Worth 85 points

PAPER ROLLERCOASTERS

Introduction:
For many people, there is only one reason to go to an amusement park: the roller coaster. Some people call it the "scream machine," with good reason. The history of this ride reflects a constant search for greater and more death-defying thrills.
How does a roller coaster work? What one may not realize is that the coaster has no engine. This is hard to imagine when a person can cruise down the track of a roller coaster at 60 miles an hour! As the car is pulled to the top of the first hill at the beginning of the ride it picks up all the energy it needs to complete the ride. After the first ascent, the coaster must complete the ride on its own. A rider is not being propelled around the track by a motor or pulled by a hitch. The conversion of potential energy (that is built up as the ride is taken up the first hill) to kinetic energy is what drives the roller coaster, and all of the kinetic energy that is needed for the ride is present once the coaster descends the first hill. Remarkable isn't it?

Objective: Each team will design a rollercoaster from a fixed track length that can carry one marble (simulates 100 paying customers!) to completion without flying off the track. Each team will calculate the total energy of their rollercoaster and determine which group has the coaster that if built in real life would be the most fun!

Permissible Materials:

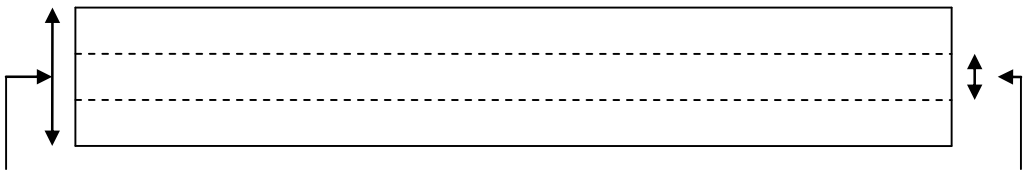
Tape	Poster Paper	Sticks and piece of string (1 m long)
Support Stand	Marble	Glue
Your teacher may allow other materials for supporting the coaster, please consult your instructor. All tracks should only be made of paper.		

Rules:

- Your rollercoaster must have a first hill with a height of at least 1 meter, and at least two additional hills. **40 points**
- Marble (100 paying customers) must complete the ride from start to finish without falling off. **20 points**

* You can earn an additional 10 points for successfully making a loop (At the top of the loop, riders are completely inverted.)

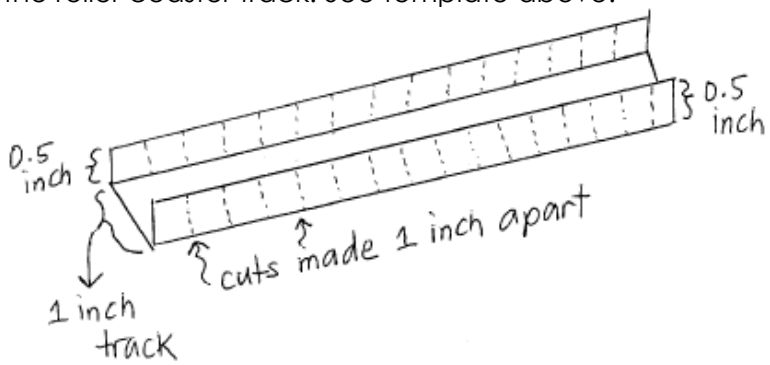
Part A: Build the rollercoaster (60 points)



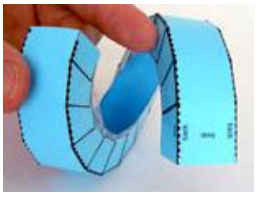
Two inches across = total width

Width of track is one inch and each folded flap is 0.5 inch

1. Cut long strips of paper an two inches wide. Fold each side to make flaps that are half an inch wide. This will be the roller coaster track. See template above.



2. Cut notches along each folded flap. Space the cut notches every one inch. This will allow you to twist the tracks into different shapes. See figure above.
3. Assemble your roller coaster. For added fun (and points), you can include the following designs in your roller coaster:



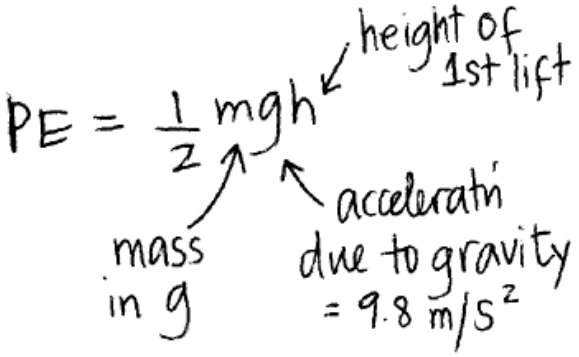
Twists Corkscrew

*Please see the Appendix for a sample of a completed product.

Part B: Calculations (20 points)

1. Start by measuring the height of your rollercoaster's first lift (where you will initially place the marble). This height should be in meters (use a meter stick!). You may use a ruler (measure in cm) and just divide the value you get by 100 to have the measurement in m.
2. Measure the mass of your marble in grams (use a triple beam or electronic balance).

3. Calculate the PE of your rollercoaster by using the formula below:



4. Identify FOUR points (A, B, C, and D) along the track of your rollercoaster (these points have to be as widely spaced apart as possible, with the last point at the very end of the track). Use the piece of string and a ruler (measure in cm) to determine the length of the track along these points.

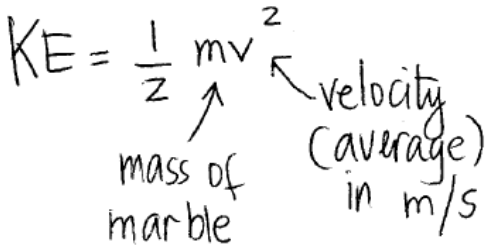
5. Complete the data table below:

POINT	Distance from Previous Point	Time Elapsed since previous point*	Average Velocity**
A			
B			
C			
D (last point on track)			

*Measure the time it takes for the marble to pass by the previous point to the next point. It is recommended you do three measurements and take the average.

**Average velocity is distance divided by time

6. Calculate the…
   - Total length of roller coaster track: _____ m
   - Total time marble takes to travel entire roller coaster length: _____ s
   - Average velocity: _____
   - Kinetic Energy of the roller coaster:



7. Total Energy of Roller Coaster:

Total Energy for your coaster is KE _____ + PE _____ = _____ Joules.

Part C: Reflection Sheet (5 points)

Rollercoaster Project Reflection Sheet

1) What was the most difficult part of this project?

2) Did your rollercoaster work perfectly the first time? If not, what went wrong, and how did you fix it?

3) What did each member of your team do? Write your answer below and give each team member a grade.

   Yourself: _____

   Teammate 1: _____

   Teammate 2: _____

   Teammate 3: _____

Appendix A Roller Coaster Sample Picture

Picture from www.paperrollercoasters.com

Students from Norwood JHS working on their roller coaster project…