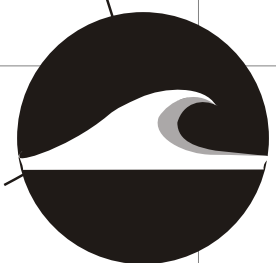
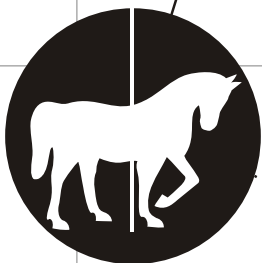


SEABREEZE PHYSICS

**Seabreeze Park
Rochester NY**

*Developed in Cooperation with
Physics Teachers at*

**Eastridge High School &
Rush-Henrietta High School
Rochester NY**



SEABREEZE PHYSICS

BUMPER CARS

Ride Specifications:

-- Car Motor 120 volts, powered by 1 HP



Questions: To perform this lab, you must find a partner to complete it with.

Mass of Bumper Car 460 lbs _____ kg

Mass of Rider (YOU!) _____ lbs _____ kg

Total Mass of Car and Rider _____ lbs _____ kg

Total Mass of your Partner and His/Her Car _____ kg

Observations While Driving: (Note velocity changes in each situation below)

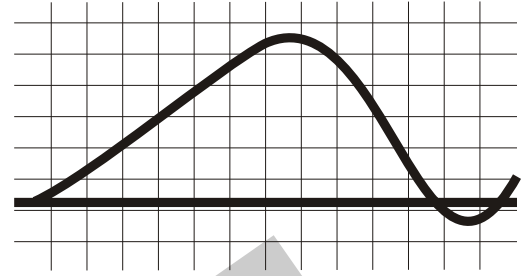
- 1) What happens to each car in a collision when:
 - a) one car is not moving and is struck in the rear-end by the other?
 - b) both cars are moving and there is a rear-end collision?
 - c) the car strikes a stationary object such as a wall bumper?
- 2) In what situation listed above are you "thrown forward", so to speak? Explain why.
- 3) In which situation are you "thrown backward"? Again, explain why.
- 4) Assume that you are travelling at 2 m/s.
 - a) Calculate the momentum of you and your car.
 - b) You collide with a wall bumper and rebound at a speed of 1 m/s. Calculate the momentum of you and your car after collision with the wall bumper. (Keep in mind that momentum is a vector quantity!)
 - c) Calculate the change in momentum of you and your car.
 - d) Assume that you are moving at 2 m/s. You strike a wall bumper and come to rest in 0.5 seconds. Calculate the impulse acting on you and your car during collision.
 - e) Calculate the force that caused the change in momentum.

SEABREEZE PHYSICS

JACK RABBIT

Ride Specifications:

Length of whole track:	655 meters
Length of track, top of first hill to brake application:	570 meters
Weight of 1 car in train:	295 kilos
Number of cars in train:	5



Questions:

- 1) By triangulation, determine the height of the first hill.
- 2) What is the maximum gravitational potential energy at the top of the first hill?
- 3) What is the maximum velocity at the bottom of the first drop? Assume the conservation of energy.
- 4) What is the average velocity of the train measured from the top of the first hill to the point where the brakes are applied?
- 5) How much power is developed as the train and passengers are lifted from the base to the top of the first hill?
- 6) At the bottom of the first drop, the track makes an almost circular arc. Determine the radius of the circle and the centripetal acceleration of the train. How many "g"s of acceleration are experienced at the bottom of the drop?
- 7) How does the calculated centripetal acceleration compare to the centripetal acceleration measured using the accelerometer?
- 8) Determine the angle of ascent and descent for the first hill. Calculate the acceleration down the first hill based on the angle of descent.

SEABREEZE PHYSICS

ON THE ROAD



Questions:

Starting up:

- 1) Draw the forces acting on you as you sit on the bus while the bus is moving at a constant speed.

- 2) Observe a ball attached to a string suspended from the ceiling. Before leaving the school, predict the motion of the ball:
 - a) at start up
 - b) while moving at a constant speed
 - c) coming to a stop at a traffic light
 - d) making a left-hand turn
 - e) making a right-hand turn

Record the actual motion of the ball:

- a)
 - b)
 - c)
 - d)
 - e)
-
- 3) Explain the motion of the ball for one of the above observations.

