Name: Partner: Teacher:

Ninja

QUALITATIVE QUESTIONS

1. a. The system consists of the train, the track, the earth and the air but not the motor that pulls the train up the first hill. How is energy transferred into the ride at its beginning.

   b. Is energy transferred into the ride anywhere else? Explain.

2. After the first hill, what force(s) cause the ride to accelerate?

3. Where during the ride is there a lateral/sideward force on the wheels of the train?

5. At what point on the ride do you feel lightest?

6. At what point on the ride do you feel heaviest?

7. What direction is your body pushed as you go around the first loop?

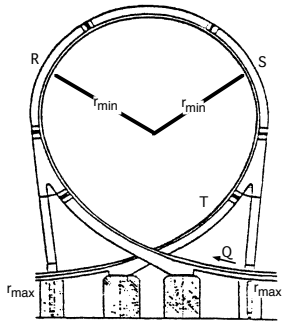
8. When you **enter** the first loop you feel (heavier) (lighter) than you usually do.

9. When you reach the top of the first loop you feel (heavier) (lighter) than you usually do.

10. While circling around inside the loop, your body is pushed (away from) (toward) the loop's center.

11. Bonus: While screaming as you approach the top of the loop (R on the diagram) your retainer falls out of your mouth.
    a. Does the retainer fall out of the car or into the car? Explain.

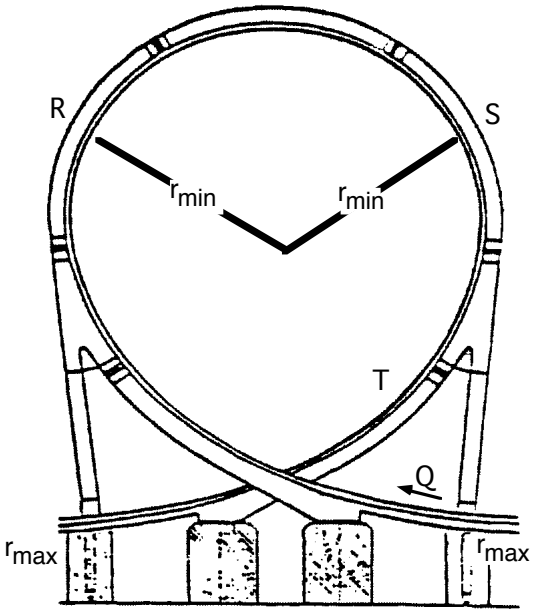
    b. From the frame of reference of someone on the ground, does the retainer appear to fall up or down before you grab it? Explain.



QUALITATIVE QUESTIONS (continued

12. Why are the curves on the Ninja banked?

13. A clothoid loop has an ever-decreasing radius as the rider enters the loop at point Q and climbs to point R. From point R to point S the loop is circular with a constant radius. At point S the radius begins to increase until it reaches its maximum value again at point T. What is the advantage of this curve over a circular loop?



14. Accelerometers mounted in the front and rear cars to a coaster can be used to measure the force component perpendicular to the rider's seat as the coaster travels through a clothoid loop. The table below gives those data recorded for this situation. Use these data to answer the questions that follow.

ACCELEROMETER DATA GOING THROUGH THE LOOP

	Front Car	**Back Car**
Entering loop	4.8 g	3.4 g
Top of loop	1.5 g	1.4 g
Exit of loop	3.2 g	4.8 g

Attempt to explain the differences in accelerometer readings for front and back cars:

a. entering the loop.

b. exiting the loop.

QUANTITATIVE QUESTIONS

1. Measure the time from the top of the first hill to the place where the train slows down due to friction at the end. The track length is 741 meters. Calculate the average speed of the ride.

2. Calculate the speed at the top of the first hill. The length of the whole train is 18.9 meters.

3. Calculate the speed at the top of the first loop.