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| Conservation of Energy and Circular Motion Lab - Student  **Equations:**  F = mv²/r  F = mg  KE = ½mv²  U = mgh  The purpose of this lab is to investigate the behavior of a metal, dye-cast hot-wheels car moving through a loop-the-loop.    http://dev.physicslab.org/img/131157be-c97c-41b5-bd9e-4488ff1c4ca5.gif  During this investigation, we will make use of energy methods as well as centripetal acceleration. |
| **Part 1. Initial measurements**   |  | | --- | |  | | 1. What is the inner **diameter** of the track's loop-the-loop in **meters (m)**? |  |  | | --- | | 1. What is the **radius** of the **loop-the-loop** in **meters (m)**? |  1. What is the **mass** of your car in **grams (g)**?   **Part 2: Initial Calculations**   |  | | --- | | 1. Using the properties of **vertical circular motion**, calculate the **critical velocity (v)**, in **meters/second (m/s)**, needed by the car to travel around the **loop-the-loop** losing contact with the track. Show your calculations. |  |  | | --- | | 1. Using conservation of energy calculate the ideal **height** **(h)**, in **meters (m)**, from which the car should be released so that it will successfully complete the **loop-the-loop**. Show your calculations. |  1. How much initial potential energy, in **Joules (J)**, will the car possess as it begins its trip down the track?   **Part 3. Experimentation**   |  |  | | --- | --- | | 1. After setting up the track so that the car is able to be released from the **height** **(h)** calculated in Part 2 above, release the car to test if it is able to successfully make it through the **loop-the-loop**. Repeat this at least three times. Did the car remain in contact with the track through the **loop-the-loop**? | | |  | |  |  | | --- | --- | | \_\_\_ yes | \_\_\_ no | | | |  |  | | --- | --- | |  |  | |  |  | | |  |  | | --- | | 1. Describe what happened. | |  |  |  |  | | --- | --- | | 1. Which of the following reasons explains why the car did not have enough **velocity** (kinetic energy) to successfully make it way through the **loop-the-loop**, | | |  | |  | | --- | | \_\_\_\_\_ The track was slippery and the car lost traction. | | \_\_\_\_\_ The speed of the car caused the loop of the track to expand and changed its radius. | | \_\_\_\_\_ There was friction on the track | | \_\_\_\_\_ When the car was moving through the loop, the normal force slowed it down causing a loss in kinetic energy. | |  | | | |  |  | | --- | --- | |  |  | | |  1. Now increase the height of the track by small intervals (1 to 2 cm) checking to see if the car successfully completes the loop-the-loop. Record your results in the table below.  |  |  |  | | --- | --- | --- | | **Description of Behavior** | **Initial height**  **(m)** | **Ending height**  **(m)** | | Does not make it, falls from track |  |  | | Makes it but occasionally loses contact with the track |  |  | | Makes it and stays in contact with the track throughout the loop |  |  |   **Part 4: Conclusions**   |  | | --- | | 1. Using the final value in your chart above for when the car was just able to complete the **loop-the-loop** and still remain in contact with the track calculate the car's experimental **potential energy** at the top of the track. |  |  | | --- | | 1. Determine the difference between the **initial** **potential energy** (in Part 2) and the **experimental** **potential energy** (Part 4) actually needed for the car to complete the **loop-the-loop**. |  |  | | --- | | 1. What does this numerical difference represent? | |

**Glossary:**

Diameter: The width of the loop-the-loop.

Height: How high above the ground or table you release the car.

Kinetic Energy: The energy, in joules (J), of the motion of the car.

Loop-the-loop: Circular loop of the track.

Mass: Weight of the car in kilograms. Measure using a scale.

Potential Energy: The potential energy, in joules (J), of the car due to gravity.

Radius: Half of the diameter.

Velocity: How fast the car travels. Specifically, how many meters it travels in one second.

**Units:**

Acceleration: meters per second squared (m/s²)

Diameter: meters (m)

Energy: joules (J)

Height: meters (m)

Mass: grams (g)

Radius: meters (m)

Velocity: meters per second (m/s)

**Reference:**

Hilburn, W.A. (2011). PhysicsLAB: Conservation of energy and vertical circles. Retrieved from

http://dev.physicslab.org/Document.aspx?doctype=2&filename=WorkEnergy\_RollerCoasterLab.xml