SEABREEZE PHYSICS

ON THE ROAD, cont'd.



Questions:

- 4) When the bus is moving at constant speed, describe:
- a) your motion relative to a person sitting next to you.
 - b) your motion relative to a person on the side of the road.
 - c) the motion of a person on the side of the road relative to you.
- 5) Determine the mass of the bus: (2.2 lbs = 1 kg)

Data: Surface area of one tire in contact with road _____ sq.inches
of people on the bus _____
Average weight of one person _____ pounds
Tire pressure as read from sidewall of tire _____ PSI (pounds/sq. in.)

Calculations:

Calculate the weight of the bus w/passengers knowing that pressure = force/area.

Actual weight of bus as found from bus driver.

- 6) With the help of a person in the front of the bus, time how long it takes to go from 0 mph to 25 mph (11 m/s) .
- a) Calculate the acceleration of the bus in m/s/s time _____ sec
 - b) Calculate the distance traveled as the bus reaches 25 mph
 - c) From the known mass of the bus and passengers, calculate the force needed to accelerate the bus to 25 mph.

SEABREEZE PHYSICS

ON THE ROAD, cont'd.



Questions:

Draw a vector diagram of the bus ride from school to Seabreeze Park. Determine the approximate resultant displacement, in both magnitude and direction. Be sure to include in your diagram the scale used to create the diagram.

SAMPLE



Questions:

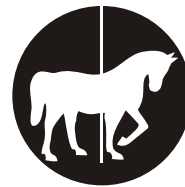
- 1) Measure the circumference of the circle made by the inner circle of horses and the circumference of the circle made by the outer circle of horses.
- 2) Determine the period of rotation for the carousel.
- 3) Using the horizontal accelerometer, measure the angle when riding an inner horse and an outer horse.

Data: Inner Circle Circum. _____m period of rotation _____m
Outer Circle Circum. _____m
Inner angle _____° outer angle _____°

- 1) Calculate the linear speed of the inner horse.
- 2) Calculate the linear speed of the outer horse.
- 3) Explain the difference in speeds between the two horses.
- 4) Calculate the centripetal force acting on you when riding the
 - a) Inner horse
 - b) Outer horse
- 5) Calculate the centripetal acceleration acting on you when riding the:
 - a) Inner horse
 - b) Outer horse
- 6) From the horizontal accelerometer, calculate the centripetal acceleration and compare those to #4 and #5, above.
- 7) Explain how the ride might be altered to achieve a greater angular acceleration without using a more a more powerful motor.
- 8) Imagine that once the carousel is turning, the motor suddenly turns off and continues to move freely with no losses due to friction. If riders moved from the inside horses to empty outside horses, which effect would this have on the motion of the carousel and why?

SEABREEZE PHYSICS

CAROUSEL, cont'd.



Questions:

- 9) The tangential velocity of:
 - a) the inner ring of horses
 - b) the outer ring of horses
- 10) The centripetal acceleration of:
 - a) the inner ring of horses
 - b) the outer ring of horses
- 11) Measure the centripetal acceleration using your horizontal accelerometer and compare to your calculated values in Question #10.
 - a) the inner ring of horses
 - b) the outer ring of horses

Thought Questions:

- 1) How does the centripetal acceleration depend on the distance you are from the center of the ride?
2. Explain how the ride might be altered to achieve a greater angular acceleration without using a more powerful motor.
3. Imagine that once the carousel is turning, the motor is suddenly turned off. Pretend that the carousel continues to turn freely with no loss in friction. If the riders moved from the inside horses to the empty outside horses, what effect would this have on the motion of the carousel? Please explain why.

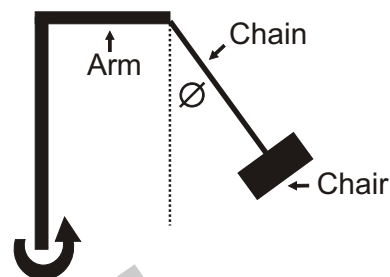
SEABREEZE PHYSICS

YO YO

Data:

Radius: 9.0 m

Time for one revolution _____ S



Qualitative questions:

- 1) Will an empty swing or one with someone in it ride higher? Why?
- 2). Describe your sensations as the ride increased in speed. Explain in terms of the physics of the ride.
- 3) Watch the ride from the beginning until it reaches full speed. What happens to the angle of the chain attached to the seats as the ride increases in speed? Why?

