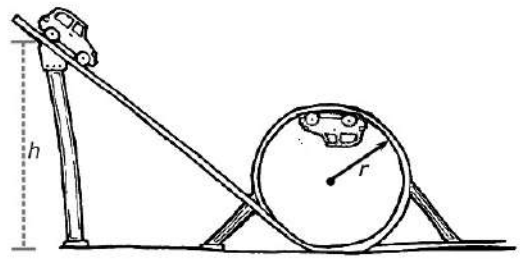
NAME ______________________________ DATE ______________

Scenario

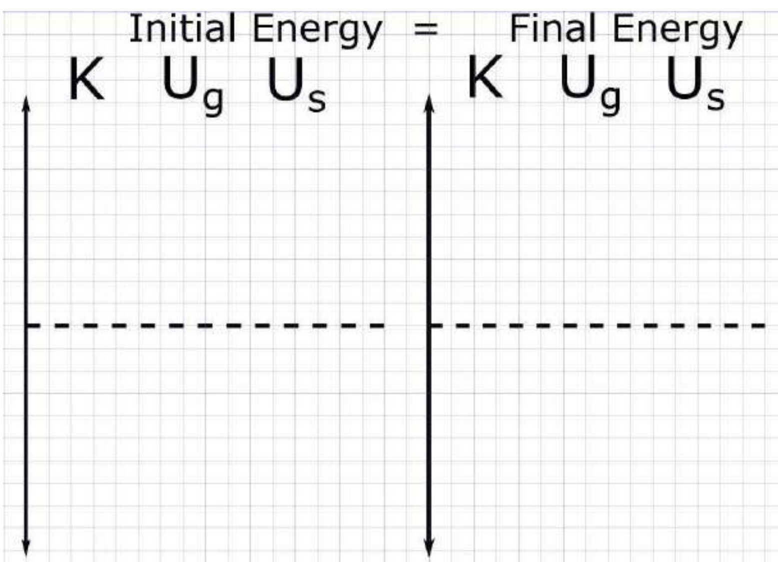
A toy car is released from rest on a smooth track with a loop de loop. The car is released from height h such that it never loses contact with the track. The system includes the car and Earth. Rotational effects from the wheels, friction, and air resistance can be ignored.



Using Representations

PART A: Draw and label free-body diagrams on the figure shown above that depicts the forces (not components) exerted on the car as it goes down the ramp and at the top of the loop. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. Each force must be represented by a distinct arrow starting on and pointing away from the car.

PART B: Fill in the energy bar chart below with the initial energy when the car is first released from height h and the final energy when the car is at the top of the loop.

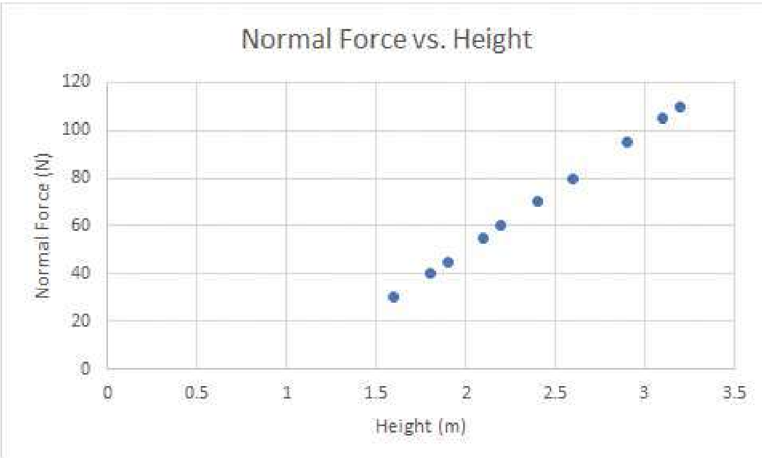


PART C: Citing the bar chart, explain why the release height must be greater than the diameter of the loop.

Data Analysis

PART D: Carlos determines that the normal force the car experiences at the top of the loop can be determined by using the equation: $F_n = \frac{2mg}{h}$.

To test the equation, he releases the cart from various heights and records the normal force at the top of the loop from the sensor in the track. The graph below is the student's plot of the data for F_n as a function of height.



Are these data consistent with Carlos's equation?

Briefly explain your reasoning.

PART E: Blake suggests that regardless of whether or not the data above are consistent with the equation, the equation could be incorrect for other reasons. Does the equation make physical sense?

PART F: What would happen if Carlos released the car from a height of 0.8 m?

______ The car completes loop. ______ The car does not complete loop.

Justify your claim using relevant features of the data shown.