PHYSICS DAY

Six Flags® DARIEN LAKE

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Physics Day
at
Six Flags Darien Lake

INTRODUCTION

Welcome to physics day at SIX FLAGS DARIEN LAKE RESORT. We hope that you will have a great day EXPERIENCING PHYSICS.

This booklet has been prepared for you to use to measure and compare what you feel with what you can determine. Your teacher should have discussed the methods of measurements that you will be making.

The booklet is arranged with the first page of a ride containing measurements and observations that you should take before, during, or after the ride. These measurements will be referred to in the calculation sections for each ride.

The rides are arranged in the book according to their general location in the park. The first are located near the entrance and picnic pavilions and the last are located near the Viper. A map had been included on the back that will help locate the rides.

Page numbers have been included at the bottom of each page. An index to the rides included in this booklet is given on the next page for your convenience. You will find the formulas used in the calculations in the FORMULA SHEET found at the back.

We hope that you will have a good time EXPERIENCING the PHYSICS that you have learned in class. The amusement park is a great place to learn as well as have fun.

Enjoy your day.

PHYSICS DAY

TABLE OF CONTENTS

BASIC FACTS YOU WILL NEED OFTEN:

YOUR MASS = ____________

YOUR WEIGHT ($w = mg$) = ____________

PHYSICS CONCEPTS

To the student:

Be sure that you do a minimum of _____ rides.

You should choose your rides so that they will cover each of the concepts listed. Place an X in the box above each concept when you have completed a ride with that concept.

As you have studied physics this year, you have covered a number of topics, ideas, and concepts that have to do with motion, forces, and circular motion. Below is a list of physics ideas or concepts that you probably have studied that are demonstrated by rides in the park.

1. Kinematics - The study of motion. Velocity, acceleration, relative motion.

2. Vectors - Addition and Resolution of forces, velocities, displacements.

3. Momentum/Force - Impulse, F = ma, conservation of momentum.

4. Power - Time rate of doing work. Rate of using energy.

5. Friction - Always acting against motion.

6. Energy - Potential, Kinetic, Conservation of mechanical energy.

7. Circular motion - Centripetal force, horizontal circles, periodic motion.

8. Vertical Circles - Circular motion in a vertical plane.

9. Probability - Random occurrences, chance. Mathematics.

As you work your way through the park and go on the rides, keep these ideas in mind. You should cover as many of the concepts as you can or are instructed to. The chart on the next page will help you to figure out what rides will cover what concepts. Most of the rides duplicate some of the concepts. As you get information on a ride, check off the concept boxes at the top of the concept chart for that ride. When you have all of the boxes checked, you will know that you have experienced all of the concepts listed above.

CONCEPT TABLE

Fill in the chart below as directed.

CONCEPT covered RIDE NAME	Kinematics	Vectors	Momentum	Power	Friction	Energy	Circular	Vertical Circles	Probability
Predator	√			√		√			
Lasso		√					√		
Carousel		√					√		
Sky-Coaster					√	√	√	√	
Silver Bullet							√	√	
Superman	√					√			
Boomerang	√					√			
Bumper Cars	√		√				√		
Pirate						√	√	√	
Mind Eraser				√		√			
UFO					√		√	√	
Viper Part 1	√					√			
Viper Part 2						√	√	√	
Poland Spring Plunge	√		√						
Ring Toss									√

SENSING SENSATIONS

FORCE-FACTORS: A force-factor enables you to express the size of a force being experienced as a multiple of the force that is exerted by gravity, also known as weight.

TO CALCULATE FORCE-FACTOR you must divide the force being applied by the normal weight of the object. Here are some examples.

RIGHT NOW you feel a force on your bottom exactly equal to your weight as the seat supports you. With a force-factor **GREATER** than 1, you **FEEL HEAVIER** than normal and feel pressed into the chair. When you feel a factor **LESS** than 1, you **FEEL LIGHTER** than usual and can feel as if you are almost lifting out of the chair. At a given point on a ride, everyone, regardless of mass, experiences the same force factor.

On a certain ride a 50-kg girl is being pushed with a force of 1500 Newtons.

(a) What force-factor is she experiencing?