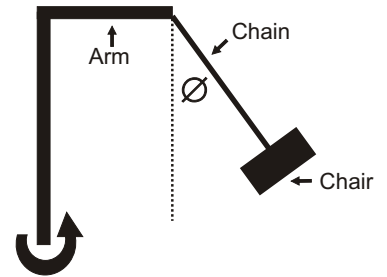
Calculations:

- 1) Calculate the maximum speed of the ride.
- 2) Calculate the centripetal force acting on you.
- 3) Calculate your weight in newtons.
- 4) Draw the following to scale, using the picture to the right.
 - a) the horizontal vector representing the centripetal force.
 - b) the vector representing your weight (mg)



SEABREEZE PHYSICS

YO YO cont'd.

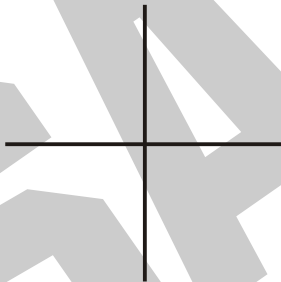


Questions:

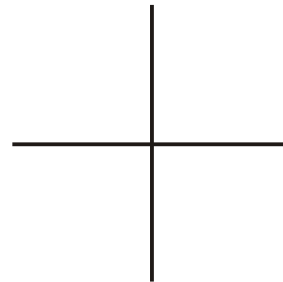
5. Measure the swing's angle from the vertical when it is in motion but not tilted. How does the angle of an empty swing compare to an occupied one? Does the mass of the rider make any difference? Is the angle of the swing independent of the mass of the swing? If so, show this is so.

6. Draw a vector diagram of the forces acting on a rider when the swing is moving and tilted for each position:

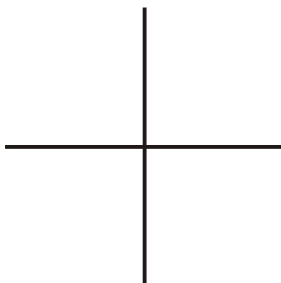
a) going up



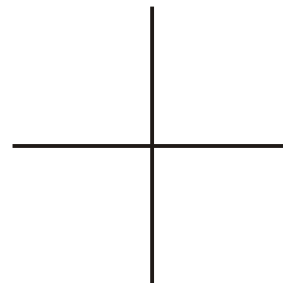
b) going down



c) at the top

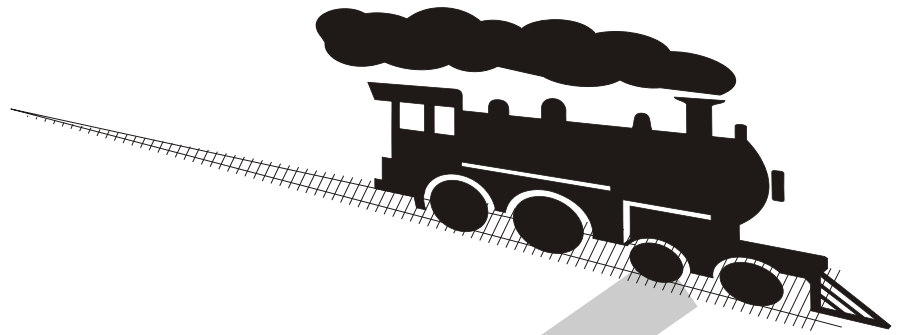


d) at the bottom



SEABREEZE PHYSICS

TRAIN RIDE



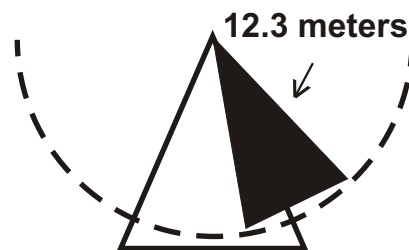
Question:

- 1) Determine the length of the train ride in meters. Describe the method you used to determine the total distance the train travels around its circuit.

SAMPLE

SEABREEZE PHYSICS

SEA DRAGON



Use the accelerometer while on the Sea Dragon to determine the acceleration at the bottom of the swing.

From the ground, determine how long it takes for 5 complete oscillations for the Sea Dragon.

