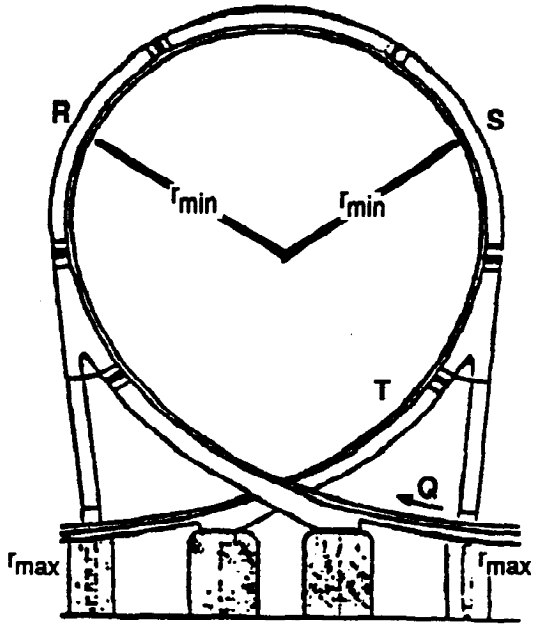
MAKE-UP ASSIGNMENTS

Listed on the next few pages are assignments that could either be used by students who did not attend Amusement park Physics, or by all students as part of your class preparation and/or follow-up the day.

THE CLOTHOID LOOP

A Clothoid loop has an ever decreasing radius as the rider enters the loop at point **A** and climbs to point **B**. From point **B** to point **C** the loop is circular, with constant radius. At point **C** the radius begins to increase until it reaches its maximum value again at point **D**.

1. What is the advantage of this curve over a circular loop?



2. Assume a coaster speed of 96.5 km/h as the center of the coaster enters the loop, a loop height of 23.16 m, and a uniform decreasing radius of curvature from 49 meters to 7 meters with a circular top loop of 130.6°. Next assume a frictionless track and calculate the velocity as the middle of the coaster passes: (a) Point A, (b) Point B, and (c) Point C.

a) _____

b) _____

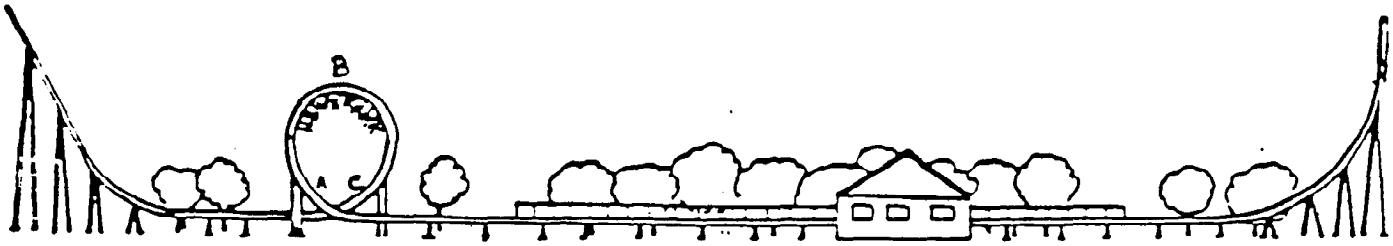
c) _____

CLOTHOID LOOP (continued)

The picture below illustrates a Shuttle Loop Coaster which uses a Clothoid loop.

The coaster carries riders through the loop forward and then backward. A slingshot flywheel catapult mechanism propels the coaster along the track.

The coaster makes the loop going forward and climbs the left ramp. The coaster then rolls down the ramp, through the loop backward, and up the right ramp. In just over 30 seconds, the coaster is back at rest in the station.



Accelerometers mounted in the front and rear cars measure the force component perpendicular to the rider's seat. The table below gives the data recorded. Use it in answering the following questions:

ACCELEROMETER DATA
GOING FORWARD & BACKWARD THROUGH LOOP

Entering loop forward	(Point A)	=	4.8g	(front car)	3.4g	(back car)
Top of loop forward	(Point B)	=	1.5g	(front car)	1.4g	(back car)
Exit of loop forward	(Point C)	=	3.2g	(front car)	4.8g	(back car)
Entering loop backward	(Point C)	=	2.6g	(front car)	4.2g	(back car)
Top of loop backward	(Point B)	=	0.5g	(front car)	0.3g	(back car)
Exit of loop backward	(Point A)	=	4.2g	(front car)	2.8g	(back car)

3. Explain differences in accelerometer readings for the front and back cars at Point A going forward and backward.

4. Explain why the g-force is less at the loop top when the coaster goes through the loop backward.

5. Acceleration is the change in velocity per unit time. Jerk is the change in acceleration per unit time. From the accelerometer data, determine the points where the rear car and the front car experience the greatest jerk. Describe location of the points.

   a. Greatest rear jerk _____

   b. Greatest front jerk _____

COASTER CALCULATIONS

The following data pertains to the **American Eagle** coaster near Chicago, Illinois. Use the data table to work the problems listed below.

DATA

Track length:	1417 m
Train mass:	4536 Kg
Greatest height:	38.7 m (first incline)
Length of 1st vertical drop:	44.8 m
Angle of 1st drop	55°
Length of 1st lift:	100 m (chain speed: 2.7 m/s
Maximum speed:	106.7 km/h
Length of ride:	2 min, 23 s
Gravity forces:	Up to 1.65 g's in the dips (1 g = 9.8 m/s^2

1. How long does it take for the coaster to climb the first hill?

2. What is the climbing angle of the first incline?

3. What is the maximum gravitational potential energy for the coaster as measured above the lowest point in the ride?

4. What is the average speed of the entire ride?

5. What is the maximum kinetic energy for the coaster?

6. Assume a speed at the top of the 1st hill of 2.7 m/s and a vertical drop of 44.8 m. What should be the speed at the bottom of the hill with no friction or air resistance losses?

7. How large are the actual friction and air resistance losses in km/h?

8. How long is the track down the first drop?

9. What is the friction and air resistance loss per meter during the drop?

10. If the coaster had the same frictional and air resistance losses for the whole trip, would it reach the station?

11. Do you expect friction/air resistance losses to be greater or less in the latter part of the ride?