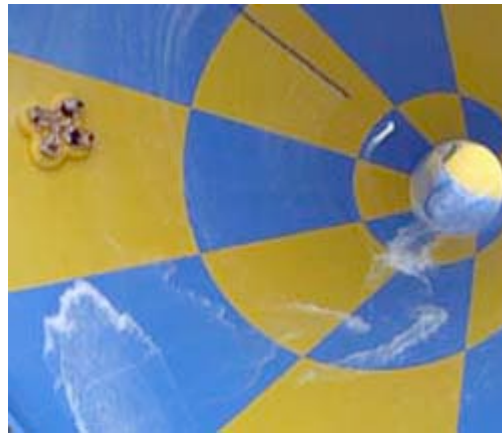


# The TORNADO

## Introduction



The Tornado looks like a huge funnel, 60-feet tall, lying on its side. This exciting ride begins on a platform 75 feet in the air, where riders are sent down a 132-foot long tunnel and thrown into the giant funnel. Riders go in groups of four, on special clover-leaf shaped tubes. The tubes are carried along by 5,000 gallons of swirling, splashing water.



## Data

Funnel Diameter:	61 feet at large end, 12 feet at small end (= 18.6 m and 3.65 m)
Maximum Speed:	30 m.p.h. = 48 km / h = 13 m / sec.
Time to end of tunnel:	_____ sec.
Total time to end of ride	_____ sec.
Number of Oscillations:	_____
Average period of oscillation (see the first calculation problem below to get the answer to this one):	_____ sec.
Manufacturer	ProSlide Technology, Inc

NOTE: This activity meets State of Texas TEKS requirements from §112.47, Physics, including items (c) (2) (B) to (D), (5) (B) and (C), and 6(A). The activity also meets state TEKS requirements from §111.32 Mathematics, including items (b) (1) (A), (B), and (D). <http://www.tea.state.tx.us/teks/>

This activity also meets National Science Education Teaching Standards B, C, and D; and Program Standard D (“Good science programs require access to the world beyond the classroom”). More details about these and other national science education teaching standards can be found at <http://www.nsta.org/standards>

### **Questions**

1. Why is the highest point of the ride at the very beginning?
2. What are some sensations you experienced while descending the tunnel?
3. What did you experience when you were poured into the funnel?
4. As you were going back and forth in the tunnel, how high were you able to swing? How did you feel at the ends of the swing? Near the middle of the swing?
5. Where on the ride did you feel you were going the fastest?

## Calculations

1. To calculate the average period of oscillation:

$$[T (\text{ride total}) - T (\text{tunnel only})] / \# \text{ counted oscillations}$$

2. Throughout the tornado portion of the ride, the riders move like a pendulum whose length from the pivot point is continuously decreasing from  $L = 9.3$  m near beginning to  $L = 1.8$  m near the end. How does that affect the period of oscillation (based on observation), all other things being equal?

3. If you had two pendula, one with  $L_1 = 9.3$  m feet, a second with  $L_2 = 1.8$  m, all else being equal, how do their periods,  $T$ , of oscillation compare? (The value  $\pi = 3.14159$ , and  $g = 9.80$  m / sec., the acceleration due to gravity)

$$T_1 = \underline{\hspace{2cm}} \text{ sec.} \qquad T_2 = \underline{\hspace{2cm}} \text{ sec.}$$

How do these values compare with your average oscillation calculation?

4. Consider the following scenarios. How would the speeds and oscillations (including the amplitude or maximum height) change if you have (a) four light people? (b) two light and two heavy people, with the heavy people sitting diagonal from each other on the tube? (c) two light and two heavy people, with the heavy people sitting next to each other on one side of the tube? (d) and four heavy people?

5. Here's a new spin on things. Suppose the tube with the above configurations starts to spin in each case, so that not only are the people going back and forth, but they are also spinning in their tubes as they go along. How would this affect the results? (Hint, think about the fact that the center of mass of an object moves consistently...)

6. Your instructor(s) may have additional questions pertaining to this ride; you may write your responses to these on the back of this sheet if needed.