Data: Time for 5 oscillations: _____ seconds

Acceleration at bottom: _____

Questions:

- 1) Calculate the period of oscillation using data from above.
- 2) Assume that the Sea Dragon behaves like a simple pendulum. Use the equation:

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

and calculate the period of oscillation of the Sea Dragon.

- 3) Which of the values (1 or 2, above) is the more reliable and why do you think so? (Include in your discussion, sources of error.)
- 4) Using conservation of energy principles, calculate the velocity of the Sea Dragon at the bottom of its swing.
- 5) Calculate the centripetal acceleration of the Sea Dragon at the bottom of its swing.
- 6) Compare the acceleration measured while on the ride with the value calculated above. Which value do you feel is more reliable and why? (Discuss sources of error in justification.)



Data and measurements:

Length of boat: _____ meters

Vertical drop of hill: 9.75 meters

Time for whole boat to pass any given point before going up to top of hill: _____ seconds

Time for boat to come down hill: _____ seconds

Time duration of the splash at the bottom of hill _____ seconds

Time for whole boat to pass any given point after splashing at bottom of hill: _____ seconds

Observations:

- 1) Why is there water on the slide or hill and not just at the bottom of the slide?
- 2) If there is a great deal of mass in the front of the boat, is the splash larger or smaller than if there is a smaller mass in the front? If so, explain why.
- 3) Is there an observable splash-time difference with a greater mass in the front than if the great mass is in the rear? If so, explain why.
- 4) Is there any place on the ride where the riders "lunge" forward involuntarily? Where does this occur and explain why.



Calculations:

- 1) Determine the average velocity of the log before going up hill.
- 2) Calculate the length of the hill.
- 3) Determine the average speed of the log down the hill.
- 4) Assuming the speed of the log at the top of the hill is the same as the speed before the hill, calculate the speed of the log at the bottom of the hill just prior to splashing.
- 5) Calculate the average acceleration of the log down the hill.
- 6) Calculate your momentum at the bottom of hill before splashing.
- 7) Calculate your momentum after splashing is complete.
- 8) Using the time of splash, calculate the average force you experience during the splash.

SEABREEZE PHYSICS

THE ANXIETY FACTOR



Data:

For four (4) of the rides you analyze (including either the Jack Rabbit or the Quantum Loop as one of the four rides you analyze), determine the following:

- 1) Your pulse rate immediately upon entering the ride.
- 2) Your pulse rate immediately after the ride ends.

To determine your pulse rate, count heart beats for either 10 seconds and then multiply this by 6, or 15 seconds and multiply this by 4, which will then give you your pulse rate in beats per minute. Fill in the chart below for the four rides.

Ride	Initial Pulse	Final Pulse
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Analysis and calculations:

- 1) For each of the four rides analyzed, determine the change in pulse from the start of the ride to the finish of the ride.
- 2) Plot a bar graph of pulse change (y-axis) against ride (x-axis) with the smallest change first through the largest change last (ascending order).

Analysis:

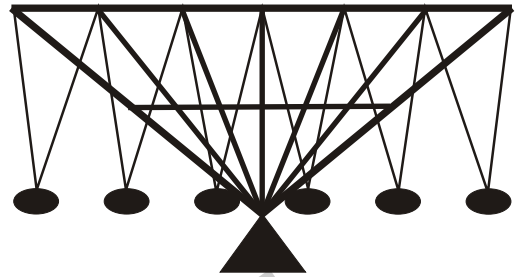
- 1) Why do you think the rides that you analyzed produced the changes in pulse rate that you found?

SEABREEZE PHYSICS

FLYING SCOOTERS

Ride statistics:

Length of Cables: 4.3 meters
Max. RPM: 10
25 HP Motor
Sweep Radius: 6.2 meters
1.0 Kw-hr Cost: \$0.10
1.0 HP = 750 watts



Questions:

- 1) Calculate the maximum speed of the Flying Scooters.
- 2) Describe how the change in flap direction changes the motion of the scooter.
- 3) If a 440-volt line is used to run the electric motor, what is the current in the line?
(Use the ride statistics for further data for this calculation.)
- 4) What is the internal resistant of the motor?
- 5) Assume the ride is operating for 6 hours. Calculate the cost of operation for one day.
- 6) What will be the cost of operating this ride for the three months of the summer?