

Marble Roller Coaster Project

Research, design, and build a roller coaster. Your roller coaster cannot be prefabricated or from a kit. It must have at least 2 hills (including the starting point), one loop, cannot have a top, and must be free-standing. Your roller coaster will transport a marble that you supply (you can use any model or size marble). You must bring your marble when the project is tested and presented. Be sure to include your name and class period on your project/rubric.

Recommended materials: Measuring tape, hot glue gun, foam pipe insulation, wood, plastic, Styrofoam.

Marble Roller Coaster Project Criteria

40 points – Calculations (MUST SHOW WORK WITH UNITS)

- Height of initial drop, height of hill, height of loop, total length of track, mass of marble
- Calculate the Potential Energy at a specific point (must specify at which point).
- Calculate the Kinetic Energy at a specific point (must specify at which point).
- Calculate the Velocity (speed) of the marble over a set distance (must specify over which distance).
- Calculate the Acceleration of the marble over a set distance (must specify over which distance).
- Describe the marble's journey from start to finish using the following terms (underline the terms in your description): *kinetic energy, potential energy, velocity, acceleration, friction, inertia, momentum, gravity, mass*

20 points – Roller Coaster/Schematic

- Have a schematic of your roller coaster (an illustration with measurements will be sufficient; should be precise).
- Color Code and Label the following areas on your illustration:
 - Most PE.
 - Most KE.
 - Where PE is converted to KE.
 - Where KE is converted to PE.

10 points – Durability Built to Last; The coaster can be transported to school and/or around classroom and still work.

10 points – Test Run Test your roller coaster to verify that the marble will travel entire track (you are allowed 3 tries for a successful run). If the marble roller coaster is too large, then a video of the presentation done at home is acceptable as long as it is in a playable format (i.e. wmv or mp4).

Marble Roller Coaster Project Rubric

Criteria	Does not meet	Meets	Exceeds
Calculations	No specifications or calculations provided.	Contains some specifications and/or calculations.	All specifications and/or calculations provided.
	Does not include all necessary components.	Includes some necessary components.	Includes all necessary components.
	Not accurate, original or organized.	Accurate, however not original or organized.	Accurate, original, and organized.
	Has poor aesthetic appeal.	Has some aesthetic appeal.	Has aesthetic appeal.
Schematic and Roller Coaster	No drawing provided.	Drawing provided.	Drawing is detailed and labeled.
	Drawing not to scale or labeled.	Drawing is close to scale and contains some labels.	Drawing is to scale and colored.
	On lined paper or too small.	On 8 x 12 copy paper.	On paper larger than 8 x 12.
Durability	Does not work without extensive adjustments after moving.	Needs small modifications when moved.	Built to last; no adjustments needed.
Test Run	All three trials are unsuccessful.	Successful test run with modifications.	Successful test run without modifications.
			Total: _____/100

Marble Roller Coaster Projects are due _____

ROLLER COASTER PROJECT

Purpose: This project will be a culminating project of the concepts of physics we covered during the third quarter. It will allow you to demonstrate your knowledge of motion, energy, and forces, as well as other areas that may apply. It is meant to be a fun project to do in class as a group. No one student is responsible for all portions of this project. **All members of the group should perform work. All work should take place in class in groups of four people or fewer.**

Requirements:

- 1) The Roller Coaster. Using any materials that you wish, construct a roller coaster with your group that will meet the requirements.
 - a. We will be using marbles for the “roller coaster cars.”
 - b. Possible materials: tubing, wood, boxes, foil, glue, PVC piping, plastic bottles, etc...
- 2) Presentation of roller coaster. This should be three minutes max, and should demonstrate the areas of physics as well as perform a run of the roller coaster.
- 3) Data table/calculations- see rubric for more information

ROLLER COASTER PROJECT AND RULES

Introduction: CaddyLand has been hearing from its customers that their roller coasters are boring. The public is threatening that if the amusement park does not build a new, more exciting roller coaster they will stop going to the amusement park.

You are part of a team of engineers that has just been asked to submit a new roller coaster design to the amusement park. Using the concepts of forces, motion, and energy, design and build a model of a workable roller coaster that could be built in CaddyLand.

