Name: _____ Date: _____ Hour: _____

Roller Coaster Project

This roller coaster project is designed to be a culminating activity on motion, forces, and energy. Using your creativity and physics knowledge, you are being asked to design a roller coaster that is exciting but also safe for the riders (marbles). While your coaster design is unique from other groups, it should still have at least one loop and a variety of turns. Remember, be creative and make the roller coaster exciting!

Rules:
-No infringing upon other group work areas! If you are messing with another group's coaster or screwing around, you take a zero on the project and will be checked out of class!
-No altering the pipe insulation! We only have a limited amount of materials.
-Your marble needs to move on the track safely. This includes stopping safely at the end of the ride.
-Do not lose your marble! It will cost you if you lose it.
-Your group must work cooperatively together. This means all members are playing an active role. You will be assessed and assessing your group members on this!
-Your group is responsible for cleaning up your workspace daily and carefully breaking down your coasters after project completion. Pipe insulation and marbles are absolutely to be returned! Damaged equipment incurs a cost.

Brainstorm: What materials will your group need? I will provide pipe insulation, tape, scissors, and a marble. Think: How will you create hills for your coaster? List items your group will need to bring in here:

Sketch: Draw two sketches of your proposed roller coaster below:

Sideview

Top View

Constructing and Testing: As you are building your roller coaster you will have to test it to see how the riders (marbles) respond. This requires you to make adjustments to make a coaster that you want within the physics of the ride. Once your marble makes it consistently from the top of your coaster to the bottom we need to collect some data.

Data:

Mass of the marble: _____ kg (You might have to place the marble in a cup to keep it from rolling off the balance.)

Mass of marble and cup: _____ kg

Mass of cup: _____ kg (subtract from above measurement to get the mass of the marble)

Time of the ride: _____ s (This is the time from the beginning to the end of the ride)

Length of the track: _____ m

Height of the 1st big hill (tallest point): _____ m

Did your marble make three consecutive, safe runs down the track? _____

Calculations: Show your work and write the correct units in your answer!

What is the average speed of your roller coaster? (Average speed = Total Distance ÷ Total Time)

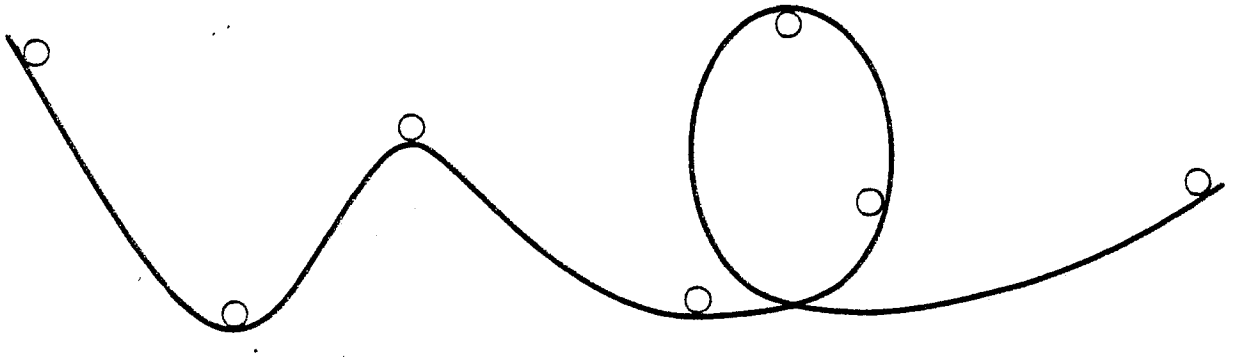
Using your average speed, what is the momentum of the marble? ($p = mv$)

What is the potential energy of your roller coaster at the top of the first hill? ($PE = mgh$)

Find the speed (distance ÷ time) from the top of the first hill to the bottom of that hill. Using that speed, find the kinetic energy of your marble? ($KE = \frac{1}{2}mv^2$) Is it close to the potential energy value?

Force diagram:

Using the picture below, number the circles from one to seven and draw the free body diagram for each moment in time on the coaster.



Presentation:

Now your group needs to make a short video or slideshow presentation to explain and show off your roller coaster. After all, what good is a design and money spent on construction if no one is willing to invest in your accomplishment? Using either a chromebook, ipad, or phone, your group needs to record video or assemble photos of your coaster in action and identify the following:

Where is potential energy the highest?
Where is potential energy the lowest?
Where is kinetic energy the highest?
Where is kinetic energy the lowest?
Explain if the marble has momentum and how you know.
What are some forces that act on the marble to slow it down?
Is energy conserved over the course of the ride?
Why is your roller coaster the best of the bunch?

Use programs such as Flipagram, Google slides, Prezi, PowerPoint, iMovie, etc.

Rubric:

Task	Excellent	Good	Below Average	Poor	Points
Drawings and Force Diagram	Neatly drawn, Easy to understand, labeled force diagram properly: 15pts	Drawing is somewhat easy to figure out, force diagram has some errors but is mostly correct: 10pts	Sketch shows little effort, hard to read, force diagram is labeled incorrectly in most instances: 5pts	No drawing and/or incomplete force diagram: 0pts	_____/15
Calculations (points go in as a test grade)	Done correctly, showing work, proper units on answers: 30pts	Calculations show work and proper units on answers in most cases. All calculations might not be correct: 20pts	No work shown, improper units or no units at all, calculations incorrect: 10pts	No calculations: 0pts	_____/30
Participation (points go in the gradebook as participation)	Group members all played a role in accomplishing the task, work was distributed equally, group stayed focused throughout the project: 30pts	Group members mostly stayed on task and worked together to complete the project: 20pts	Only one or two group members worked on the project, others were off task during the project work time:10 pts	Group members didn't work together and were distracting other groups: 0pts	_____/30
Presentation	Video/slideshow is complete and explains/shows every detail clearly: 30pts	Video/slidesho w is explains/shows most details clearly: 20pts	Video/slidesho w is incomplete or lacking explanations of details: 10pts	Video/slideshow is missing: 0pts	_____/30
Successful Trials	Marble rolled successfully down the track 3 times in a row: 15pts	Marble rolled down the track successfully 2 out of 3 times: 10pts	Marble rolled down the track successfully 1 out of 3 times: 5pts	Marble never successfully went down the track: 0pts	_____/15

Total Points _____/120