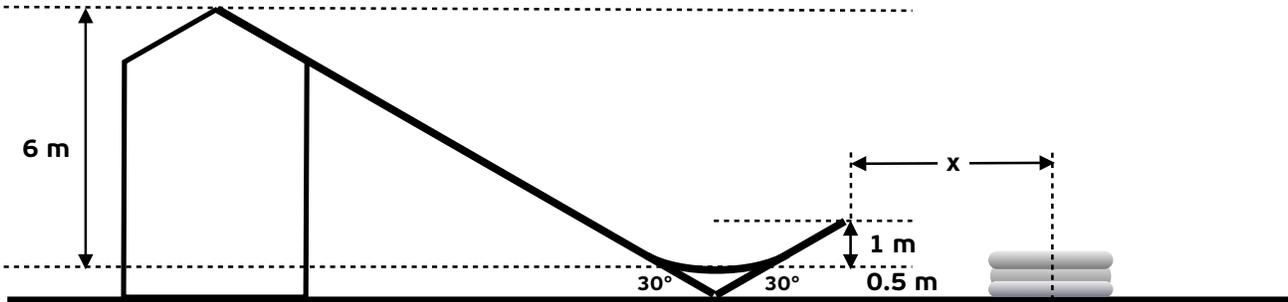




# The Ultimate Backyard Water Slide X

A backyard water slide enthusiast constructed a ramp from a portion of his home's roof to ground level. As is the case with Olympic ski jumps, the ramp then turns upward to launch whatever came down the ramp. The high end of the ramp is 6 meters above its lowest point, and the jump portion rises 1 meter above that low point. The ramp is inclined at  $30^\circ$  on both sides. A small pool is placed so as to catch the water slide rider, as shown in the illustration.



To establish the correct position the pool, a 7-kg bowling ball is rolled down the ramp (while it is still dry), and onto the lawn. The pool is then centered on the indentation made by the ball.

1. What will be the launch speed  $v_0$  of the bowling ball when it reaches the end of the ramp?
  - a. Describe the strategy you will use to make this calculation. What is the story of this process? What is the headline (i.e., Kinematics, Conservation of Momentum, etc.) and what are the details (i.e., uniform gravitational acceleration of a body in free fall, the sum of the momenta of the bullet and target is equal to the momentum of the compound body, etc.)?

- b. Calculate  $v_0$ .

2. The distance,  $x$ , in the diagram is where the bowling ball lands. Calculate  $x$ .
- Make an organized list of known relevant quantities.

- Calculate the distance  $x$ .

With the pool now in place, the water slide enthusiast dons his rubbery wetsuit and the rubbery ramp is doused with water. This creates a very low friction (aquaplaning) situation. When the enthusiast goes for his inaugural ride, the resulting video was recorded. [Watch video now.]

3. The outcome was not as predicted. Without explaining why, describe the simple nature of the error (in terms Goldilocks might understand).

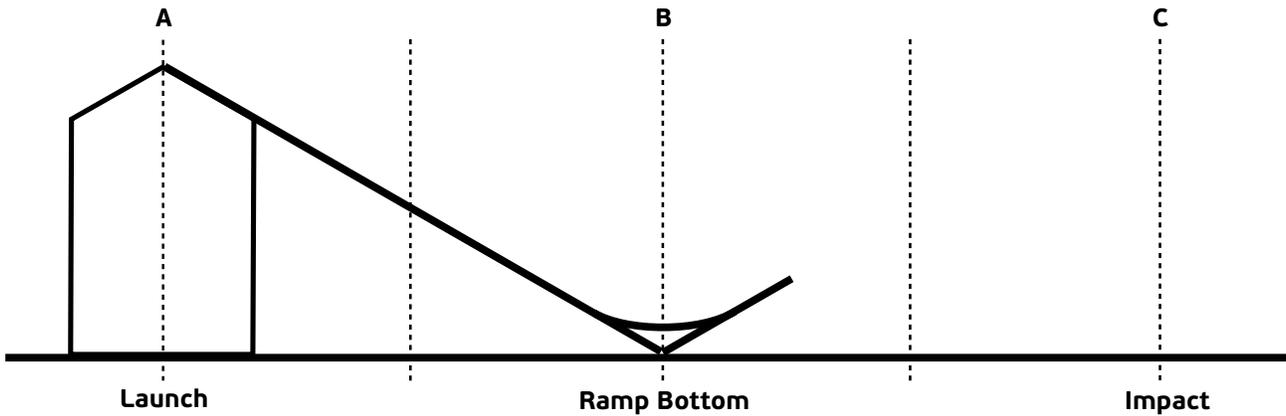
4. Why did the enthusiast follow a different trajectory than the bowling ball did?

5. Calculate a more accurate launch speed for the enthusiast.

6. Calculate a more accurate landing point distance ( $x$ ) for the enthusiast.

7. Speculate: What would have happened if the pool had been placed at this newly-calculated distance? (Could it have resulted in a different injury to the enthusiast?)

Consider the water slide shown below. An enthusiast slides down a frictionless slide beginning at rest from the rooftop at A. He moves past the bottom of the slide at B and eventually becomes a projectile which impacts the ground at C. The horizontal distance AB is equal to the horizontal distance BC.



8. a. Draw the trajectory of the enthusiast from launch to impact.
- b. Is the apex of the enthusiast's trajectory closer to \_\_\_ B or \_\_\_ C or \_\_\_ same for both?
- c. Does the enthusiast spend more time passing from \_\_\_ A to B or \_\_\_ B to C or \_\_\_ same for both? Briefly justify your choice.

- d. Label the following points or segments along the trajectory.
  - i. maximum potential energy
  - ii. maximum kinetic energy
  - iii. maximum velocity in the horizontal direction

e. On the graph below, sketch a plot of the enthusiast's kinetic energy with a solid line and his potential energy with a dashed line, from launch to impact.

