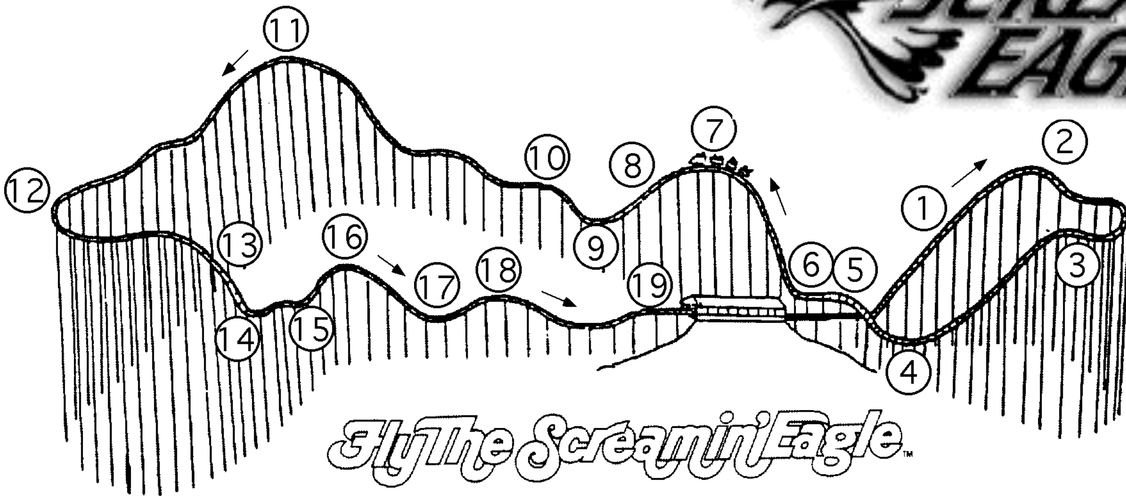
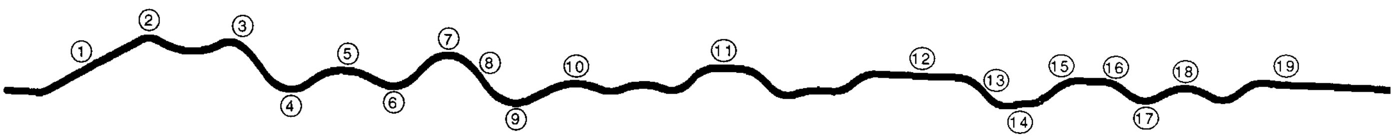


If the track were stretch out so that it were entirely in a single plane, the profile would look like the diagram below.



Some of the numbered sections of the track are described to the right. The times are approximate but should be fairly consistent with the graphs on the next page.

Point	Description	Time (s)
1	Lift	
2	Top of lift	48
3	First hill	58
4	Bottom of first hill	63
5	First bump	65
7		70
9		73
11	Corner	83
12	180˚ turn	92
14		99
17	Valley	110
19	Brake shed	118

About the graphs

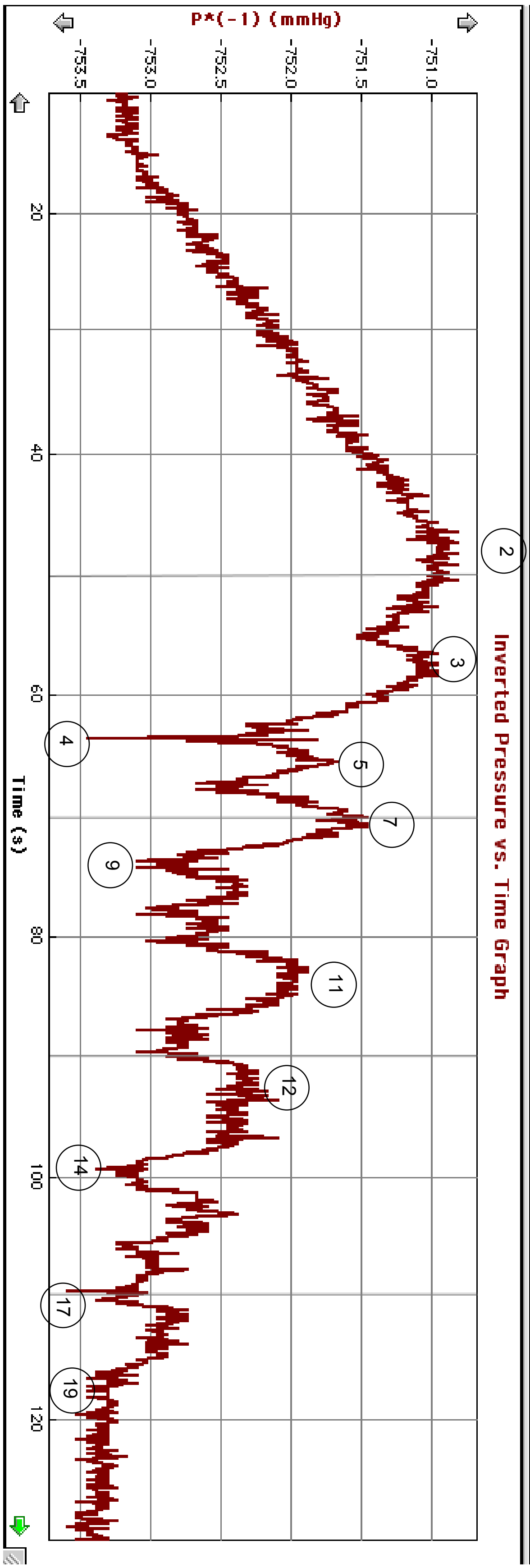
The graphs on the following page were produced by attaching a barometric pressure sensor and an electronic "accelerometer" to a portable electronic data collection device. The device collected data at a rate of 20 samples per second. These readings were plotted against time to yield the graphs.

