

Rollercoaster Project

Planet Holloway Physics

Objective:

To build a model marble roller coaster that can be used to demonstrate several physics concepts.

Materials:

Do not use - anything expensive, anything made specifically for model roller coasters

Do use - recycled materials from home or inexpensive craft and hardware type items. Examples are paper towel tubes, toothpicks, cardboard, poster board, craft sticks, wire, rubber bands, plastic soda bottles, dowels, etc.

Procedure:

Construct a model rollercoaster that meets the following criteria:

- The coaster will be no bigger than **24" x 24" x 36"(high)**
- The marble will be able to travel the entire roller coaster course without any "crashes"
- The marble must travel **up** at least **12" vertically** on the track total during the "ride"
- The marble must **change direction horizontally** by at least **90 degrees** per turn for at least **6 separate turns**. A continuous turn up to 360° counts as one turn.
- The marble must travel for at least **5 seconds** (longer than 10 earns extra credit)
- The marble must travel the course without any assistance (motorized or from the owner)
- The coaster cannot be made of tubing or hoses (unless cut). The walls must not go past vertical.

Attach included labels in appropriate locations on the rollercoaster (all need to be visible from the front of the rollercoaster)

Include an explanation for all labels (summary document of all labels)

- label name
- definition
- units
- equation relating to term
- where it is found
- what it does for the rollercoaster (think about changing energy, momentum, or how the riders feel)

Attach a free-body diagram depicting all forces acting on your marble in the middle of the ride (side view)

Scoring:

100 points possible – labels correctly placed and justified

100 points possible – label summary document

10 points possible – correct free-body diagram with all forces involved

10 points possible – no bigger than 24" x 24" x 36"(high)

10 points possible – travels the entire course

10 points possible – travels for at least 5 seconds

10 points possible – six 90 degree turns – continuous turns count as 1 for every 360°

10 points possible – travels a total of 12" vertically up during the "ride"

Bonus features:

5 points possible – travels for at least 10 seconds

5 points possible – travels for at least 15 seconds

5 points possible – makes a vertical loop of at least 3" in radius (so 6" high total) (5 pts/loop)

10 points possible – increase in mechanical energy device (marble activated, non electrical). This device must place the marble at a new location, at least 6" higher in elevation, such that it continues on the track from that point toward the end of the "ride." (Does not count toward 12" vertical gain).

Note – the max total score is capped at 290 points. That means the best possible grade you can receive with extra credit is 290/260.

Notes:

The rollercoaster is not graded on appearance, but on performance and on the understanding of the scientific principles involved. Do not spend time making it “pretty”, but work on the bonus features and discussing where and why the labels belong where they do. Also the summary page is worth 100 points, be sure it is complete and thorough.

Include the labels on the following page on your roller coaster. Use all labels, but if they do not apply to your coaster, put them on the base off to the side.

Rollercoaster labels

Cut out these labels and place them on the appropriate locations on your rollercoaster
They should all face the same direction and be readily visible

Max. Potential Energy	Max. Kinetic Energy	Max. Velocity	Work due to gravity
Increasing Potential Energy	Centripetal Force	Centripetal Acceleration	Velocity Increasing
Positive Impulse	Negative Impulse	Conservation of Momentum	Conservation of Energy
Acceleration = 9.8 m/s/s	Projectile Motion	Mechanical Equilibrium	Newton's First law of motion
Increasing Kinetic Energy	Velocity Decreasing	Kinetic Friction	Newton's Second Law of Motion
Work_{net} is negative	Work_{net} is positive	Newton's Third Law of Motion	Hooke's Law

Any label that does not belong on your rollercoaster should be placed on the base. Be sure you can justify why it does not belong on your rollercoaster. (This is rare).

Score sheet
Include with project

Names:

Coaster Name – _____

Category	Points possible	Points Earned
Labels and explanation	100	
Summary Page	100	
Free-body diagram	10	
Correct size	10	
Travels entire course	10	
Travels 5 seconds	10	
Completes 6 turns (90°)	10	
Travels up 12'' vertically	10	
<i>Sub total</i>	<i>260</i>	
<i>Bonus points</i>	<i>These points are not required</i>	
Travels 10 seconds	5	
Travels 15 seconds	5	
6'' vertical loop	5 /loop	
Increase in mechanical energy	10	
<i>Total</i>	<i>260</i>	
<i>Score Cap</i>	<i>290 maximum points</i>	