

Paper Roller Coasters

Engineering Journal

Name:

Group:

Period:

Due date:

Problem: You are a roller coaster manufacturer competing for a bid to build a roller coaster for an amusement park. Your task is to design and build the most fun and exciting roller coaster you can, given the space allowed, and be able to explain the physics behind it. You will then present your roller coaster design and justify why yours is the best.

Criteria:

- Roller coaster is made entirely of paper and tape (except for one element of your design).
- Roller coaster is fixed securely to a base 18" x 24".
- End point is free from obstruction.
- Sign identifying the roller coaster is prominently displayed.
- Roller coaster includes at least one curve, loop, and hill.
- Roller coaster includes one element of your own design that adds to the fun and excitement of the roller coaster.
- A marble must successfully complete the track 3/3 times.
- Marble maintains contact with the track throughout each run.
- Must be sturdy and neatly put together.

Ask - questions to clarify your task

Questions	Answers

Plan/Imagine: Brainstorm ideas for your roller coaster design: Consider the following:

- Height of starting point
- Where you will position the curve, loop, and hill
- What element of your own you could include to make it more fun

Design: Estimate how many of each template you will need and create a detailed drawing showing each piece you will use. Label parts.)

- Columns (2) _____
- Beams (2) _____
- Diagonal Supports (2 each) _____
- Shelf (10) _____
- Brackets (enough) _____
- Straight Track (4) _____
- Sharp Turn (2) _____
- Wide Turn (2) _____
- Loop (4) _____

Plan: Sketch a rough draft of your roller coaster. **Diagram should include** how you will build your roller coaster. Show each piece (ride element) and label each part. Show where your ride element will be and how you will make it.

Improve:

How could you change your design to:

- Be more fun and exciting
- Have the marble complete the entire track
- Stay in contact with the track throughout the entire course
- Other: _____

What I changed	Why I changed it	Result of change

Improve: Draw a final plan for your new roller coaster (Detailed drawing showing each piece you will use. Label parts.)

Create: Make your roller coaster following your plan.

Experiment: After you build your roller coaster, test it out. Check for:

- Is it fun and exciting?
- Does the marble complete the entire track?
- Does the marble stay in contact with the track the whole time?

Reflection : What worked and what didn't work?

Roller Coaster Data sheet

Diagram: Draw a diagram of your roller coaster.

- Label the top A and the bottom E.
- Find another point on the track where the marble is speeding up. Label it B.
- Find another point on the track where the marble is not speeding up or slowing down. Label it C.
- Find another point on the track where the marble is slowing down. Label it D.

At each point on the diagram, draw in and label vectors for velocity ($v \rightarrow$) and acceleration ($a \rightarrow$). Make sure the arrows are pointing in the right direction and their lengths are proportional to their relative magnitudes.

Use points A, B, C, D, and E to fill in the data table:

Point	Location	Height (m)	PE (J) PE=mgh	Ideal KE (J) KE=ME-PE	Ideal ME (J) ME=PE _A	Ideal v (m/s) $v = \sqrt{\frac{2KE}{m}}$
A	Top					
B						
C						
D						
E	Bottom	0				

Questions

1. At what point do you have the greatest PE? _____ At what point do you have the greatest KE?

2. At what point do you have the lowest PE? _____ At what point do you have the lowest KE?

3. Attach a 1-m length of straight track to the end of your roller coaster. Time how long it takes for the marble to travel the 1 m after traveling down the roller coaster. Do this 5 times, and take the average. Use the average time and 1-m distance to calculate the final velocity of the marble at the bottom of the coaster:

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average t (s)		Equation	Plug in #s	V (m/s)

4. Does the ideal velocity at the bottom of the track (see table) match the actual velocity that you calculated above? Why or why not?

5. Why is your roller coaster the best? State as many reasons as you can and back up each one with data or observations from your roller coaster. Your answer should include the concepts of potential energy, kinetic energy, velocity, and acceleration. Answer this on a separate sheet of paper and attach it.