QUALITATIVE QUESTIONS

1. Energy is put into the ride at its beginning. Is energy put 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?

4. Did you feel upside down when you were at the top of the first loop? Why or why not?

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.

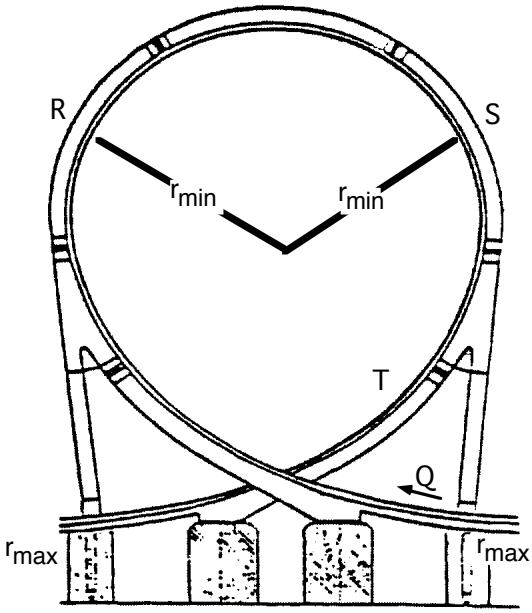
11. While screaming as you approach the top of the loop, your retainer falls out of your mouth. Which way does it go:
    a. from your frame of reference? Explain.

    b. from the frame of reference of the ground? 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

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.

4. Approximate the centripetal acceleration at the top of the first loop. Assume the height is equal to the diameter of the loop (although we know that this is not exactly true since the loop is a clothoid rather than a circle.) The crossbars are 5 m apart.

QUANTITATIVE QUESTIONS (continued)

5. If the mass of the loaded train, the height of the initial incline, and the time required for the train to travel up the incline is known, the power of the motor used to pull the train up the incline can be estimated. Measure the angle the incline makes with the horizontal, the length of the incline, and the time required for the train to move from the bottom to the top of the incline.

   Angle of incline _____ Length of incline _____ Time to go up the incline _____

   The mass of the train fully loaded with 28 60.0 kg physics students is about 7000 kg.

   a. Using the angle of inclination and the length of the incline, calculate the vertical height of the train at the top of the incline above its lowest position.

   b. Assuming the train moves up the incline without friction and at constant speed, the work done by the motor equals the increase in potential energy of the loaded train as it moves up the incline. Calculate the increase in potential energy of the train.

   c. The work done per unit time is the power supplied by the motor. Calculate the power supplied by the motor in kilowatts.

   d. Under real conditions the power rating of the motor used would have to be greater than this value. Why?