

Energy Transformations Investigation

Complete the following questions while working through the [Unit 4 Energy Transformations Investigation](#).

Purpose

To investigate energy transformations between gravitational potential energy and kinetic energy.

Hypothesis

Make hypotheses regarding the following:

- a. Where on each roller coaster will the speed be the highest?
- b. Where on each roller coaster will the speed be the lowest?
- c. How will the mass of the cart affect the energies?
- d. How will the mass of the cart affect the speed?
- e. Will energy be conserved?

Materials

Make a list of materials used in the simulation.

Method

1. Build a roller coaster with three hills, where the first hill is the highest and the last hill is the lowest. Run your coaster with three different cart masses and record: the mass of the cart, the height of each hill, the height of the lowest points between the hills, and the end height. In addition, record the speed of the cart at each of the heights recorded. You should organize your observations in a table similar to the one shown below:

Position	Cart 1 mass: ____ kg		Cart 2 mass: ____ kg		Cart 3 mass: ____ kg	
	Height (m)	Speed (m/s)	Height (m)	Speed (m/s)	Height (m)	Speed (m/s)
Top of hill 1						
Lowest point between hill 1 and hill 2						
Top of hill 2						
Lowest point between hill 2 and hill 3						
Top of hill 3						
Lowest point on the roller coaster						

2. Repeat for a roller coaster where the first hill is the highest and the second hill is the lowest.
3. Repeat for a roller coaster where the second or third hill is the highest.

Observations

All of your data tables and any qualitative observations should be placed in this section.

Analysis

1. Calculate the kinetic energy and the gravitational potential energy for each of the six positions recorded in your observation charts. You may want to use a spreadsheet to save time. Be sure to show at least one worked example for each type of calculation and record the results in a table such as the one below:

Position	Cart 1 mass: ____ kg		Cart 2 mass: ____ kg		Cart 3 mass: ____ kg	
	E_k (J)	E_a (J)	E_k (J)	E_a (J)	E_k (J)	E_a (J)
Top of hill 1						
Lowest point between hill 1 and hill 2						
Top of hill 2						
Lowest point between hill 2 and hill 3						
Top of hill 3						
Lowest point on the roller coaster						

2. Were your hypotheses about where the speed will be highest correct? If not, discuss the possible reason for the differences.
3. Were your hypotheses about where the speed will be the lowest correct? If not, discuss the possible reason for the difference.
4. How did the mass of the car affect the energies? Does this agree with your hypothesis? If not, discuss the possible reason for the difference.
5. How did the mass affect the speed of the cart? Does this agree with your hypothesis? If not, discuss the possible reason for the difference.
6. Was energy conserved?

Conclusion

Summarize your results.