Since the beginning of modern roller coasters in the 1400's, manufactures have been trying to 'out-do' each other. Until, in the 1700's a series of accidents shifted the manufactures' emphasis on safety. Today, injuries seldom occur on roller coasters and the riders flock to the fastest and tallest coasters around. To maintain demand, the amusement parks need to supply the tallest and fastest roller coasters for the 'thrill-seekers'. The burden of safety lies in the hands of the manufactures and amusement park owners. Both must spend millions of dollars insuring the safety of their rides.

You are an engineer working at an amusement park. A group of riders complained of headaches after riding the new roller coaster. After investigating the occurrence it is found that the headaches were caused by excessive alcohol consumption. However, in fear of a lawsuit, the owner of the park demands the ride be shut and wants you to perform a full investigation regarding the safety of the ride.

Questions
1. What safety issues should you be concerned with? What injuries are most common on roller coasters?
2. What is wrong with a coaster that causes these types of injuries? What is 'g-force' and how does it relate to the safety of a ride?
3. Is there a difference between positive and negative g-force? How do they affect the body differently?
4. What criteria will you use to govern the safety of the coaster? Are there national or professional standards that regulate the safety of roller coasters? What injuries are the most common on roller coasters?
5. What government regulations have been recently implemented regarding roller coasters?
6. The shape of vertical loops is similar to an upside down teardrop. This shape is known as a clothoid loop (also spelled klothoid). Why is this shape used in roller coaster design and how does this shape affect the velocity, acceleration and safety of the ride?

New Jersey recently passed a law that limits the g-force on a roller coaster to 5.6 g's for a period no longer than 1.0 seconds.

7. What physics principles will you use to determine if the ride in question meets the new found standard?
8. Should there be a distinction between negative and positive g-force when determining a safe limit?
9. What is the difference between 'red out' and 'black out' as a result of excessive g-force?
10. Assuming zero energy losses, determine velocity and g-force experienced at Points A, B, C, D & E.
11. Using your book or another source, make a reasonable estimate for the coefficient of friction for a roller coaster car. Then calculate the percent of energy lost due to non-conservative forces acting on the ride between successive points and the velocity and g-force at points A, B, C, D & E.

Some internet resources can be found on the back of this sheet
A layout of the ride is below. Use this and the data provided to determine the safety of the ride. Write a report that addresses the safety of the ride and make a recommendation regarding the operating status.

Resources
http://www.learner.org/interactives/parkphysics/coaster/
http://hypertextbook.com/facts/index-topics.shtml
http://science.howstuffworks.com/roller-coaster.htm