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Types of Questions:

A Any type of question	C Calculations, Estimates, etc.	D Diagrams & Drawing
E Essay	MC Multiple Choice	RC Ride Comparison Charts & Questions

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Calculation Aids

FORMULAE

$$S = s_0 + v_0t + a_0t^2/2$$

$$E_p = mgh$$

$$E_k = mv^2/2$$

$$p = mv$$

$$v = 2\pi r/T$$

$$W = Fd$$

$$hp = .7W$$

$$C = 2\pi r$$

$$A = \pi r^2$$

UNIT CONVERSION FACTORS

$$1 \text{ m} = 100 \text{ cm} = 3.281 \text{ ft}$$

$$1 \text{ km} = 1000 \text{ m} = 0.6214 \text{ mi}$$

$$1 \text{ in} = 2.540 \text{ cm}$$

$$1 \text{ mi} = 5280 \text{ ft} = 1.609 \text{ km}$$

$$1 \text{ mi/min} = 60 \text{ mph} = 88 \text{ ft/s}$$

$$1 \text{ g} = 9.80 \text{ m/s}^2$$

$$1 \text{ kg has a weight of } 2.205 \text{ lb when } g = 9.80 \text{ m/s}^2$$

$$1 \text{ N} = 0.2248 \text{ lb}$$

$$1 \text{ J} = 10^7 \text{ ergs} = 0.239 \text{ cal}$$

$$1 \text{ ft}\cdot\text{lb} = 1.356 \text{ J}$$

$$1 \text{ hp} = 746 \text{ W} = 550 \text{ ft}\cdot\text{lb/s}$$

PACING

Determine the length of your stride by walking at your normal rate over a measured distance. Divide the distance by the number of steps and you can get the average distance per step. Knowing this, you can pace off horizontal distances.

My Pace = _____

Calculation Aids

TRIANGULATION

For measuring height by triangulation, you may use your horizontal accelerometer.

Instructions

1. Measure the distance between you and the ride (d)
2. Measure the height of the string hole (h_2)
3. Take a sighting at the highest point of the ride and record the measure of the angle (θ)
4. Since $h_1/d = \tan \theta$, then $h_1 = d (\tan \theta)$
Look up the tangent value for the angle measured
5. Multiply this tangent value by the distance from the ride
6. Add this project to the height of the string hole to get the total height.

Example

$$d = 100 \text{ m}$$

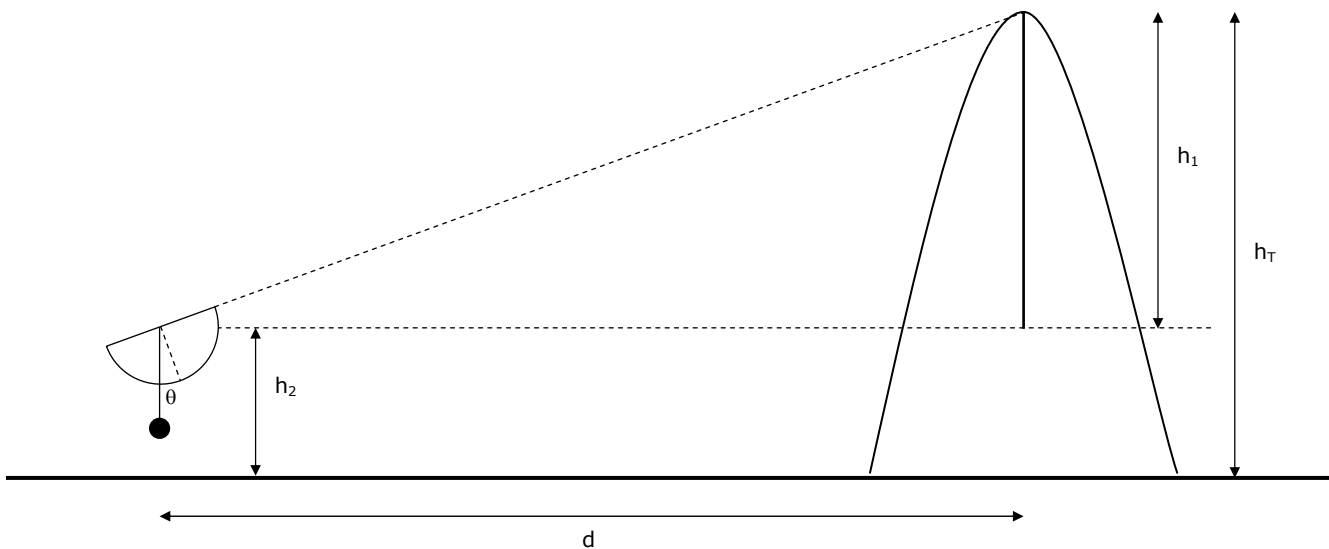
$$h_2 = 1.5 \text{ m}$$

$$\theta = 20^\circ$$

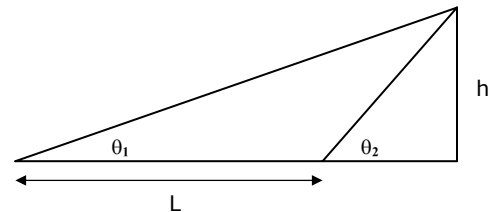
$$\tan 20^\circ = 0.36$$

$$h_1 = 100 \text{ m} * 0.36 = 36 \text{ m}$$

$$h_T = 36 \text{ m} + 1.5 \text{ m} = 37.5 \text{ m}$$



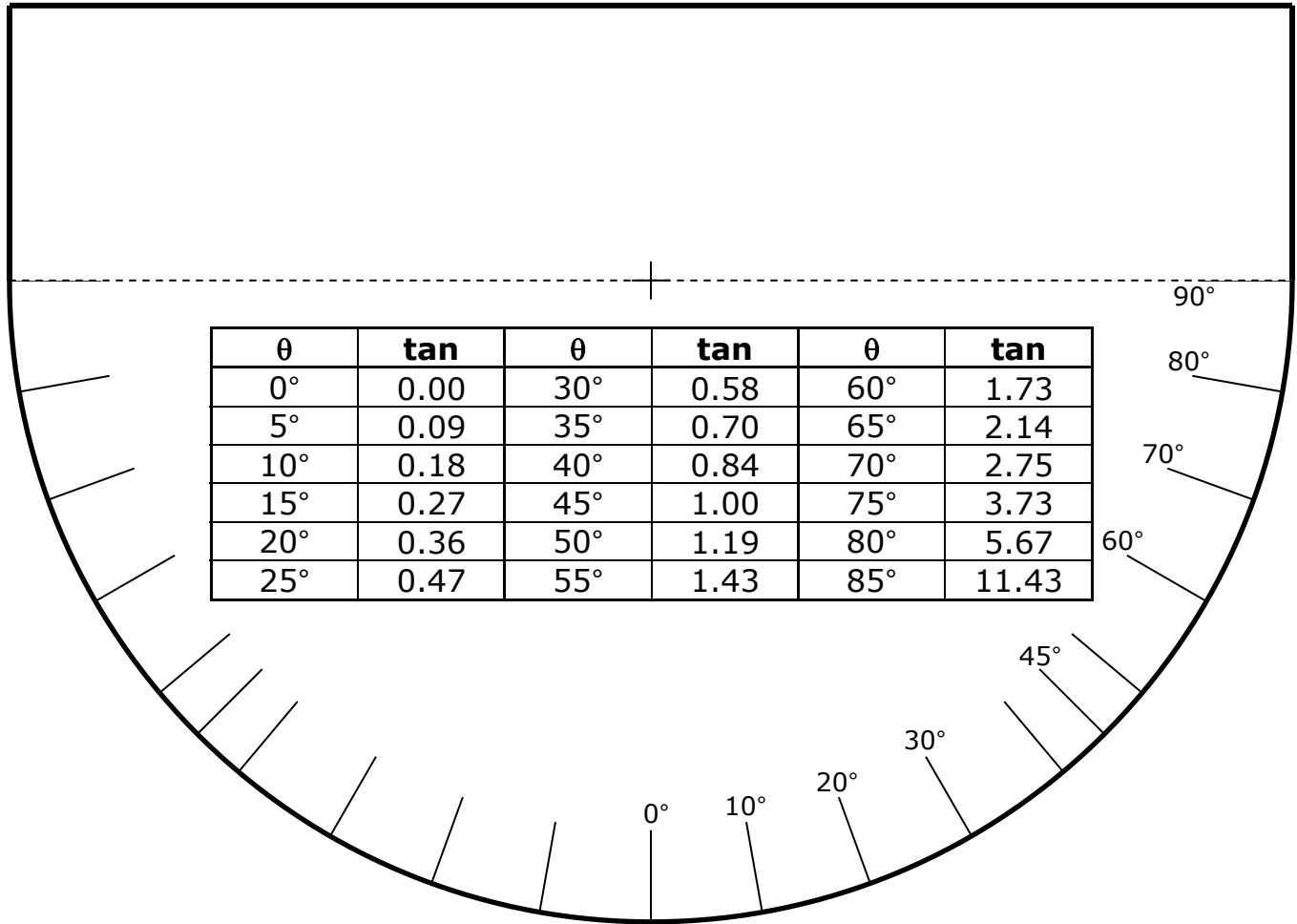
There are other ways to measure distance. If you can think of one, use it. For example, a similar but more complex triangulation could be used. If you can't measure the distance L because you can't get close to the base of the structure, use the Law of Sines as shown to the right.



