Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**# \_\_\_\_\_\_\_** Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_

**Roller Coaster Physics**

**Objective:** To investigate *potential* and *kinetic* energy by building a roller coaster for marbles using the given materials.

**Materials (per group):**

* 2 six foot sections of ¾ inch inner diameter, thin wall, pipe insulation track
* 1 marble (acting as your coaster cart)
* cup (to catch marble at end of track)
* masking tape
* timer

**Part One: Group Planning and Design**

***You will be creating a roller coaster that complies with the following Coaster Criteria:***

* Coaster cart (marble) must be able to complete the ride without human interference or assistance.
* Track may be attached to the wall, table, chairs, etc. but no one should have to (and are not allowed to!) stand on a table or desk for any reason.
* Your coaster must be reliable. It has to stand up to repeated time trials without failing, falling apart or requiring repairs.
* Coaster contains at least 3 of the following design elements:
* One six inch (or more) drop
* 180⁰ turn
* An uphill section
* 360⁰ loop
* A spiral
* A camel back (two equal height humps)
* Coaster must stop the cart before the end of the track (don’t kill your riders).

As a group, brainstorm design ideas and then make a NEAT drawing of your planned Roller Coaster in the box below.

***Label the point with the highest potential energy (PE) and the point with the highest kinetic energy (KE).***

**Part 2: Group Design Testing**

**Procedure:**

1. Test build your group’s roller coaster design.

* Please try to keep your tape usage reasonable!!
* Test your Coaster when appropriate by placing and letting the marble go down the track. Remember…*you cannot hold the track while the marble is in the track.*
* Modify the Roller Coaster as needed so that the marble will stay in the track for its entire trip. As you make modifications, be sure that you still have at least 3 of the required elements.
* When your design works (the marble stays in for the whole ride), add the cup at the end of the track to catch the marble without falling over or moving more than 5cm (remember, your marble must slow down before the end of the track and the cup can **NOT** be attached or taped down).

2. Create a ***detailed*** drawing of the final design that will allow your group to recreate it for testing tomorrow. (You may

also want to take a picture to allow a quicker rebuild tomorrow)

3. VERY CAREFULLY remove all pieces of tape from the track and return the track to your teacher.

**Final Design**

**Part Three: Coaster Testing**

1. Build your coaster based on your Final Design from yesterday.

2. Measure the distance (length) of your roller coaster from beginning to end. Measure from the point your marble starts, keeping in mind that most of your coasters do not start at the very end of the track. Record this number in your data table.

3. Complete four trials of your roller coaster and record the times it takes the coaster to travel from beginning to end in

the Data Table.

4. Record the formula for speed in the Data Table.

5. Calculate the average distance and average time for your trials.

6. Calculate the speed for EACH trial and the average speed.

7. Clean up. **Be sure to CAREFULLY remove all tape from the track and anywhere in the room you stuck it!!**

**Data Table:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial # | Distance  (m) | Time  (s) | Formula  for Speed | Speed  (m/s) |
| 1 |  |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| Average |  |  |  |  |

**Part Four: Analysis and Conclusions**

1. Label the following **on your final drawing** ***BY LETTER***:

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

2. How did the shape of the track affect the speed of the marble? Where was it greatest? Least? BE SPECIFIC!!

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. If you were able to increase the height of your roller coaster, how would the increased height change the energy of

your coaster? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_