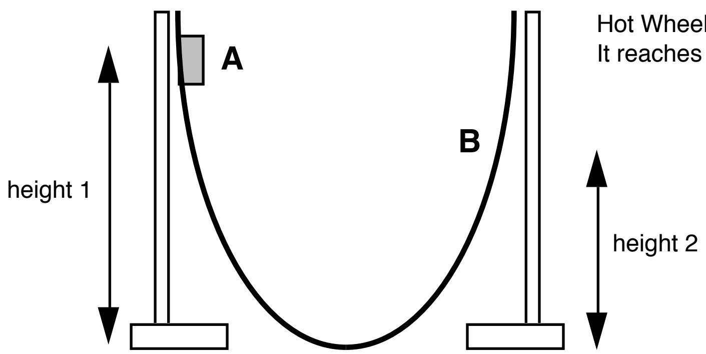
Lab 9-2: **Hot Wheels**

Purpose: 1. To define and determine the efficiency of a Hot Wheels track.
2. To determine the height from which a Hot Wheels car must be released to have it just make it around the loop-the-loop track.

Discussion: This lab combines the ideas of centripetal force and conservation of energy. You will set up a loop-the-loop with Hot Wheels track and calculate the minimum height from which to release a Hot Wheels car so that it safely completes the loop. In order to do this, you must first derive an expression for the minimum height from which to release the car so that it just makes the loop-the-loop in an ideal case. Then you will determine the energy efficiency of your Hot Wheels set up, and combine the results to determine the actual release point.

Part 1: Determining the efficiency of your Hot Wheels track.



Hot Wheels car is released from point **A**.
It reaches point **B** on the opposite side.

If a Hot Wheels car were placed on a U-shaped track and released, it would ideally rise to the same height on the opposite side of the track. The potential energy of the car at the top of the track would change into kinetic energy at the bottom of the track. The kinetic energy would then change back into potential energy as the car goes up to the same height on the opposite side. (No energy would be lost to any other transformation.) In the lab, however, there are a number of other energy transformations that take place, and some of the car's original potential energy is "lost" to these other transformations; the car will not rise to the same height. We will define the *efficiency* of the Hot Wheels set-up as the ratio of how much potential energy the car has on the far side of the track to how much potential energy the car had originally. In symbol form:

$$Efficiency = \left(\frac{PE_{final}}{PE_{original}}\right)$$

Procedure:

1. Set up the Hot Wheels track as shown in the diagram above. Secure the track with tape, books, braces etc. so that the track does not move when the car is released.
2. Release the hot wheels car from starting point A. This height (h_1) and the height to which the car rises (h_2) on the other end of the track are to be recorded.

Data:

Trial	h_1 (cm)	h_2 (cm)
1		
2		
3		
4		
5		
average		

Lab 9-2: **Hot Wheels**

Part 2: Determining the minimum height from which to release the Hot Wheels car

Discussion: The hot wheels car is going to come down a hill with enough speed so that it will be able to go through a loop and just barely leave the track at the top of the loop as it continues through the rest of the loop. So what is the minimum height?

If the track were 100% efficient, we know that the minimum height from which to release the car is just two and one half times the radius of the loop.

$$h_{ideal} = 2.5r$$

The Hot Wheels track is not 100% efficient, however. The car must be released from a higher point than given by the above equation because some energy is lost.

Procedure:

1. Do Questions 1 to 3 (below) to determine your predicted minimum height.
2. Set up the loop-the-loop.
3. Put the Hot Wheels car on the track at the calculated height, and let it go!
4. Experimentally determine the minimum height to see how close your prediction was.

Questions:

1. From Part 1, what is the ideal minimum height so the car just makes the loop?

2. From Part 2, calculate the efficiency of your track. (Think of it as a fraction - how much energy did the car keep going from one side to the other.)

3. Calculate the actual height from which you should release the car so that it just makes the loop.

4. How close was your predicted minimum height to the actual minimum height?

5. Why is your set-up *not* 100% efficient? Specifically, what happened to the energy that the car "lost" in going from point A to point B?

6. What is the normal force on the car at the top of the loop if it just barely makes the loop?

7. Why doesn't gravity pull the car off the track?