Knowing θ_1 , θ_2 , and L , the height can be calculated using the expression

$$h = \frac{\sin \theta_1 \sin \theta_2}{\sin (\theta_2 - \theta_1)} L$$

Horizontal Accelerometer, Triangulation Tool



MATERIALS

This page

Scissors

Pencil

Tape

10 inches of string or heavy thread

Weight (key, heavy washer, etc)

Rubber band (to be used as a tether)

1. Cut out around the bold line.
2. Roll flat edge down around pencil to the dashed line. Secure the roll with tape. Remove pencil.
3. Poke a small hole in the paper at the crosshairs (+). Tie a string through the hole and tie the other end to the weight.
4. Securely attach the rubber band tether.

For more durability, use thick paper or attach to thin cardboard.

Air Crow MC

Circle the best answer.

1. During the ride, when you make the sail point toward the outside of the circle,
 - a. you fly higher.
 - b. you fly lower.
 - c. you turn toward the inside of the ride.

2. During the ride, when you make the sail point toward the inside of the circle,
 - a. you fly higher.
 - b. you fly lower.
 - c. you turn toward the outside of the ride.

3. Which of the following determines how high you fly?
 - a. the direction your sail is pointing.
 - b. the speed of the ride.
 - c. both of the above.

4. What is different about each car?
 - a. the color of something in the picture.
 - b. they have different numbers.
 - c. nothing, they are all exactly the same.

5. Which of the following affects this ride the greatest?
 - a. Sunshine.
 - b. Rain.
 - c. Wind.

Coasters Fill-In

Fill in the blanks with the correct word from the following word bank.

Accelerate	Centripetal Force	Friction
Gravity	Inertia	Kinetic Energy
Mass	Momentum	Parabola
Potential Energy	Weightless	

1. As you roll over a peak, you rise off your seat and you feel _____.
2. The shape of a roller coaster hill is called a _____.
3. As you fall down a roller coaster hill, you _____.
4. The force of _____ pulls you down the roller coaster peaks.
5. The _____ force slows you down throughout your coaster trip.
6. When you are the highest above the ground, you have the most _____.
7. When you are moving the fastest, you have the most _____.
8. Because of your speed at the bottom of a roller coaster hill, you have enough _____ to climb to the top of the next hill.
9. An inward _____ is required to make you turn.
10. Your body has _____ and, therefore, tries to move in a straight line when a roller coaster track turns.
11. An empty coaster and a loaded coaster will travel down the hill at the same speed. Therefore, we can say that a coaster's speed is not affected by its _____.

Coasters RC

	Cornball Express	Galaxi	Hoosier Hurricane	Lost Coaster of Superstition Mountain	Tig'rr
Capacity of one train					
Number of trains in service					
Length of track (feet)	2,060 ft		3,000 ft	1,420 ft	
Length of track (meters)		400 m			540 m
Estimated height of first hill					
Angle of first drop					
Length of first drop					
Time from the loading gates to the top of the first hill					
Time for train to go from top to bottom of the first drop					
Time from top of first hill to the braking station at end					
Time from braking station to loading gates					
Time to load and unload train					
Total Time of one ride cycle					
Average speed during first drop					
Average speed during entire ride					

Coasters RC

1. Which coaster has the highest hill?
2. Which coaster has the fastest first drop?
3. Which coaster has the fastest average speed?
4. Which coaster takes the longest amount of time to get from the top of the first hill to the braking station?
5. Does the coaster from question number 4 have the slowest average speed? Why or why not?
6. Based on the above information, which coaster do you think can have the most riders in one hour? Explain your reasoning.
7. Choose a coaster from above and calculate the speed at the bottom of the drop hill. Show your work.

Coaster: _____

Cornball Express E

Answer the following questions. Use complete sentences.

1. Where on the ride did you feel you were going the fastest? Why?
2. Where on the ride did you feel like you were lifted off your seat?
3. How did the ride cause that feeling?
4. Look at the supports that hold the track in place. Why do you think there are more supports on curves than in straight portions of the track?
5. Attempt to measure the centrifugal force felt in the helix turn near the end of the ride. What is the value?
6. How could you increase the centrifugal force felt by passengers in a train without increasing the speed of the train?
7. If you increased the centrifugal force in the helix turn, how would you have to change the support structure of the track?

Cornball Express MC

Circle the best answer.

1. As you fall downhill,
 - a. you feel lighter than you usually do.
 - b. you feel heavier than you usually do.
 - c. you grow wings and begin to fly.

2. As you climb a hill,
 - a. you feel lighter than you usually do.
 - b. you feel heavier than you usually do.
 - c. you grow wings and begin to fly.

3. The coaster
 - a. pushes you inward on curves.
 - b. pushes you outward on curves.
 - c. pushes animals off the track.

4. Tracks are
 - a. tilted inward on curves.
 - b. not tilted on curves.
 - c. tilted outward on curves.

5. A curve that makes a sharper turn
 - a. is tilted more than a gentle curve.
 - b. is tilted less than a gentle curve.
 - c. does not tilt (didn't you read my answer to number 4?)

6. You are slung outward more on a curve
 - a. when you are traveling faster.
 - b. when you are traveling slower.
 - c. when you lean toward the center of the curve.

Den of Lost Thieves A

1. How many points do you get for hitting a *regular* target? 1.
2. How many points do you get for hitting a *bag of gold* target? 2.

Austin, Cody, Evan, and Pete all rode the Den of Lost Thieves. Calculate their scores using the clues below.

Pete hit 29 *regular* targets and scored 410 total points.

Evan hit as many *bag of gold* targets as the difference between the number of *regular* targets that Pete and Cody hit.

Austin hit three more targets than Evan.

Cody hit the same number of *regular* targets as Pete hit total targets.

Evan hit a dozen more *regular* targets than one-third of the number of *regular* targets that Cody hit.

Cody hit half as many *bag of gold* targets as Evan.

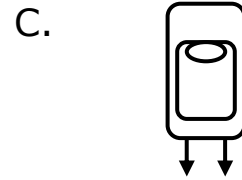
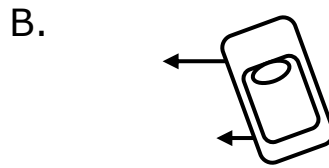
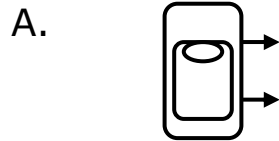
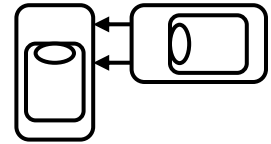
Austin hit as many *bag of gold* targets as Pete and Cody combined.

	Targets Hit			Points Scored		
	Regular	Bag of Gold	Total	Regular	Bag of Gold	Total
Austin						
Cody						
Evan						
Pete						

3. Who hit the most targets? 3.
4. Who scored the most points? 4.

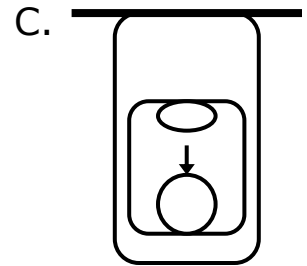
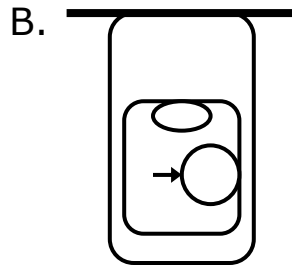
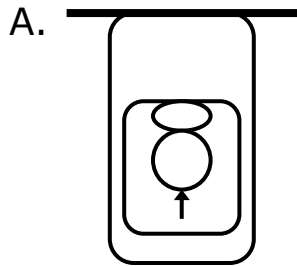
Dodgem A

1. When someone bumps your car on the side like the picture shows, which way does your car go?



2. Why do you think the car goes this way?

3. When you run straight into a wall, which way does your head go?



4. Why does your head go that way?

5. How are the dodgem cars powered?

A. Gasoline

B. Wind

C. Electricity

6. How does the power reach the cars?

7. Why do the cars have bumpers?

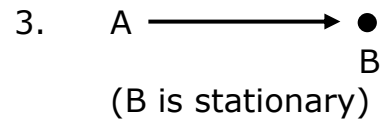
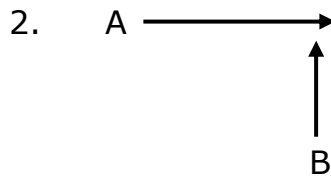
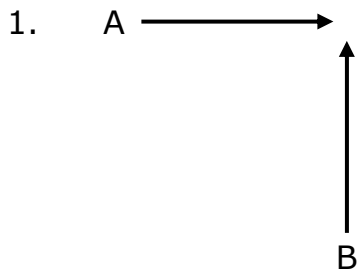
Dodgem C

1. Time the duration of the ride 1.
2. Estimate the circumference of the rink 2.
3. Estimate the maximum speed of an average car 3.
4. If you were able to ride along the circumference of the rink at full speed for the duration of your trip, how far would you travel?
4.
5. Calculate the deceleration of a car in an "average" collision. Use an appropriate kinematics equation and show your method.
5.
6. Express the answer to question 5 in g's 6.
7. Calculate the kinetic energy of your car.
7.
8. Is your mass significant in this calculation? 8.
9. Calculate the momentum of your car.
9.

Dodgem D

Before You Ride

The diagrams below represent two cars with the same mass in a collision (As seen from above). The arrows show the direction the cars are travelling as well as the velocity of each car. The longer the arrow, the greater the velocity. Below each diagram, describe what you think will happen to the cars after they collide. You may write sentences or draw your own diagrams to show what will happen.



4. Suppose the mass of car A is twice the mass of car B. This may be expressed as $M_A = 2M_B$. How will this change your predictions for questions 1-3?

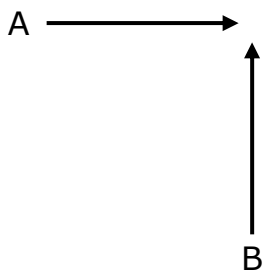
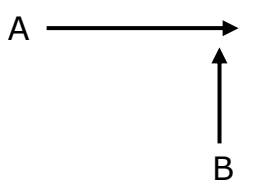
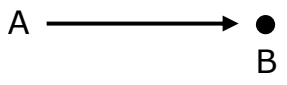
As You Ride

5. Keep track of the three types of collision you wrote about. Make a mental note of what happens as you have each collision, or as you observe others having similar collisions.
6. What effect does the mass of the riders have on the collisions?

Dodgem D

After You Ride

Re-examine the three types of collisions. Based upon your riding experience, draw a diagram showing the result of each collision.

	$M_A = M_B$	$M_A = 2M_B$
 <p>A →</p> <p>↑ B</p>	7.	8.
 <p>A →</p> <p>↑ B</p>	9.	10.
 <p>A → ●</p> <p>B</p>	11.	12.

Dodgem E

Answer the following questions. Use complete sentences.

1. If your car is hit head on by another car, what direction is your car accelerated? How do you know?
2. If your car is hit head on by another car, what determines whether your car continues to move forward or backward after the collision?
3. If you were riding in the only car with a much smaller mass than all the other cars, how would your ride be different? Explain why.
4. Describe your body's reaction to several different collisions. Example, how do you react if you are hit from behind vs. hit from the side?
5. What is the reason for having rubber bumpers around the cars?

Dodgem MC

Circle the correct answer

1. In a head-on crash, the driver is thrown
 - a. forward
 - b. backwards
 - c. upwards
2. When a car is hit from the rear, the driver is thrown
 - a. forward
 - b. backwards
 - c. upwards
3. When a car runs into a wall, the driver is thrown
 - a. forward
 - b. backwards
 - c. upwards
4. The driver feels the biggest jolt when the car is hit
 - a. head-on
 - b. on the side
 - c. from the rear
5. The car accelerates forward on impact when hit
 - a. head-on
 - b. on the side
 - c. from the rear
6. The car changes direction on impact when hit
 - a. head-on
 - b. on the side
 - c. from the rear
7. Bumpers make colliding cars
 - a. bounce apart
 - b. stick together
 - c. jump up
8. The cars are powered by
 - a. gasoline
 - b. magic
 - c. electricity
9. When the power to the cars is shut off, the cars
 - a. immediately stop
 - b. coast to a stop
 - c. never stop

Games E

Answer the following questions. Use complete sentences.

1. What forces are at work when you launch a frog from a *Frog Bog* catapult?
2. In the *Frog Bog* game, what factors play a role in where your frog lands?
3. What factors play a role in how much water is splashed by a frog as it lands?
4. What makes the lily pads turn?
5. Through observation alone, describe how you think the *Water Race* game works.

Games E

6. What forces are at work when you throw a dart in the *Dart Toss*?

7. Is any particular column better than the others to drop your chips in *Ploink*? Why or why not? If so, which column is the best one to start in?

8. What forces are at work when you sling a balloon from a *Water Wars* slingshot?

9. What factors play a role in how drenched you make your opponent?

Games Probability

In general, the probability of an event occurring is given by:

$$\frac{\text{Number of desired outcomes}}{\text{Total number of outcomes possible}}$$

Let's say you roll a six-sided die one time. You may roll a 6, 5, 4, 3, 2, or 1. There are six different possibilities, so the total number of outcomes possible is 6.

The probability of rolling a 4 is:

$$\frac{\text{Number of desired outcomes}}{\text{Total number of outcomes possible}} = \frac{1}{6}$$

So a person has a 1 in 6 chance of rolling a 4.

The probability of rolling an even number {2, 4, 6} is:

$$\frac{\text{Number of desired outcomes}}{\text{Total number of outcomes possible}} = \frac{3}{6} = \frac{1}{2} \text{ (reduce the fraction)}$$

The probability of *not* rolling a 3 is:

$$\frac{\text{Number of desired outcomes}}{\text{Total number of outcomes possible}} = \frac{5}{6}$$

In the *Fishin' Frogs* game, a player fishes with a pole until he or she pulls out a Frog. The color of the dot on the bottom of the Frog determines the type of prize the player wins. Assume that there are 4 frogs with Green dots, 12 frogs with Blue dots, 24 frogs with Orange dots, and the rest have Pink dots. Find the probability that a player will win:

1. A Small Prize

1.

2. A Medium Prize

2.

3. A Large Prize

3.

4. A Jumbo Prize

4.

5. Any Prize

5.

6. Something other than a Small Prize

6.

General Logic

Heather, Kady, Kristen, and Laura are all in a band together. After their performance at Indiana Beach, they went out to enjoy the rides. Each girl has a unique favorite ride. The girls agreed to ride the four favorites first.

First, use the following clues to find which rides are the favorites. Write the answers in the chart on the next page.

Ride 1: You walk to the top of this water ride.

Ride 2: This ride was rebuilt as a coaster in 2002.

Ride 3: You may listen to music coming from this ride as you feed the carp.

Ride 4: This ride has 40 seats and 2 places to board.

Now, use the clues below to figure out which ride is each girl's favorite, and the riding order.

Heather loves going round and round.

Laura's ride was ridden either second or third.

Kady does not like rides that may get her wet.

The girls began riding at the Northernmost ride at Indiana Beach.

The ride with the longest name was ridden just after Kady's favorite ride.

General Logic

	Heather	Kady	Kristen	Laura	First	Second	Third	Fourth
Ride 1 _____								
Ride 2 _____								
Ride 3 _____								
Ride 4 _____								

The girls rode _____'s favorite ride, _____, first.
name ride

The girls rode _____'s favorite ride, _____, second.
name ride

The girls rode _____'s favorite ride, _____, third.
name ride

The girls rode _____'s favorite ride, _____, fourth.
name ride

Gondola Wheel C

Answer the following questions. Clearly show your methods for solving.

1. Measure the time for one revolution. 1.
2. Calculate the rotational speed in revolutions per minute. 2.
3. Use triangulation to estimate the distance from the top of the wheel to the boardwalk. 3.
4. Use triangulation to estimate the distance from the center of the wheel to the boardwalk. 4.
5. Use the answers to questions 3 and 4 to find the radius. 5.
6. Calculate the circular tangential speed using $v = 2\pi r/T$ 6.
7. How long does one entire ride take? 7.
8. How far does each gondola travel during one complete ride? 8.

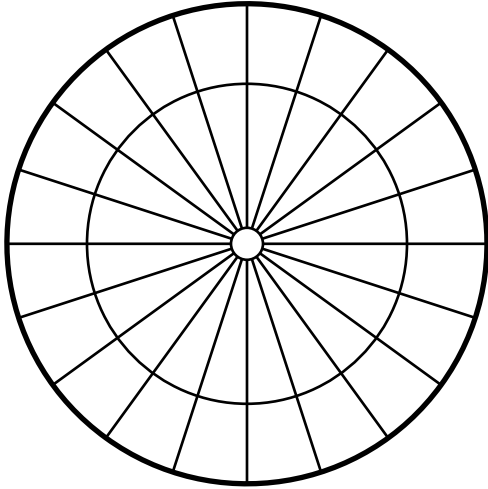
Gondola Wheel C

9. What is your average linear velocity? 9.
10. What is the centripetal acceleration for the wheel? 10.
11. Determine your potential energy with respect to the boardwalk when stopped at the top. 11.
12. What is your average kinetic energy? 12.
13. How many revolutions would the wheel make if it ran continuously for 10 hours? 13.
14. If the wheel broke loose from its moorings and rolled over Lake Shafer (frictionless across the top of the water), how long would it take to reach the Norway Dam half a mile away? 14.
15. How many rotations would it take to reach the Norway Dam? 15.

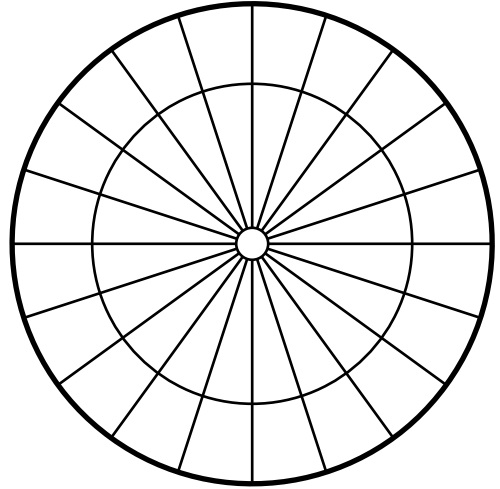
Gondola Wheel D

Indicate the best answers on the diagrams below
(Assume the wheel is turning clockwise)

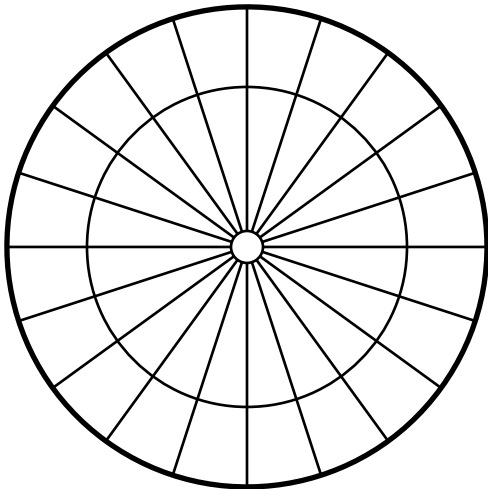
1. Where do you weigh the most during the ride?



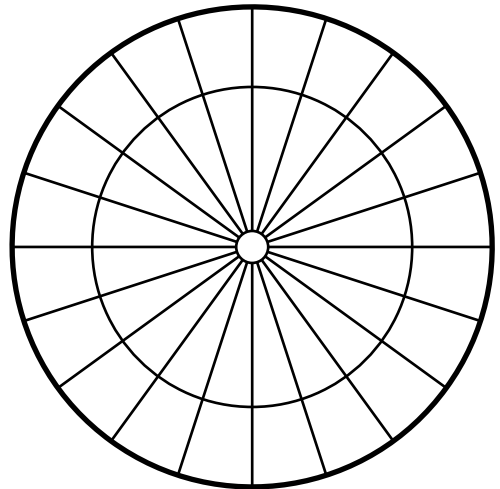
2. Where do you weigh the least during the ride?



3. Trace the shape of the path of a car if it came off at the nine o'clock position.



4. Where do you feel the most "peculiar" sensation?



5. Explain why you feel so peculiar at the point in number 4.

Gondola Wheel MC

Circle the best answer.

1. Once the Gondola Wheel reaches full speed, you
 - a. feel lighter as you travel up.
 - b. feel lighter as you travel down.
 - c. don't feel lighter when you are traveling up or down.

2. Once the Gondola Wheel reaches full speed, you
 - a. feel heavier as you travel up.
 - b. feel heavier as you travel down.
 - c. don't feel heavier when you are traveling up or down.

3. You feel slightly heavier
 - a. at the top of the ride.
 - b. at the bottom of the ride.
 - c. at no time during the ride.

4. During the ride, you are
 - a. moving faster at the top.
 - b. moving faster at the bottom.
 - c. moving at the same speed at the top and bottom.

5. The forces you feel
 - a. become stronger as the ride gains speed
 - b. become weaker as the ride gains speed
 - c. stay the same as the ride gains speed

6. If the Gondola Wheel turned at the same speed as the Falling Star,
 - a. riders would be bored
 - b. riders would be scared
 - c. riders would be itchy

Hoosier Hurricane E

Answer the following questions. Use complete sentences.

1. Where is the highest hill on the ride?
2. Why is it there?
3. Did you feel lateral forces on the ride (i.e. were you thrown from side to side in the train car?) If so, what forces caused that feeling? Use a diagram if necessary to help explain.
4. How did your body move when the Hoosier Hurricane reached a peak?
5. How did your body move when the Hoosier Hurricane reached a valley?
6. How did your body move when the roller coaster rode along a curve?
7. State the scientific law that accounts for your answers to problems 4-6.

Hoosier Hurricane MC

Circle the best answer.

1. The peaks get
 - a. higher during the ride.
 - b. lower during the ride.
 - c. sharper during the ride.

2. The higher you are
 - a. the slower you are moving.
 - b. the faster you are moving.
 - c. the narrower the tracks.

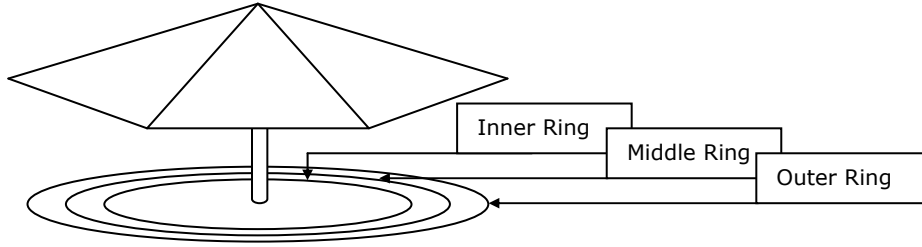
3. The lower you are
 - a. the slower you are moving.
 - b. the faster you are moving.
 - c. the narrower the tracks.

4. The faster you are moving
 - a. the less steep are the hills.
 - b. the more steep are the hills.
 - c. the easier it is to catch butterflies.

5. As you climb a hill,
 - a. you gain speed.
 - b. you lose speed.
 - c. you fetch a pail of water.

6. As you fall downhill,
 - a. you gain speed.
 - b. you lose speed.
 - c. you break your crown.

Merry Go Round C



Answer the following questions. Clearly show your methods for solving.

1. What is the time for one revolution of the outer ring of horses? 1.

2. Estimate the distance between two horse poles on the outer ring. 2.

3. How many horses are in the outer ring? 3.

4. Estimate the length of a chariot. 4.

5. How many chariots are there? 5.

6. Use the answers to questions 2 to 4 above to calculate the circumference of the outer ring. 6.

7. Use the circumference to calculate the radius of the outer ring. 7.

8. Use the circumference and time for one revolution to calculate the average speed of an outside horse. 8.

Merry Go Round C

9. Use the speed and radius to calculate the centripetal acceleration of an outer ring rider. 9.
10. Convert the answer to number 9 to an equivalent reading in g's. 10.
11. Estimate the distance between the outer and inner rings. 11.
12. Use your estimate to calculate the radius of the inner ring. 12.
13. Calculate the time for one revolution of the inner ring. Explain why you do not need a stopwatch. 13.
14. Calculate the speed of the inner ring. 14.
15. Use the speed and radius to calculate the centripetal acceleration of an inner ring rider. 15.
16. Convert the answer to number 15 to an equivalent reading in g's. 16.

Merry Go Round C

17. How do the speeds of the inner and outer rings compare?

18. How do you think the speed of the middle ring is related?

19. Use any technique to calculate the speed of the middle ring.

19.

20. Time the length of one ride.

20.

21. How far does a horse on the outer ring travel during one ride?

21.

22. How far does a horse on the middle ring travel during one ride?

22.

23. How far does a horse on the inner ring travel during one ride?

23.

24. How many people could ride the Merry Go Round if it held the maximum number of riders for 3 hours? Assume that it takes three minutes between each ride. Chariots seat four passengers.

24.

Merry Go Round MC

Circle the best answer to complete each sentence.

1. Your body is pushed slightly
 - a. to the outside as the ride turns.
 - b. to the inside as the ride turns.
 - c. backwards as the ride turns.

2. The horses
 - a. go up and down at different times.
 - b. go up and down at the same time.
 - c. do not go up and down.

3. The horse next to you
 - a. moved the same direction as yours.
 - b. moved in a direction different from yours.
 - c. did not move.

4. You feel lighter when your horse
 - a. is moving up.
 - b. is moving down.
 - c. is stopped.

5. The horses
 - a. move faster on the outside ring.
 - b. move faster on the inside ring.
 - c. move at the same speed, regardless of ring.

Money C

Find the regular prices for the following:

- | | |
|---|--------------------------|
| 1. Park Entrance Fee (Age 3 & over) | 1. <input type="text"/> |
| 2. Pay One Price Ride Pass (P.O.P.) – Under 48 inches | 2. <input type="text"/> |
| 3. P.O.P. – 48” and over | 3. <input type="text"/> |
| 4. Combination Ride & Water Park Pass (Combo) – Under 44” | 4. <input type="text"/> |
| 5. Combo – 44” to Under 48” | 5. <input type="text"/> |
| 6. Combo – 48” and over | 6. <input type="text"/> |
| 7. Water Park Pass | 7. <input type="text"/> |
| 8. Action River Only | 8. <input type="text"/> |
| 9. Sand Beach Swimming Only | 9. <input type="text"/> |
| 10. Universal Ride Ticket | 10. <input type="text"/> |
| 11. Gold Star Book (10 Tickets) | 11. <input type="text"/> |

Pay-One-Price Ride Pass (P.O.P.) – This pass allows guests to ride all Pay-One-Price rides as many times as desired during the chosen ride session. Normal ride session times are 11 a.m. to 6 p.m. or 4 p.m. to 11 p.m.

Combination Ride and Water Park Pass (Combo) – This pass allows guests to ride all P.O.P. rides from 11 a.m. to 11 p.m. plus allows entrance to the Water Park.

Water Park – The Water Park is open from 11 a.m. to 6 p.m. and includes Five Water Slides, a Speed Slide, Action River, and Sand Beach Swimming. Guests under 44 inches tall are not allowed in the Action River or on Water Slides.

Notice: Swimwear is required in swimming and Water Park areas. Life vests are required for children 44” to 48” tall on Water Slides & Action River. Children under 13 years of age must be accompanied by a paying adult 18 years or older.

Money C

The Sanson Family loves to visit Indiana Beach. Use the information from the first page along with the following table to answer the questions below.

Name	Age	Height
Kevin	30	6' 1"
Jennifer	30	5' 6"
Jacob	7	4' 3"
Katie	4	3' 2"

12. The entire family is planning to visit Indiana Beach and purchase P.O.P. Passes. How much will the entire day cost excluding games, shopping or eating, etc? Do not forget to add in the Park Entrance Fee.

12.

13. Jennifer's mother, Kathy, visits the family one sunny day. The family decides to go to Indiana Beach for the afternoon. This time, they want to do all the Water Park options available. Kathy chooses to only lounge in the Action River. How much will the afternoon of fun cost?

13.

14. Kevin decides to take Jacob and a friend to Guy's Day Out at I.B. Jacob's friend, Jimmy, is six years old and three foot eleven inches tall. How much will it cost to buy Combo passes for all three?

14.

15. Near the end of the season, the four Sansons head to Indiana Beach for a couple hours. They plan to ride the Den of Lost Thieves, the Shafer Queen (Short Trip), Dodgem, and the Train (One Way). How many Gold Star Books and/or Universal Tickets should they purchase in order to save the most money? You will need to find out how many tickets are required for each ride.

Gold Star Books Universal Tickets

16. How much will the purchase from number 15 cost?

16.

Revolving Rides RC

Complete the following chart.

	Primary Axis of Revolution (Horizontal, Vertical, Both)	Action of Seats (Spin, Swing, etc.)	Rider Capacity	Time for One Ride	Revolutions per Ride	Average RPM	Estimated Radius	Estimated Circumference	Distance Traveled During Ride	Average Speed of Outermost Rider
Merry-Go-Round										
Tilt-A-Whirl										
Chaos										
Flying Bobs										
Paratrooper										
Music Express										
Falling Star										
Flying Scooter										
Water Swings										
Gondola Wheel										

Revolving Rides RC

Use the chart to answer the following questions.

1. In your opinion, which of the rides on the chart is the best?
2. List the factors that make a good ride. Include information from the chart as well as any information not listed.
3. On which of the rides do you feel you are moving the fastest?
4. Which ride actually has the fastest average speed?
5. On which of the rides do you travel the farthest during one ride?
6. On which of the rides do you travel the shortest length during one ride?
7. Which of the rides on the chart can facilitate the highest number of riders per hour? For the purpose of this question, assume that each ride may be unloaded and loaded in the same amount of time.

Rocky's Rapids Log Flume A

Find three people who want to ride the Log Flume and make sure all three have horizontal accelerometers. Hold the accelerometers parallel to the motion and brace them against the side of the log. Each person should read the angle of the accelerometer at the bottom of the hill (the splash). Pay attention to the feelings you experience during the drop.

Angle 1

Angle 2

Angle 3

1. Calculate the acceleration at the bottom of the hill.
2. Were you thrown forward or pushed back at the bottom of the hill?
3. Why do you think that is?
4. How much did the three angles differ? Explain the difference.
5. How does the drop on Rocky's Rapids compare to the one on the Hoosier Hurricane?
6. Of the two rides, which was scarier?
7. Which has a better feeling of weightlessness?

Rocky's Rapids Log Flume C

Distance from start of the ride to the bottom of the lift: 396 feet

Answer the following questions. Clearly show your methods for solving.

1. How long does it take for the boat to travel from the start of the ride to the bottom of the lift? 1.
2. How long does it take for the boat to travel down the hill? 2.
3. How long does it take the boat to travel the level area from the start of the ride to the bottom of the lift? 3.
4. Calculate the average speed of the boat before the lift. 4.
5. Calculate the speed of the boat at the bottom of the drop hill, before the splash. Assume the speed at the top is zero and there are no friction losses. 5.
6. Estimate the height of the drop hill. 6.
7. Estimate the angle of the drop hill. 7.
8. Use the height and angle of the drop hill to calculate the length. 8.

Rocky's Rapids Log Flume C

9. Use the length of the hill and the time the boat took to travel down the hill to calculate the speed of the boat at the bottom of the drop hill. Assume that $V_f = 2d/t$, since $V_{av} = d/t$ and $V_{av} = (V_i + V_f)/2$ and we assume $V_i = 0$.

9.

10. Do the speeds calculated in Number 5 and Number 9 agree? Explain your answer.

11. When boarding a boat, what is the relative velocity between you and the boat you are boarding?

11.

12. Estimate the mass of a loaded boat.

12.

13. Determine the minimum amount of work the electric motor must do to lift a loaded boat to the top of the hill. Disregard friction.

13.

14. Determine the horsepower of the motor. Assume no friction.

14.

Rocky's Rapids Log Flume MC

Circle the best answer

1. The boat
 - a. is carried uphill on a conveyor belt.
 - b. is pulled uphill by a chain.
 - c. propels itself up the hill.

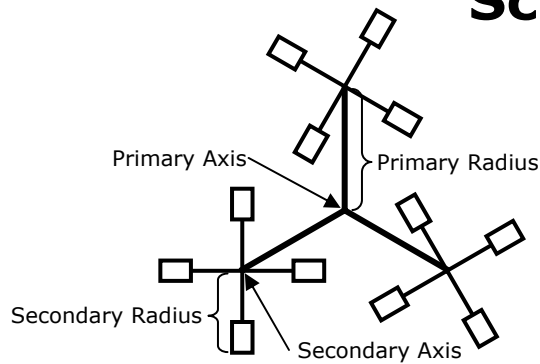
2. The water
 - a. is carried uphill with the boat.
 - b. is not on the hill.
 - c. flows uphill.

3. Until you reach the hill, the boat travels
 - a. through the water.
 - b. with the water.
 - c. against the water.

4. The water is
 - a. higher on the inside of the curves.
 - b. the same height throughout the curves.
 - c. higher on the outside of the curves.

5. A heavier boat
 - a. falls faster than a lighter boat.
 - b. falls at the same speed as a lighter boat.
 - c. falls slower than a lighter boat.

Scrambler C



Answer the following questions. Clearly show your methods for solving.

1. Estimate the length of the Primary Radius. 1.

2. Estimate the length of the Secondary Radius. 2.

3. What is the rotation direction around the Primary Axis as viewed from above? (Clockwise or Counterclockwise) 3.

4. What is the rotation direction around the Secondary Axis as viewed from above? (Clockwise or Counterclockwise) 4.

5. When the ride reaches full speed, how long does it take for one revolution about the Primary Axis? 5.

6. When the ride reaches full speed, how long does it take for one revolution about the Secondary Axis? 6.

7. What is the turning rate around the Primary Axis (rpm)? 7.

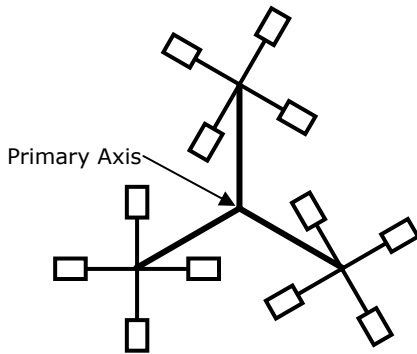
8. What is the turning rate around the Secondary Axis (rpm)? 8.

Scrambler C

9. Find the maximum lateral acceleration (measured at full speed). 9.
10. Find the minimum lateral acceleration (measured at full speed). 10.
11. Given the rotation speed and the radius of the car cluster, write an equation to describe the velocity vs. time for an individual car in the frame of reference of the car cluster. 11.
12. Given the rotation speed and the radius of the car cluster, write an equation to describe the velocity vs. time for a car cluster in the frame of reference of the stationary ground around the ride. 12.
13. Add the results of your two equations to predict the overall motion of an individual car relative to the stationary ground. 13.
14. Sketch the graph that is formed by this equation.
15. Find the maximum acceleration (dv/dt) of an individual car as given by your equations. 15.
16. Find the minimum acceleration (dv/dt) of an individual car as given by your equations. 16.
17. How do your answers to numbers 15 and 16 compare with the answers to numbers 9 and 10?

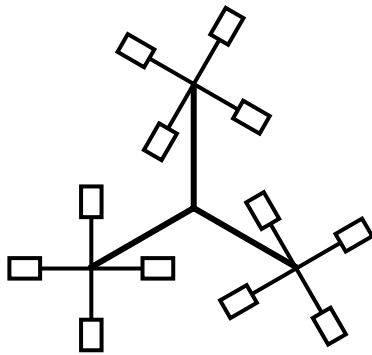
Scrambler D

1. Indicate on the diagram below the directions of rotation.

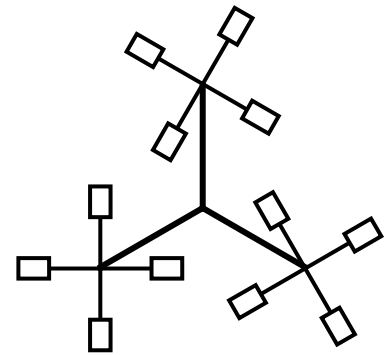


2. Sketch the path of a rider for one revolution around the primary axis, as seen from above.

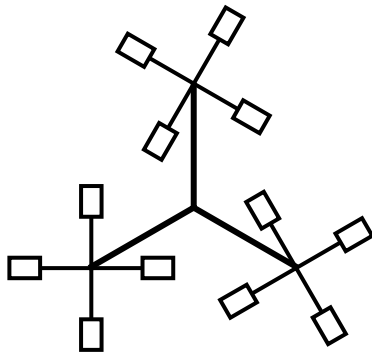
3. Label the point on the diagram below where your speed is the greatest.



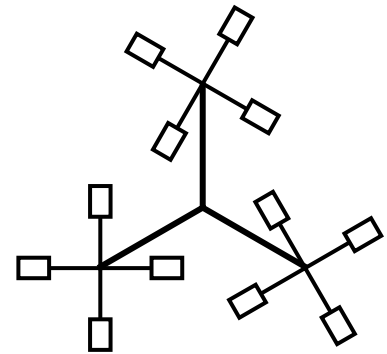
4. Label the point on the diagram below where your speed is the least.



5. Label the point on the diagram below where your acceleration is the greatest.



6. Label the point on the diagram below where your acceleration is the least.



7. Explain why the answers to questions 3-6 make sense in terms of Physics.

Scrambler E

1. Describe the sensations you felt during the ride.
2. Describe the direction of both the primary and secondary rotation. Are they the same or different directions?
3. What effect does the answer to number 2 have on your sensations during the ride?
4. What would happen if both the primary and secondary rotation were in the same direction? How would a ride like that feel?
5. What forces are at work on your body as you ride this ride?
6. Why do you think this ride is called the Scrambler?

Scrambler MC

Circle the best answer.

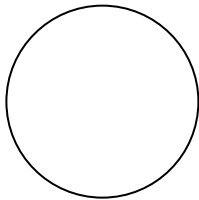
1. You are moving fastest
 - a. as you get farther from the ride's center.
 - b. as you get closer to the ride's center.
 - c. at the start of the ride.

2. The ride pushes you
 - a. outward as you make the turns.
 - b. inward as you make the turns.
 - c. upward as you make the turns.

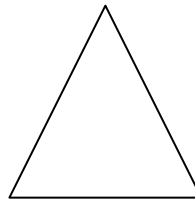
3. Your path is straightest when you are
 - a. closer to the ride's center.
 - b. farther from the ride's center.
 - c. traveling from the center to the outside of the ride.

4. Which of the following shapes best shows your path on this ride?

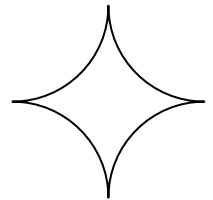
a.



b.



c.



Skycoaster C

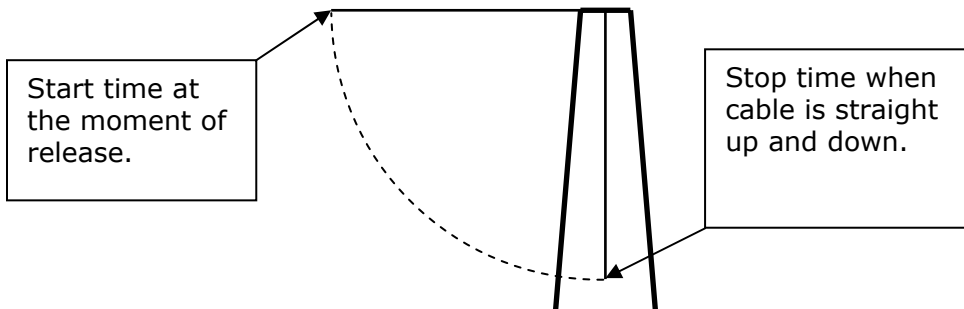
Fill in the chart with the following times:

Time of First full swing in seconds	
Time of Second full swing in seconds	
Time of Third full swing in seconds	
Time of Fourth full swing in seconds	
Time of Fifth full swing in seconds	
Time of Sixth full swing in seconds	
Average Time in seconds	

1. You should notice the times are very similar; they should be exactly the same. Give possible reasons why the times differ.

2. Find the time from the moment they release to the moment they are closest to the ground. See picture below.

2.



3. Find the maximum speed for the ride. Multiply the time by 9.8 meters per second.

3.

4. Convert this speed to miles per hour.

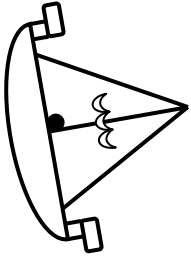
4.

Sea Dragon A

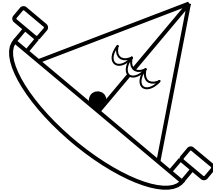
Sit in the center of the ride.

1. When the ride gets to full speed, at which point do you feel the heaviest?

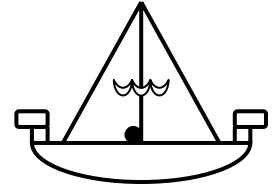
A.



B.

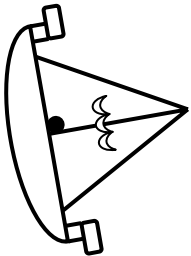


C.

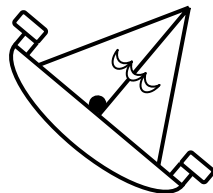


2. At which point do you feel the lightest?

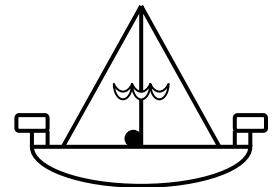
A.



B.



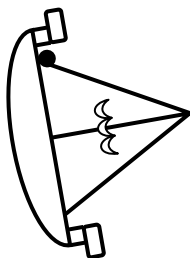
C.



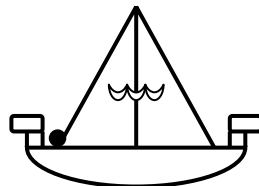
Now sit at one end of the ride.

3. When the ride gets to full speed, at which point do you feel the heaviest?

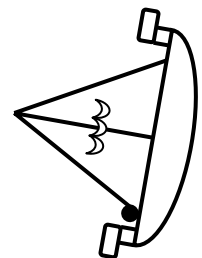
A.



B.

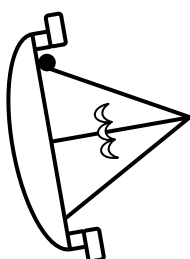


C.

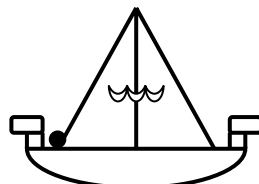


4. At which point do you feel the lightest?

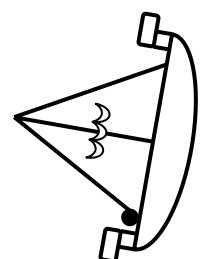
A.



B.

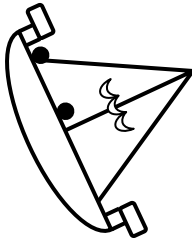


C.

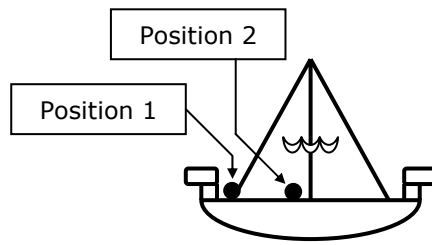


Sea Dragon C

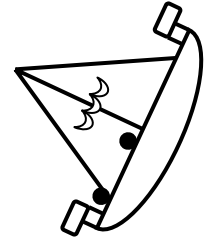
Point A



Point B



Point C



Fill in the following chart with the vertical acceleration at each point.

	Point A	Point B	Point C
Position 1	1.	2.	3.
Position 2	4.	5.	6.

7. Estimate the radius of the ship's path. 7.
8. Estimate the highest elevation that a rider in Position 1 is lifted. Assume zero elevation when the ride is at Point B. 8.
9. Using a stopwatch, determine the period of oscillation. 9.
10. Calculate the frequency of the pendulum. 10.
11. Using a horizontal accelerometer, find the maximum angle that the accelerometer displaces. 11.
12. What were the differences in acceleration between riding in Positions 1 and 2? 12.
13. At what point is the acceleration at its maximum? 13.
14. What direction is the acceleration? 14.
15. At what point is the velocity of the Sea Dragon a maximum? 15.

Sea Dragon C

16. At what point is the velocity of the Sea Dragon a minimum? 16.
17. How much kinetic energy does the Sea Dragon have at Point B? 17.
18. Calculate the maximum centripetal acceleration for the ride. 18.
19. Calculate the gravitational potential energy of a 75 kg rider in Position 1 at Point A. 19.
20. How much work was done to lift this rider to that height? 20.
21. How much horsepower is required to lift the ride to Point C? 21.
22. Calculate the speed of a rider in Position 2 at Point B. Assume no friction loss (hint: PE = KE) 22.
23. Calculate the speed of a rider in Position 2 at Point B using the formula for circular tangential speed: $v = 2\pi r / T$ 23.
24. How do your answers to questions 22 and 23 compare? Explain.

Sea Dragon D

Draw force diagrams. Label all forces exerted on a rider at each point.

1. The ship is motionless at the beginning of the ride	2. The ship is motionless at the maximum height of the ride
3. The ship is at a 45° angle to the ground on the way up	4. The ship is at a 45° angle to the ground on the way down
5. The ship is at the low point of the swing and speeding up	6. The ship is at the low point of the swing and slowing down

Sea Dragon E

1. What forces are at work on you as you ride the Sea Dragon?
2. In what respect is the Sea Dragon similar to a pendulum?
3. How is it different from a pendulum?
4. When did you feel you were going the fastest?

Describe your sensations as you pass through, or are at, the following points.

5. Motionless at the beginning of the ride
6. Motionless at the maximum height of the ride
7. At 45 degrees with the ground on the way up
8. At 45 degrees with the ground on the way down
9. At the low point of the swing speeding up
10. At the low point of the swing slowing down

Sea Dragon MC

Circle the correct answer.

1. To feel the lightest, you should sit _____ the center of the boat.
 - a. closer to
 - b. farther from
 - c. under

2. When the boat passes the lowest point, you are traveling the _____.
 - a. fastest
 - b. slowest
 - c. low road

3. When you are the highest from the ground, you are traveling the _____.
 - a. fastest
 - b. slowest
 - c. high road

4. When the boat passes the lowest point, you feel _____.
 - a. lighter
 - b. heavier
 - c. upside down

5. When you are the highest from the ground, you feel _____.
 - a. lighter
 - b. heavier
 - c. incomplete

6. How does swinging forward compare with swinging backward?
 - a. same feeling
 - b. different feeling
 - c. This ride swings?

7. Which of the following does the motion of the Sea Dragon most resemble?
 - a. parachute
 - b. pendulum
 - c. popcorn

8. What makes the Sea Dragon move?
 - a. water
 - b. wind
 - c. tires

Water Swings C

Answer the following questions. Clearly show your work.

1. Use the horizontal accelerometer to measure the average angle the swings hang while rotating. 1.

2. Determine the rotational period of the swings. 2.

3. On the boardwalk, measure the diameter of the swings when the ride has reached its maximum velocity. 3.

4. Along the cables of the ride, measure the support forces on the riders in g's using the vertical accelerometer. 4.

5. Use the diameter to find the circumference of the swings. 5.

6. Use the circumference and the rotational period to find the velocity at its maximum. 6.

7. Use the diameter of the swing to find the radius. 7.

8. Use the velocity and the radius to calculate the centripetal Acceleration. Use the formula $a = v^2/r$. 8.

Water Swings MC

Circle the best answer

1. As the ride turns faster, the swings
 - a. move toward the center.
 - b. don't move inward or outward.
 - c. move away from the center.

2. At the beginning of the ride,
 - a. the swings are closer to the middle than at any other time.
 - b. the swings are farther from the middle than at any other time.
 - c. the swings are not closer or farther from the middle than they will be later.

3. More weight in a swing,
 - a. makes it swing lower.
 - b. makes no difference in height.
 - c. makes it swing higher.

4. When the top of the swing support tilts,
 - a. you feel heavier when you are moving downward.
 - b. you feel heavier when you are closest to the ground.
 - c. you feel heavier when you are moving upward.

Indiana Beach Timeline

- 1922 Lake Shafer is created by the construction of Norway Dam.
- 1923 Earl Spackman and his family spend their first summer in a cottage at Lake Shafer.
- 1925 Mule teams pull a wagon of gravel that was spread by 2x4s to make a beach when Lake Shafer was lowered to fill newly completed Lake Freeman.
- 1926 Earl Spackman opens Ideal Beach with sandy beach swimming area, bath house facilities, a refreshment stand and 10 rental boats.
- 1927 Rental cottages and a 20-room hotel opened. Water Toboggan slide added.
- 1928 Passenger boat runs up and down the lake every 1 ½ hours: fare is 25¢.
- 1929 Monon railroad offers weekend excursions for \$3 round trip from either Indianapolis or \$3.50 from Chicago.
- 1930 New Ideal Beach Casino (Ballroom) burns down the night before opening day. Vaudeville acts, fireworks, motor boat races, and parachute jumps are featured.
- 1932 Vaudeville acts, radio stars and moving pictures presented every Sunday.
- 1937 12-foot wide, 650-foot long promenade pier built around bathing beach. Dance Pavilion (Ballroom) doubled in size to 6,000 feet and roll back roof installed. Water Toboggan slide rebuilt with a double track.
- 1940 Roller skating rink, grocery store, novelty & curio shop opened.
- 1941 Bowling Alley opens. Glen Miller and his band play in the Ballroom.
- 1944 Archery and miniature golf are added. Water merry-go-round is featured at the bathing beach.
- 1946 Earl Spackman passes away and his son, Tom Spackman takes over operations.
- 1947 First permanent rides: the Ferris wheel, the merry-go-round and the Rolo Plane (later called the Bullet) are added. Vaughn Monroe draws a record crowd.
- 1950 Man spends 71 days in a chamber under the surface of Lake Shafer protesting excise taxes.
- 1951 New Beach House Hotel opens, replacing original structure.

Indiana Beach Timeline

- 1952 Season opens with Daylight Fireworks. Name changed to Indiana Beach. New Kiddyland is connected to the Beach by a new Boardwalk.
- 1953 First Tilt-A-Whirl added.
- 1954 Park's southern area raised from a submerged island in Lake Shafer. The Summer Shop opens. Skill games opened, including Fascination, Skee Ball, and Shuffleboard tables.
- 1955 Indiana Beach begins advertising on TV in Indianapolis, Bloomington and Lafayette in Indiana and Champaign, Illinois. A gift shop with a "Terrainscope" Observatory was built on Paradise Island. Pronto Pups first appear.
- 1956 Island Miniature Golf opened. A giant spotlight beam was used to attract guests. A man was shot from a cannon for the closing week of the season.
- 1957 Bill Haley and the Comets perform in the Ballroom.
- 1959 New Aqua Theater introduced with water ski show and a boat jumping through fire. The ski show is currently still running.
- 1961 Eleven Trampolines were installed on Paradise Island.
- 1962 The Ski Rotor is created – a GM motor turned a long pole allowing night time skiing. Go cart track was added to Paradise Island.
- 1963 The Beach Boys draw a record crowd of 2600 people.
- 1964 Skyroom Restaurant built above the Ballroom. Sonny and Cher perform.
- 1965 Indiana Beach Campground opens June 25. Sky Ride, Bumper Cars and Antique Autos rides are added. Kiddyland was located at the end of Fascination.
- 1966 Introduction of the Shafer Queen paddle wheel passenger boat.
- 1967 Indiana's largest suspension bridge is built to connect Paradise Island to new south parking lot. Jefferson Airplane performs to a crowd of 4200.
- 1968 Taco Shoppe opens. REO Speedwagon and Iron Butterfly perform. Gold Star ticket books are introduced. Rides cost 25¢.
- 1969 Mystery Mansion dark ride and walk through Haunted House open. P.O.P. ride sessions begin Tuesday through Thursday from 1-6 p.m.

