?

3. Estimate the number of revolutions made by the passenger pod during one minute.

4. What is the direction of the centripetal acceleration experienced by the riders at the bottom of the swinging motion?

DRAGON SWING

1. Measure the acceleration of the Dragon Swing at the **bottom** of the arc using your vertical accelerometer.

2. Tell what forces are acting on the riders at the **top** of the ride's swing.

3. Do you seem to weigh more or less than normal at the bottom of the swing? Explain your answer.

4. Measure the time for one complete cycle (up and back motion). This is known as the **period of motion**.

5. At what position along the arc are the riders moving the fastest? How do you know?

MONTEZOOMA'S REVENGE®

1. What word best describes the motion of the train as it leaves the station?

2. Why doesn't the passengers fall out of their seats at the top of the loop? Explain using forces. Hint: It has nothing to do with the seat belts or harnesses.

3. What physics concept or principal explains why the train reaches a greater height at the forward tower compared to its height at the return tower?.

4. What is the name of the force used to stop the train as it returns to the station?

BOOMERANG

1. Estimate the height (in meters) of the last car when it reaches its highest point on the track. See Perilous Plunge question #2 for estimating hints.

2. Knott's Berry Farm gives the maximum speed obtained by the train as 26.3 m/s. How fast is this in miles per hour?

3. If you average a speed of 13 m/s on this ride, what distance do you cover during the ride? *(Hint: First find out how much time the train is in motion.)*

SUPREME SCREAM

1. Stand next to the Supreme Scream structure and estimate the height of each section using the hint in Perilous Plunge question #2. Then determine the height the riders reach just before being dropped.

2. Now, estimate the distance the riders fall with the first drop.

3. Use a stopwatch to determine, to the nearest tenth of a second, the time for the first drop.

4. Use your answers for questions #2 and #3 to estimate the average downard speed during the first drop.

5. The riders are brought to a safe and gentle stop at the end of the first drop by a process which transfers kinetic energy to a gas trapped in a cylinder. In addition to “a decrease in volume,” what other physical change does the gas undergo during this compression?

BIGFOOT RAPIDS®

Make these measurements near the end of Big Foot Rapids close to the picnic site.

1. Estimate, in meters, the width and depth of the Rapids near the waterfall. use the chart below to help you estimate. Circle your best estimation from each column on the chart.

Width	**Depth**
0.5m (1.6 ft.)	0.25m (1.3 ft.)
1.0m (3.2 ft.)	0.50m (1.6 ft.)
1.5m (5.0 ft.)	0.75m (2.5 ft.)
2.0m (6.4 ft.)	1.00m (3.2 ft.)

2. Determine the speed of the "boat" in meters per second, by timing it as it travels an estimated distance along the fence. Remember that one meter is about as long as three feet

3. Does the waterfall "run" continuously? Why do you think this is so?

4. Use a calculator and your answers for questions #1 and #2 above to determine the volume of water in cubic meters per second, which flows through the rapids near the waterfall. *(Hint: width x depth = area . . . area x speed of "boat" = volume flow rate, in cubic meters per second.)*

Wheeler Dealer Bumper Cars

1. Which of Newton's Laws is best used to describe what happens most between the bumper cars?

2. Where do the cars get their power?

3. What is the purpose of the rubber bumpers on the cars?

4. Observe a collision and describe it using conservation of momentum concepts.

Sierra Sidewinder

Take a Ride on the Wild Side

1. What is the height of the Sierra Sidewinder Station Platform?

2. The "spinning" movement of each Sierra Sidewinder car is correctly described as a "rotation" rather than a "revolution." Why?

3. Does the Sierra Sidewinder ever undergo motion described as "revolution"? If so, where?

4. The Sierra Sidewinder travels over 425 meters of track. Estimate the average speed of the "train" from the time it leaves the station until it encounters the braking mechanisms upon its return.

5. Identify at least two forces acting on riders while the Sierra Sidewinder is rotating.

Pony Express The Ride

1. Stand in the area in front of the loading area. Look at the mechanism used to push the "horses" for the acceleration. Measure the time the ride is pushed by the accelerating mechanism.

2. If the maximum speed of the ride is 17.00 meters per second, what is the acceleration?

3. Follow the track of the ride along its initial 15 meters. Look for the mechanism that launches the ride. What is this large disc called?

4. Look at the "horses" as they leave the last turn and approach the loading area. Describe the mechanism used to slow the "cars." How do you think these devices work?

5. If the track is 381 meters what is the average speed of the ride?

WINDSEEKER

1. How many seconds are needed for riders to reach maximum height?

2. How many seconds are needed for riders to attain maximum “full swing diameter”?

3. Name as many “types” or “kinds” of acceleration exxperienced by the riders.

4. Are these riders undergoing “rotation” or “revolution”? Explain.

5. Describe the “free fall path” taken by an object dropped by a rider at the maximum height?

6. How Many times do the riders “go around” at the top?

7. How many seconds does it take to “gp around” just once at the top?

8. How do the Knott’s Berry Farm Ride Operators insure an equal weight distribution or riders?

Notes: