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| Conservation of Energy and Circular Motion Lab - Student**Equations:**F = mv²/rF = mgKE = ½mv²U = mghThe 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.gifDuring this investigation, we will make use of energy methods as well as centripetal acceleration.  |
| **Part 1. Initial measurements**

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| 1. What is the inner **diameter** of the track's loop-the-loop in **meters (m)**?
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| 1. What is the **radius** of the **loop-the-loop** in **meters (m)**?
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1. What is the **mass** of your car in **grams (g)**?

**Part 2: Initial Calculations**

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| 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.

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| 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.

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1. How much initial potential energy, in **Joules (J)**, will the car possess as it begins its trip down the track?

**Part 3. Experimentation**

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| 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**?
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| \_\_\_ yes | \_\_\_ no |

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| 1. Describe what happened.

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| 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**,
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| \_\_\_\_\_ 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. |
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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.

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| **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**

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| 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.
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| 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**.
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| 1. What does this numerical difference represent?

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**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