If we round g off to 10 m/sec^2 she weighs 500 Newtons.

$$\text{force-factor} = \frac{\text{Force being applied}}{\text{Weight}} = \frac{1500\ \text{N}}{500\ \text{N}} = 3$$

(b) If her friend weighs 120 pounds, what force in pounds is her friend feeling? They will feel the same force-factor. This time, the number we were given is the person's weight. Her normal weight is 120 pounds, but she is experiencing a force-factor of 3 and is therefore feeling a force of 3 times her normal weight. The force on her must be 3 x 120 pounds = 360 pounds.

YOUR TURN, SHOW YOUR WORK

An 80-kg boy is on a ride where he is feeling a force of 2000 Newtons.

(a) ***What force-factor is he experiencing?***

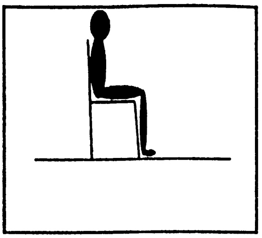
force-factor = __________

(b) ***What force will his 500 N girlfriend feel?***

Force = __________ newtons

SENSING SENSATIONS

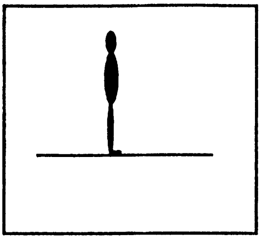
1) Here you are in a chair. Show the size and direction of the force the chair is exerting on you.



On what part of your body is this force exerted?

____

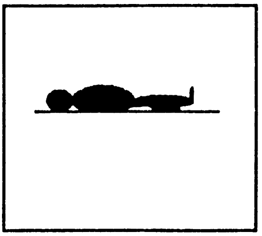
2) Here you are standing up. Show the size and direction of the force the ground is exerting on you.



On what part of your body is the force exerted?

____

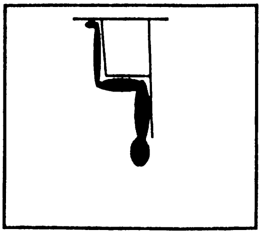
3) Here you are lying on the ground. Show the size and direction of the force and the ground is exerting on you.



On what part of your body is the force exerted?

____

4) Here you are upside down and strapped into a chair. Show the size and direction of the force that keeps you from falling out.



What is exerting this force and on what part of your body is it exerted?

________________ ________________

5) Based on your answer to the previous questions, how could you tell what position you were in if your eyes were closed?

CONSCIOUS COMMUTING

As you ride to Six Flags Darien Lake, be conscious of some of the PHYSICS on the way.

A. STARTING UP

THINGS TO MEASURE:

As the bus pulls away from a tollbooth or stop sign, find the time it takes to go from rest to 40 miles per hour. You will have to put someone up front to help.

t = _____S

THINGS TO CALCULATE: always show equations used and substitutions

1. Convert 40 miles per hour to meters per second. v = _____
   (1.0 MPH = 0.44 meters/second)

2. Find the acceleration of the bus. a = _____

3. Using your mass in kilograms and Newton's Second Law, find the average forward force on you as the bus accelerates from rest. F = ______

4. Is this force greater or less than the force gravity exerts on you (your weight).

   ____

5. Calculate the force-factor that you felt. Force-factor = _____________
   (NOTE: the force-factor has no units)

CONSCIOUS COMMUTING

THINGS TO NOTICE AS YOU RIDE:

1. As you start up, which way do you FEEL pushed (forward or backward)?

2. If someone were watching from the side on the road, what would that person see happening to you in relation to the bus?

3. How can you explain the difference between what you feel as the bus starts up and what the observer sees? (You may want to use FRAMES OF REFERENCE)

GOING AT A CONSTANT SPEED - THINGS TO NOTICE

1. Describe the sensation of going at a constant speed. Do you feel as if you are moving?

2. Are there any forces acting on you in the direction you are moving? Explain what is happening in terms of the principle of inertia.

ROUNDING CURVES - THINGS TO NOTICE

1. If you eyes are closed:

a. How can you tell when the bus is going around a curve?

b. What do you feel when you are seated facing forward?

c. What do you feel when you are seated with your back against the side of the bus?

2. Before the bus starts around a curve, concentrate on a tree or a building that is directly in front of you. From the law of inertia, you know that your body should continue straight ahead unless an unbalanced force acts on it. See if you can sense the force that causes you to go around the curve.

a. What is the direction of the force?

b. If the turn was tighter (smaller radius), how would the force be different?

c. How is this force applied to your body: (a) the friction of the seat, (b) your seat mate, (c) the wall, (d) the arm of the seat, or (e) a combination of these? Explain:

3. Many of the rides in the amusement park involve going around curves. Be prepared to compare what you are feeling on the bus with sensations on the rides. Predict some differences you expect to feel

THE PREDATOR

MEASUREMENTS

Height of first hill = 27 meters

Angle of first hill, θ = _____

Time up first incline = _____ S

Length of train = ________m

Measure the following times as you watch the train pass a support tower.

Gate at top: t = ____ s First hill at the bottom: t = _____s

OBSERVATIONS

1. What is the advantage of a long shallow first incline?

2. Why is the first hill always the highest?

3. Why is the track of the roller coaster banked?

4. Where do feel zero force acting on you?

5. What does this tell you about the shape of the track at that point?

CALCULATIONS

1. What is your potential energy at the top of the first hill? Potential Energy = ____

2. How much power is used to get you up the first hill? Power = ___

3. Calculate the final speed at the bottom. Final Speed = ____

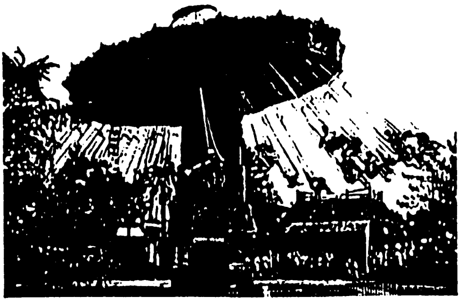
4. What kinetic energy does this speed give at the bottom of the first hill? Kinetic Energy = ___

5. How much energy was lost to friction? ____

6. Was energy conserved (within errors)? Explain yes no

LASSO

Radius of ride at top speed __11__m.



MEASUREMENTS TO MAKE

Time for 5 revolutions
at top speed t = _____

PERIOD T = _____

Maximum angle chain
makes with the vertical.
Θ = _____ °

Force meter reading in
seat at top speed _____

OBSERVATIONS:

1. Sketch what happens to the swings as the ride speeds up.

Start	Slow	Fast

2. How do you feel as the ride speeds up?

3. Compare the angle to the vertical of the chain on an empty swing with that of an occupied one at the same radius.

Greater Smaller The Same

4. Describe the change in the motion that occurs after the ride is up to full speed.

5. What is the motion of the top of the ride?

6. How does the force meter reading relate to how you feel on the ride?

CALCULATIONS

1. Calculate the maximum speed of the swings. Speed = ____

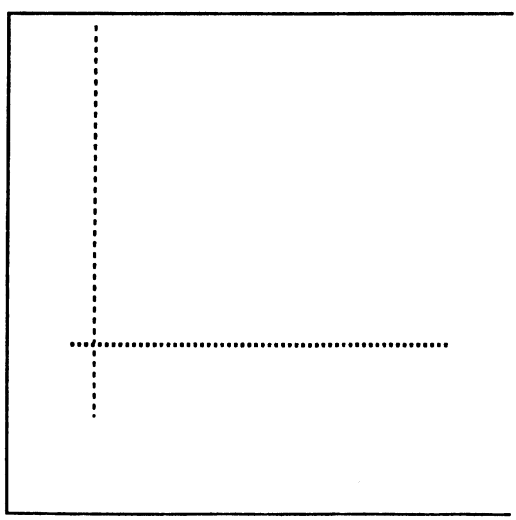
2. Calculate the centripetal force acting on you. $Force_C$ = ____

4. Multiply the force meter reading by your weight to get the measured tension in the chain. Tension = _______

5. Calculate the tension by addition of vectors. Draw to scale a horizontal vector representing the centripetal force. Draw to scale a vertical vector equal in magnitude to your weight but directed upwards. These are the components of the tension. Add these to find the resultant force vector (tension), and determine its magnitude and direction.

Magnitude = ________

Angle with vertical = _______°



6. Compare the angle determined in your drawing with the angle measured while observing the ride?

7. How does the tension in your diagram compare with the measured tension?

CAROUSEL

MEASUREMENTS BEFORE RIDING:

PERIOD T = _________

OF HORSES IN OUTER RING ____

SPACE BETWEEN POLES ____

OF HORSES IN INNER RING ____

SPACE BETWEEN POLES ____

MEASUREMENTS WHILE RIDING:

Hold the force meter vertical. Use the horizontal meter and record the angle.

INSIDE HORSE
Force meter at bottom _______ at top _______ Angle _____°

OUTSIDE HORSE
Force meter at bottom _______ at top _______ Angle _____°

OBSERVATIONS:

How do the readings on the vertical force meter relate to the force sensations you experienced?

How does the radial force meter reading on an inner horse compare with that on the outer horse?

CALCULATIONS

1. Calculate the average maximum speed of an outer horse. (distance = distance between horses x number of horses) Maximum Speed = __________

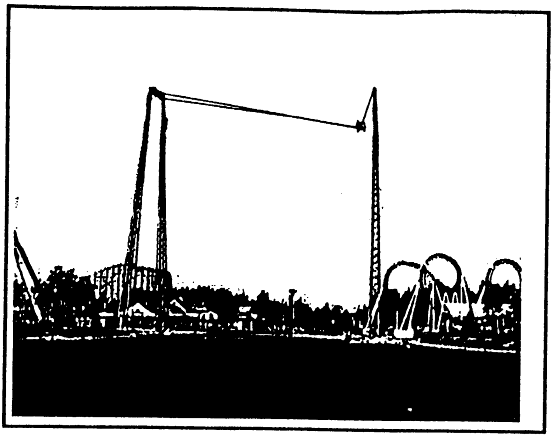
2. What is the average maximum speed of an inner horse? Maximum Speed = __________

3. Calculate the centripetal force acting on you when you ride an outer horse. Centripetal Force = _______

4. Calculate the centripetal force acting on you when you ride an inner horse. Centripetal Force = _______

5. Calculate the net force exerted on you. Since the centripetal force and your weight are at right angles use the Pythagorean theory to find your net force. Net Force = _____N

THE SKY COASTER



All physics must be done by observation.

MEASUREMENTS:

Length of cables = ________

Time to reach bottom of first swing = __________

Number of swings before capture by attendant = _______

Distance capture loop extends = ___________

Period of swing at beginning of ride = __________

Period of swing near end of ride = __________

OBSERVATIONS:

Approximately how far do the riders fall until the cable become tight?

Observe several rides. Do the riders swing the same number of times before capture?

What factors seem to affect the ride. What makes one ride different from another?

What would you expect to measure for a force factor at the top? What would you estimate for a force factor at the bottom?

CALCULATIONS

(Use your mass and weight for all calculations)

1. What would your potential energy be at the top before release? PE = _______

2. What would your kinetic energy be at the bottom? KE = _______

3, What would be your velocity at the bottom? v = _______

4. What would be your centripetal force at the bottom? F_C = _______

5. What would be the force acting on you at the bottom? F_{BOT} = _______

6. What should be your force factor? Ff = _______

7. What is the length based on your measurement of the period at the end? L = _______

8. Based on the number of swings it takes to stop, what percent energy is lost to friction on each swing? % = _______

SILVER BULLET

RADIUS OF RIDER'S SEAT AT
TOP SPEED r = _8_m

MEASUREMENTS TO MAKE

TIME FOR 5 ROTATIONS
AT TOP SPEED t = _____

PERIOD AT TOP SPEED T = _____

FORCE METER (BOTTOM) = _____

FORCE METER (TOP) = _____

OBSERVATIONS

1. Watch the ride as it starts up and sketch what happens to the angle of the cars.

Start	Slow	Fast

2. Describe the sensations the riders have on the ride as it gets faster. When do the riders no longer sense the angle of the car?

3. Use vector concepts to explain, in terms of forces, why the angle changes as the speed increases.

4. When the ride is VERTICAL, where do riders feel

   a. the heaviest? b. the lightest?

5. Describe the rider's sensations when the car is halfway up or halfway down the vertical circle.

CALCULATIONS

1. Calculate the top speed of the car. Speed = _______

2. Calculate the centripetal force on YOU at top speed. $Force_C$ = _______

3. For the ride in the vertical position, calculate the force the SEAT exerts on YOU at the bottom. $Force_{bottom}$ = _____

4. Calculate the force-factor a rider experiences at the bottom of the ride. F-factor = _____

5. For the vertical position, calculate the force the SEAT exerts on YOU at the top. $Force_{top}$ = ________

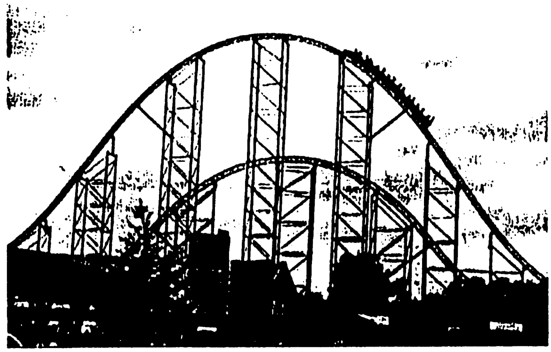
6. Calculate the force-factor a rider experiences at the top. F-factor = ________

7. How do the calculated values of the force-factors top (#6) and bottom (#4) compare to the values measured by the riders?

8. Using the force-factor at the top of the ride, explain why riders do not FEEL upside down.

SUPERMAN

MEASUREMENTS TO MAKE



Length of train = ________m

Angle of first drop = _______

Measure the following times as you watch the train go over the double hill. Measure all times from start to end from corresponding supports

Big hill from bottom to bottom: t = _______s

Small hill from bottom to bottom: t = _____s

From picture, determine the height that you measured the corresponding times.

Height of big hill = ____________m   Small hill = _______________m

OBSERVATIONS

1. What is a physics definition of weightlessness?

2. List several locations on the ride that you feel weightless.

3. Why is the second hill so much lower than the first hill?

4. What shape should a rollercoaster hill be to produce a feeling of weightlessness.

CALCULATIONS

1. From the angle of the first drop, calculate the Normal Force exerted on you by the track. F_N = __________

2. Determine the final vertical velocity after the first big hill. V_f = __________
(Use the height, 1/2 the total time, and $V_f = 2\ V_{ave}$)

3. Determine the vertical acceleration down the hill. a = __________

4. Find the percent difference from g (9.8 m/s^2). %diff = ________

5. Determine the final vertical velocity after the second hill. V_f = __________
(Use the height, 1/2 the total time, and $V_f = 2\ V_{ave}$)

6. Determine the vertical acceleration down the hill. a = __________

7. Find the percent difference from g (9.8 m/s^2). %diff = ________

8. A good measure of a weightless feeling is how close your vertical acceleration is to the acceleration due to gravity of a free-fall object. How do your measurements compare?

THE BOOMERANG

MEASUREMENTS TO MAKE

Length of train = _______m

Angle of ramp = ________

Length of ramp (estimate by number of train lengths)

length = ____________m

Distance train climbs on return ramp = _______m

Measure all times by timing a train as it passes a reference point.

Time at bottom of starting ramp(on initial trip) = ________s

Time at bottom of return ramp (on initial trip) = ________s

Time at bottom of return ramp (on return trip) = ________s

FORCE METER READINGS:

Initial trip	Maximum ______	Minimum __________
Return trip:	Maximum ______	Minimum __________

OBSERVATIONS:

1. Where on the ride is the maximum force felt?

2. Where on the ride is the minimum force felt?

3. Why does the ride pull the train up the return ramp?

CALCULATIONS:

1. Using the ramp length and angle, calculate the height of the initial ramp. (h = L/sine Θ) — h = ________ m

2. Calculate your Potential Energy at the start. — PE = __________

3. Calculate your Kinetic Energy at the station on the way. — KE = _________

4. Compare Potential Energy to Kinetic Energy for the initial trip. — %diff = _______

5. Calculate your Kinetic Energy at the bottom back ramp on the initial trip. — KE = _________

6. Calculate your Kinetic Energy at the bottom back ramp on the return trip. — KE = _________

7. Calculate the Potential Energy added by lifting the train on the return ramp. — PE = _________

8. Compare Potential Energy added #7 to differences in the Kinetic Energies of #5 and #6 of the return ramp. — %diff = _______

BUMPER CARS

This is your chance to take your frustrations out on other people. Apply Newton's Laws to your fellow students! See if the conservation of momentum really works.

MEASUREMENTS TO MAKE

You will need to determine the top speed of the cars. Pick two points in the ride and estimate or measure the distance between them. Then time several cars to determine a top velocity.

Length used for speed determination l = _____

Times used for speed determination t1 = _____ t2 = _____ t3 = _____

Radius of shortest turn at full speed R = _____

OBSERVATIONS

1. When a person hits a car at rest, describe the motion of the car doing the hitting.

2. Describe any patterns you observe that may relate to the mass of the drivers. Large driver vs small, same size, etc.

3. Describe how Newton's Third Law applies to the cars?

CALCULATIONS

1. Calculate the top speed of the car. Use an average of your times. Speed = ________

2. Calculate the centripetal force on YOU going around a corner at top speed. $Force_C$ = ________

3. Calculate your momentum. p_{you} = _____

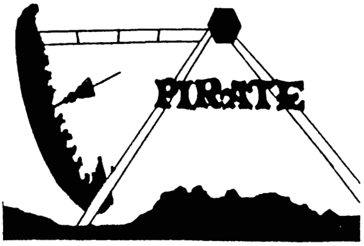
4. After you have hit someone, estimate your speed. Or use a value you observed. V_{final} = _____

5. Determine your final momentum. p_{final} = ________

6. Assuming that the collision takes place in a time of 0.1 second, determine the force on you. Force = ________

7. In the space, draw one possible circuit diagram for the construction of the Bumper Cars ride.

THE PIRATE



MEASUREMENTS GIVEN

Radius of swing = 13 m

MEASUREMENTS TO TAKE

Period of swing

At small swing _____

At maximum swing _____

FORCE METER MEASUREMENTS

At top of swing _____

At bottom of swing _____

At top of swing on other side _____

OBSERVATIONS

1. Where do you feel the greatest force?

2. Where do you feel the smallest force?

3. Can you detect where the force changes direction? Where should it be?

4. Do you ever feel "weightless"? Where should you?

5. Place a penny in your palm. Just before you reach the highest point, pull your hand down and observe what happens to the penny. What do you see?

CALCULATIONS

1. What is your potential energy at the top of the swing? PE = ________

2. What is your maximum speed at the bottom of the swing? v_{bottom} = ________

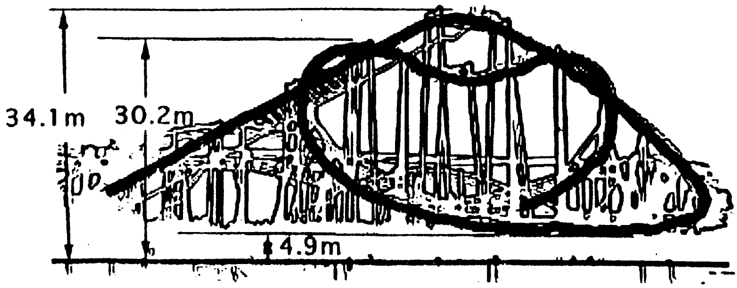
3. Calculate the force on you at the bottom of the loop F_{bottom} = ________

4. Calculate the force-factor at the bottom. F-factor = ________

5. Calculate the period you would expect if the swing were a simple pendulum? T = ________

6. How does your measured period compare with your calculated period?

THE MIND ERASER



MEASUREMENTS

Time to climb first hill: t = _______s Height climbed: h = _______m

Length of train (determine while waiting) length = _____m

Measure the following times as you watch the train pass a support tower.

Support at bottom of first drop: t = ____ s First loop at top: t = _____s

FORCE-METER READINGS

Top of first hill _____ Bottom of first hill _____

Make these measurements at the top of the first loop.

First roll start _____ First roll middle ______ Firs roll end ______

OBSERVATIONS

1. Why is the first hill of a roller coaster always the highest?

2. Where does the meter give a maximum reading? Why here?

3. Do you ever feel upside-down? Explain your answer.

4. Describe the motion of the hair of someone in front of you as you go through a roll.

CALCULATIONS

1. What is your potential energy at the top of the first hill? PE = ________

2. What power was used to lift you to this height? P = ________

3. What is your speed at the bottom of the first hill? v = ________

4. Calculate your kinetic energy at the bottom of the first hill? KE = ________

5. Find the percent difference between #1 and #3 Was energy conserved? Explain. % diff = ________

6. Calculate your speed at the top of the first loop. v = ________

7. Calculate your kinetic energy at the top. KE = ________

8. Calculate the potential energy lost at the top. ΔPE = ________

9. Find the percent difference between #6 and #7 Was energy conserved? Explain % diff = ________

THE UFO

RADIUS OF RIDE r = 8.5 m

MEASUREMENTS TO MAKE

TIME FOR 5 ROTATIONS
AT TOP SPEED t = _____

PERIOD AT TOP SPEED

T = _____

FORCE METER READINGS TO MAKE

AT TOP SPEED JUST BEFORE TILT (LEVEL) = _____

AT BOTTOM DURING MAXIMUM TILT (BOTTOM) = _____

AT TOP DURING MAXIMUM TILT (TOP) = _____

OBSERVATIONS

1. Describe the sensations the riders have on the ride as it gets faster.

2. When the ride is VERTICAL, where do riders feel

   a. the heaviest? b. the lightest?