To appease the public, your roller coaster must have a “thrill factor.” There must be at least one loop, at least one turn, at least two hills, and if possible, a “jump.” Your roller coaster also needs to be safe for the public, so you will also need to calculate the speed, acceleration, PE and KE on various locations of your roller coaster.

You will need to be able to explain your roller coaster to the board of directors of Six Flags. You will need to include in your explanation why you think your roller coaster is the “best choice” and should be built in the amusement park. Keep in mind that the board of directors is made up of a team of scientists. You will want to impress them with your knowledge of how forces, motion and energy help your roller coaster work, why it is safe to ride, and why it is “thrilling.”

Rules

- 1) Your roller coaster must fit within the confines of your “construction area.” There is no height limit, and you may not intrude on another group’s area without their permission.
- 2) Your roller coaster must bring your marble safely to a stop. Drops and jumps are permitted, but the marble must be safely caught by the track without getting stuck.

- 3) Hills and loops must involve trading kinetic energy for potential energy. Horizontal loops are considered turns.
- 4) Extra time will not be permitted. Deadlines are absolute. Absences or unexpected school closures will not result in extra time.
- 5) Your group is responsible for completely removing your roller coaster and cleaning the surrounding area after completion of the project.

CALCULATIONS AND ANALYSIS

1. LABEL the following points on your roller coaster:

- a. Where the kinetic energy is the highest
- b. Where the kinetic energy is the lowest
- c. Where the potential energy is the highest
- d. Where the potential energy is the lowest
- e. Where there is positive acceleration
- f. Where there is negative acceleration
- g. Newton's 1st Law
- h. Newton's 2nd Law
- i. Two forces that might slow your marble down (what kinds of forces have we talked about in class?)

Measure and record the following measurements for your roller coaster.

Time of ride = _____ (seconds)

Mass of the marble = _____ (kg)

Go weigh your marble (you may have to weigh it in a cup, then weigh the cup, and subtract to get just the weight of the marble).

Length of the track = _____ (meters)

Using the measurements above, calculate the following items for your roller coaster. Please show all of your work and label all of your answers with the correct units!!!!

2. Average speed of the ride (remember your speed equation???)

3. Acceleration of marble at one location on your roller coaster (remember your acceleration equation???)

4. The Force at one location on your roller coaster. Remember your force equation?
(Use your acceleration from above)

5. Gravitational Potential Energy at the beginning of your ride **P.E**

6. Kinetic Energy at one location on your roller coaster: **K.E = $\frac{m \times v^2}{2}$**

ROLLER COASTER PROJECT RUBRICS

Criteria for Presentation

	Possible Points	Points Earned
Presentation was appropriate length (2-3 minutes)	5	
Information was organized	5	
Presentation was understandable	5	
Total Points	15	

Student Evaluation

Roller Coaster # _____

Roller Coaster Name _____

Criterion	Points Possible	Points Earned/ Comments
Appearance: Does the roller coaster look good? Is it neat? Is it decorated?	3	
Number of Loops/Hills: Does the roller coaster have one or more loops or hills? How does it compare with others?	3	
Number of Turns: How many turns does the roller coaster have? How does it compare with others?	3	
Thrill: Is the track open for all/part of the loops? Can the passengers “see” out? How abrupt are any changes in motion? Are there any jumps?	3	
Creativity: Does the roller coaster have a name? Is there anything unique about this roller coaster?	3	
Total Points	15	

For an evaluation to be counted, you must give a comment explaining the score to the designers. You may not give something a score of zero unless that feature is missing completely. You must give at least two positive comments for your scores to count. Any overly negative comments will be thrown out.

Self Evaluation

Student Name: _____

Roller Coaster Name: _____

Group Member Names: _____

Criterion	Points Possible	Points Earned/ Reasons	
Teamwork: Did you help each other? Did you work together, or did everyone try to do their own thing?	2.5		
Individual participation; Did you do your fair share of the work? Did you help with every step, or just do one part?	2.5		
Group Participation: Did everyone contribute equally? Was everyone involved in each step (building, analysis, clean up, etc.)? Give each person in your group up to 2.5 points for their participation.	2.5	Name	Points and Reasons
Respecting each other: Did you listen to each other? Did everyone get to share their ideas? Were any group members put down?	2.5		
Total points	10		

Total Possible Points for Project: 120