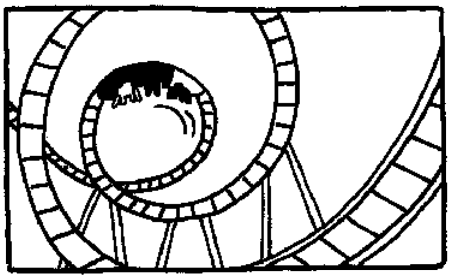
Name: _____ Date: _____
Period:_____

Rolling Roller Coaster



Background: Have you ever ridden a roller coaster? If you have, you were probably more concerned with fun than the science behind its operation. Roller coasters are machines that use potential and kinetic energy. Work is done moving the cars to the top of the first hill. The work transfers gravitational potential energy to the cars. When the cars crest the top of the hill, potential energy coverts into kinetic energy and the ride begins. The kinetic energy carries the cars through a series of loops, turns, and hills until the end is reached.

Purpose: In this activity, you will experiment with how roller coasters change potential energy into kinetic energy and back again several times.

Procedure:

1. With your group, create a simple roller coaster track (include hills, but **no loops**). Use tape to secure the track to the support structures.
2. Roll the ball bearing through the tube. Make sure one member of the group is prepared to catch the ball bearing at the end of the run. You may have to adjust your track at this time to get the ball bearing to complete the run.
3. Once you have a successful run, sketch your track design below.
4. On your sketch, label the **highest** position **Point A** and the **lowest** position **Point B**. Also choose two other points along the track and label them **Points C** and **D**.

5. Using a meter stick, measure the distance from the **ground** to each of the points **(in cm)** on the track that you labeled on the sketch. Record your data below.

Point	A (highest point)	B (lowest point)	C	D
Distance From Ground (cm)				

6. The mass of your ball bearing **(in grams)** is recorded below. **Divide this mass by 1000** to convert it to kilograms. Record this mass below. **This is the mass you will use for the calculations!**

Mass of Ball Bearing (g)	3.43	Mass of Ball Bearing (kg)	

7. Using the formula **PE = m × g × h** ($g = 10\ m/s^2$), calculate the potential energy of the ball bearing at each point on the track. **Divide each of your answers by 100 to convert the answers to Joules.** Record your answers below.

Point	A	B	C	D
Potential Energy (kg cm m/s^2)				
Potential Energy (J) After dividing by 100				

8. The kinetic energy of the ball bearing at its highest point is zero. What is the total energy **in Joules** (potential + kinetic) of the ball bearing at this point? Explain your answer.

_____

_____

9. What is the total energy **in Joules** of the ball bearing at all points on your track? Explain your answer.

_____

_____

10. Using the formula **KE = Total Energy – PE**, calculate the kinetic energy of the ball bearing at each point.

Point	A	B	C	D
Kinetic Energy (J)				

11. Using the formula $KE = \frac{1}{2}\ m \times v^2$ ($v = \sqrt{\frac{KE}{\frac{1}{2}\ m}}$), calculate the velocity of the ball bearing at each point.

Point	A	B	C	D
Speed (m/s)				

* to calculate the speed, divide the kinetic energy at each point by half the mass (in kg) and then hit the square root button on your calculator.

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POST-LAB

Answer all questions in **complete sentences!**

1. What happened to the **speed** of the ball bearing as you released it at the top of your roller coaster track?

_____

_____

2. Why couldn't you have the **highest hill** at the **end** of the roller coaster? Explain.

_____

_____

_____

3. What happens to the ball bearing's **total mechanical energy** as it goes through the track? (Does it **increase, decrease or remain the same**) Explain.

_____

_____

_____

4. Where on your roller coaster tracks does the ball bearing have potential energy changing to kinetic energy? (**going uphill or downhill**) Explain.

_____

_____

_____

5. Where is kinetic energy changing to potential energy? (**going uphill or downhill**) Explain.

_____

_____

_____

After turning in the lab, you may experiment with other formations for your roller coaster. You may combine your track with other groups' tracks to make complicated formations.