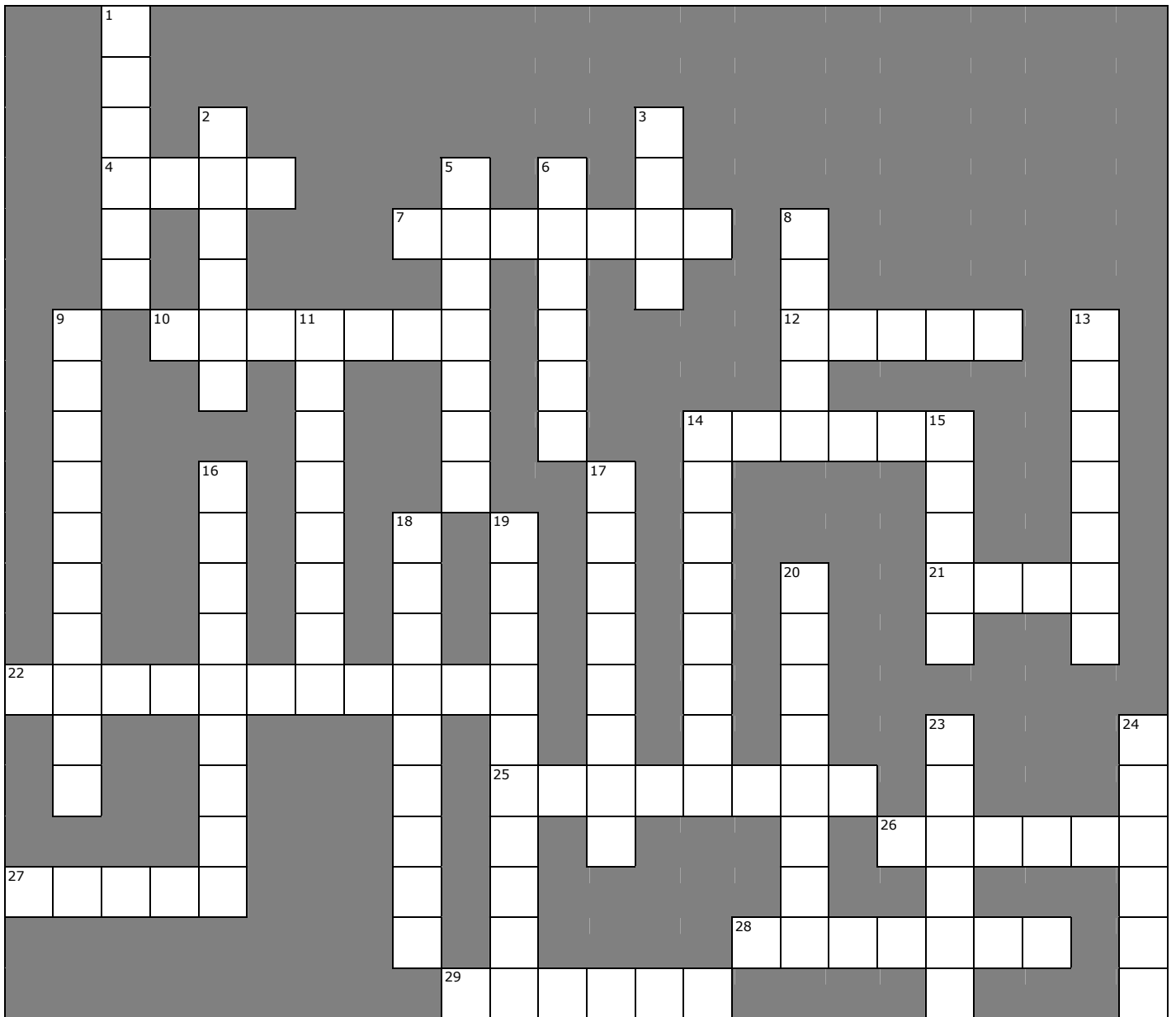
Indiana Beach Timeline

- 1970 Campground ferryboats added to carry campers from the campground to the Indiana Beach Boardwalk.
- 1971 Galaxi Coaster introduced. Wabash Cannonball Express train replaces smaller Monon miniature train.
- 1973 A larger, faster Shafer Queen is launched. The old craft is converted into Pronto Princess floating restaurant.
- 1974 Roundup and Sky Diver rides added.
- 1975 Elephant Ear stand opens on July 5.
- 1978 Superstition Mountain opens.
- 1980 Haunted House burns down over Labor Day weekend.
- 1983 Dr. Frankenstein's Haunted Castle, built of steel and cement blocks, is erected over the remains of the old Haunted House.
- 1984 Tig'rr Coaster added.
- 1986 Adopted the popular mascot, I.B. Crow, and "There's more than corn in Indiana" advertising theme.
- 1987 Water Park opens featuring Lazy River and 3 water slides.
- 1989 Giant Gondola Wheel and Convoy Race in Kiddlyland are added.
- 1990 New attractions include Falling Star ride and Boat Tag.
- 1991 Water Park expanded with addition of 2 new tube slides and a longer, quarter mile Action River.
- 1994 New 4.5 million dollar Hoosier Hurricane roller coaster opens.
- 1995 Sky Coaster thrill ride added.
- 1997 New Tilt-A-Whirl and Chaos replace Twister and Trabant rides.
- 1998 Yogi Bear Jellystone Camp Resort opens. Big Flush Water Coaster added. Mystery Mansion updated and renamed as the Den of Lost Thieves.
- 1999 Frog Hopper and Double Shot rides are added.

Indiana Beach Timeline

- 2000 Renovation of Dr. Frankenstein's Haunted Castle is completed.
- 2001 The Cornball Express, Indiana Beach's second major roller coaster, opens.
- 2002 Renovation of Superstition Mountain converts the classic ride into a coaster.
- 2004 Air Crow added.
- 2005 A Documentary of Indiana Beach is produced.
- 2006 Splash Battle replaces Boat Tag and a Splash Bash is added to the Sand Beach Swimming Area.

I.B. Timeline Crossword Puzzle



I.B. Timeline Crossword Puzzle

ACROSS

- 4 Type of slide added to the Water Park in 1991
- 7 This restaurant was built in 1964
- 10 The largest roller coaster at Indiana Beach is the _____ Hurricane, built in 1994
- 12 The second roller coaster at Indiana Beach
- 14 The first roller coaster at Indiana Beach
- 21 Introduced in 1959, the _____ Theatre is where the water ski shows are performed
- 22 This stand opened the day after Independence Day (2 words)
- 25 The common name of the building that burnt down the night before it was scheduled to open
- 26 The number of trampolines originally installed in 1961
- 27 The ride that replaced the Trabant
- 28 One of the attractions added in 1944
- 29 The Terrainscope Observatory was built on Paradise _____

DOWN

- 1 Type of building built on the remains of the burnt down Haunted House
- 2 The name of the park mascot adopted in the 80's
- 3 Kiddie ride added in 1999: _____ Hopper
- 5 One of the rides added a decade after the Pronto Pups first appeared
- 6 The original Shafer Queen was converted into the _____ Princess in 1973
- 8 This opened in 1927 with 20 rooms
- 9 This artist performed the same year that the Bowling Alley opened at Ideal Beach (2 words)
- 11 Last name of the founder of Indiana Beach
- 13 One of the attractions added in 1990 (2 words)
- 14 Type of ticket book introduced in 1968 (2 words)
- 15 The original name for our park was _____ Beach
- 16 This group performed the year before Sonny and Cher (2 words)
- 17 One of the skill games opened in 1954 (2 words)
- 18 How the season opened the same year that the name was changed to Indiana Beach
- 19 These were added at the beginning of the 1970's to transport campers to the park
- 20 This device allowed night time ski shows (2 words)
- 23 Another name for the Rolo Plane
- 24 Last name of an artist that performed at Ideal Beach in 1947