3. Do the riders ever feel upside down(where)?

4. Describe the rider's sensations when the car is halfway up or halfway down the vertical circle.

5. Just before you tilt, lift your feet. Do you slide down the cage?

CALCULATIONS

1. Calculate the top speed of the ride. Speed = _______

2. Calculate the centripetal force on YOU at top speed. $Force_C$ = _______

3. For the ride in the vertical position, calculate the force the CAGE exerts on YOU at the bottom. $Force_{bottom}$ = _____

4. Calculate the force-factor a rider experiences at the bottom of the ride. F-factor = _____

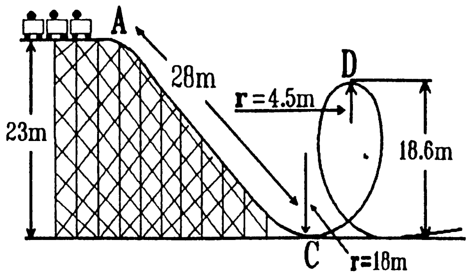
5. For the vertical position, calculate the force the CAGE exerts on YOU at the top. $Force_{top}$ = ________

6. Calculate the force-factor a rider experiences at the top. F-factor = ________

7. What is the percent difference between the calculated values and the measured values of the force-factors at the top (#6) and bottom (#4)?

8. If you did not slide when you lifted your feet, calculate the minimum coefficient of friction between you and the cage. μm = ________

THE VIPER



MEASUREMENTS

Length of train (determine while waiting) length = _____m

Measure the following times as you watch the train pass a reference point.

Top of first hill: t = ____ s Bottom of hill: t = _____s

Top of first loop: t = ____ s

FORCE-METER READINGS

Top of first hill _____ Bottom of pretzel _____

Bottom of first hill _____ Top of pretzel _____

Top of loop _____ Top of corkscrew _____

OBSERVATIONS

1. Why is the first hill of a roller coaster always the highest?

2. Where does your meter read closest to zero? How do you feel at this point?

3. Where does the meter give a maximum reading? Why is it a maximum here?

CALCULATIONS:

1. What is your potential energy at the top of the first hill? PE = ________

2. Calculate the speed at the top of the first hill. $V_{average}$ = _____

3. What is your kinetic energy at the top of the first hill. $V_{average}$ = _____

4. Calculate the speed at the bottom of the first hill? V_{final} = _____

5. What is the your kinetic energy at the bottom of the first hill? KE = _______

6. Find the percent difference between the total energy (potential + kinetic) at the top and the kinetic energy at the bottom. Within experimental error, was energy conserved? Explain your answer.

THE VIPER PART 2

THE LOOP

CALCULATIONS:

USE YOUR INFORMATION FROM PART 1 OF THE VIPER TO ANSWER THE FOLLOWING QUESTIONS.

1. Calculate the centripetal force the track exerts on you at the bottom. F_C = ________

2. Calculate the total force on you at the bottom of the loop. F_{bottom} = ________

3. Calculate the force-factor at the bottom of the loop. F-factor = ________

4. Why is it important that the radius be large at point C?

5. Calculate your Potential Energy at the top of the loop. (Point D) PE = ________

PART 2: THE LOOP

CALCULATIONS:

6. Calculate your speed at the top of the loop? v_{top} = ________

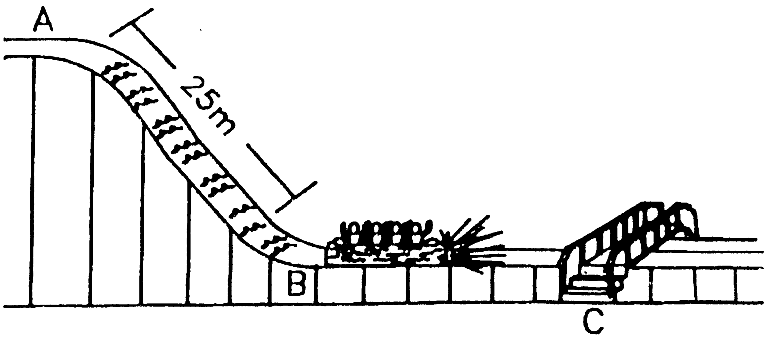
7. Calculate the centripetal force the track exerts on you at the top. F_C = ________