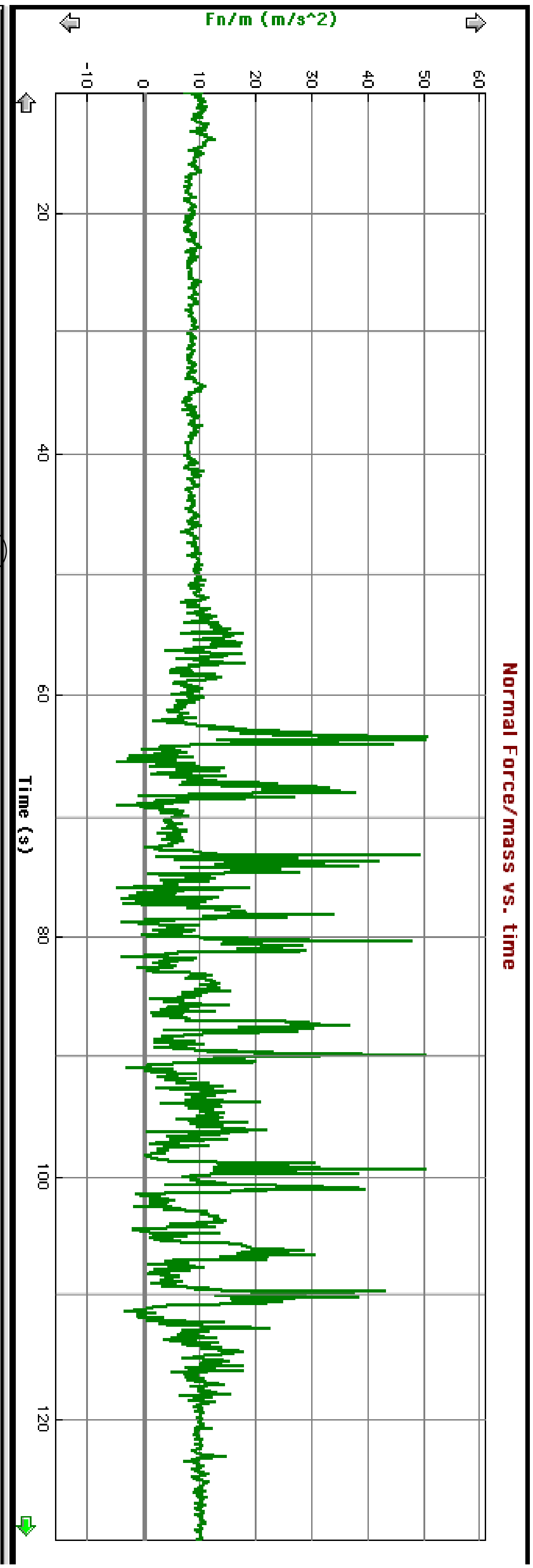
Normal Force/mass vs. Time Graph

When oriented vertically, "accelerometers" <u>do not</u> actually measure acceleration. They measure the Normal Force to Mass ratio rather than the Net Force to Mass ratio. Since gravity always acts downward on the object, the Normal Force will never be the **net** force in a vertical situation. Consequently, you will have to make appropriate adjustments to the graph readings in order to determine accelerations. This discrepancy between "accelerometer" readings and actual acceleration is explained in detail in the acceleration portion of the **Suggestions for Making Measurements** manual.