8. Calculate the total force on you at the top of the loop. F_{top} = ________

9. Calculate the force-factor at the top. F-factor = ________

10. Why is it important that the top radius be small?

POLAND SPRING PLUNGE



MEASUREMENTS (Measurements on the diagram are accurate)

LENGTH OF A BOAT ________m

TIME TO COME DOWN SLIDE ________s

DURATION OF THE SPLASH ________s

TIME NEEDED FOR WHOLE BOAT
TO PASS UNDER THE FRONT EDGE
OF THE BRIDGE, POINT C ________s

OBSERVATIONS

1. Why is there water on the slide and not just at the bottom?

2. If there is a lot of mass up front, is the splash larger or smaller? Explain why this is so.

3. Does the distribution of mass influence the duration of the splash? Describe your observations.

4. Where on the ride do the riders lunge forward? Explain why this is so.

CALCULATIONS

1. Calculate your average speed down the slide. $v_{average}$ = ____________

2. Calculate your final speed at point B. v_B = __________

3. Calculate your momentum (p_B) at point B. p_B = __________

4. Calculate your speed after the splash as the boat passes point C. v_C = __________

5. Calculate your momentum (p_C) at point C. p_C = __________

6. Calculate your momentum change from B to C. Δp = __________

7. Using the time of the splash calculate the average force that you experience during the splash. F_{splash} = __________

8. Calculate the force-factor during the splash. F-factor = __________

RING TOSS

PROBABILITY AND CHANCE

"He who trusts all things to chance, makes a lottery of his life." Keeping this in mind, go to the arcade area and locate the ring toss. Watch someone (or do it yourself) throw 200 rings. It does NOT have to be the same person throwing all the rings to make your calculations. Gather the following data. *(Is it better to be lucky than wise?)*

Number of throws ____________

Number of successful throws (if zero, then assume one) ____________

Cost of prize $10.00 (est.)

Number of throws to win ____________

QUESTIONS

1. What was the % of successful throws? % = _____

2. If it takes one successful throw to win a prize, how many rings would have to be thrown to win, based on your percentage? (assume the last throw is the successful one) # rings = _____

3. What is the cost/ring?(lowest possible cost) cost/ring = _____

4. Assuming every customer throws until he/she wins a prize, what is the profit per customer for this concession? Profit/player = _____

5. Based on the cost of each prize, what is the number of rings you can purchase and still break even? # rings = _____

FORMULA SHEET

USE THESE FORMULAS FOR YOUR CALCULATIONS

WEIGHT

$$F_g = mg$$

FORCE-FACTOR

$$F_f = \frac{forcefelt}{weight}$$

AVERAGE VELOCITY

$$v_{ave} = \frac{\text{distance}}{time}$$

FINAL VELOCITY

$$v_{final} = 2(v_{ave})$$

ACCELERATION

$$a = (v_f - v_I)/t$$

CIRCUMFERENCE

$$Cir = 2\pi r$$

CIRCULAR VELOCITY

$$v = \frac{2\pi r}{T}$$

MOMENTUM

$$p = mv$$

IMPULSE

$$\Delta p = F\Delta t$$

CONSERVATION OF ENERGY

$$\Delta KE = \Delta PE$$

POTENTIAL ENERGY

$$PE = mgh$$

KINETIC ENERGY

$$KE = \tfrac{1}{2}mv^2$$

CENTRIPETAL FORCE

$$F_c = \frac{mv^2}{r}$$

FORCE AT BOTTOM

$$F_b = F_c + mg$$

FORCE AT TOP

$$F_t = F_c - mg$$

POWER

$$P = \frac{W}{t}$$

PERIOD OF PENDULUM

$$T = 2\pi\sqrt{\frac{L}{g}}$$

COEFFICIENT OF FRICTION

$$\mu = \frac{F_{weight}}{F_{centripetal}}$$

Thank you for Attending Physics Day at Six Flags Darien Lake!