Inverted Pressure vs. Time Graph

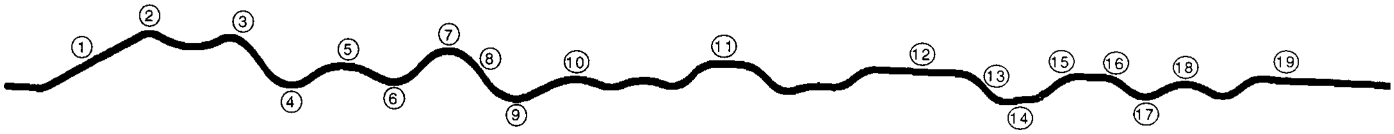
Since the pressure in a fluid in a gravitational field changes with height, the atmospheric pressure as measured by a barometer can be used to gauge vertical position. In the inverted pressure vs. time graph on the following page, the opposite (-) value of the atmospheric pressure was plotted against time. Since atmospheric pressure gets <u>smaller</u> as the height increases, the inverted pressure graph resembles the profile of the ride. This can be very helpful as you attempt to interpret the normal force/mass vs. time graph.


P*(-1) (mmHg)
Inverted Pressure vs. Time Graph
Time (s)
-753.5
-753.0
-752.5
-752.0
-751.5
-751.0
20
40
60
80
100
120
2
3
4
5
7
9
11
12
14
17
19


Fn/m (m/s^2)
Normal Force/mass vs. time
Time (s)
-10
0
10
20
30
40
50
60
20
40
60
80
100
120

QUALITATIVE QUESTIONS

If the track were stretch out so that it were entirely in a single plane, the profile would look like the diagram below.



Some of the numbered sections of the track are described to the right. The times correspond to a graph found on the first page.

Point	Description	Time (s)
1	Lift	0
2	Top of lift	48
3	First hill	58
4	Bottom of first hill	63
5	First bump	65
7		70
9		73
11	Corner	83
12	180˚ turn	92
14		99
17	Valley	110
19	Brake shed	118

1. List the number or numbers from the track profile that best match the phrases below:

   ______ maximum velocity

   ______ maximum kinetic energy

   ______ maximum gravitational potential energy

   ______ freefall area

   ______ 3 weightless zones (there are more than 3)

   ______ where a machine makes the ride go instead of gravity

   ______ where friction has greatest effect

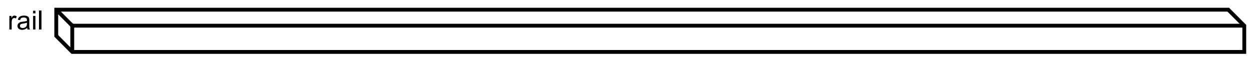
2. Why is point 2 higher than point 7? Use the term "energy" in your answer.

3. Identify at least three reasons that energy becomes stored as internal energy in the system consisting of the roller coaster, the earth and the surrounding air, from point 1 to point 19, in this ride.

   a.___________________________ b.___________________________
   c.___________________________

QUALITATIVE QUESTIONS (continued)

4. Look at the wheels on the cars and notice that some are above the track and some are below the track. At some times during the ride, the bottom seems to drop out from you. Write the number corresponding to one of those times here __________. Make a sketch of the wheels and explain which wheels were pressing against the rails at this time.



5. List two points where you feel heavy. _______ ________

   List two points where you feel light. _______ ________

Note: The questions that follow refer to a normal force/mass vs. time graph. This graph can be found on page 2 of this packet. An explanation of this graph is on page 1.

6. Describe and give reasons for the shape of the pressure and normal force/mass graphs when:

   a. The rollercoaster is in a valley.

   b. The rollercoaster passes over a hilltop.

7. As you go down the first large hill you are obviously speeding up. Should the accelerometer reading during this section account for this acceleration? Explain!

QUALITATIVE QUESTIONS (continued)

8. Is there any relationship between the shape of the profile of the track and your normal force/mass vs. time graph? Explain any similarities and differences you notice!

9. Analyze your normal force/mass vs. time graph. What does it say when you are
   a. NOT accelerating?

   b. Accelerating upwards (toward your head)

   c. Accelerating downwards (toward your toes)

10. What was the <u>direction</u> of your acceleration as you went over the first bump (point 5)?

11. Draw and label a force diagram for your body at the top of the first bump (point 5). You **feel** weightless at this point. Be sure the length of force vectors are representative of the relative sizes of the forces.

12. Draw and label a force diagram for your body at the bottom of the first hill (point 4). Be sure the length of force vectors are representative of the relative sizes of the forces.