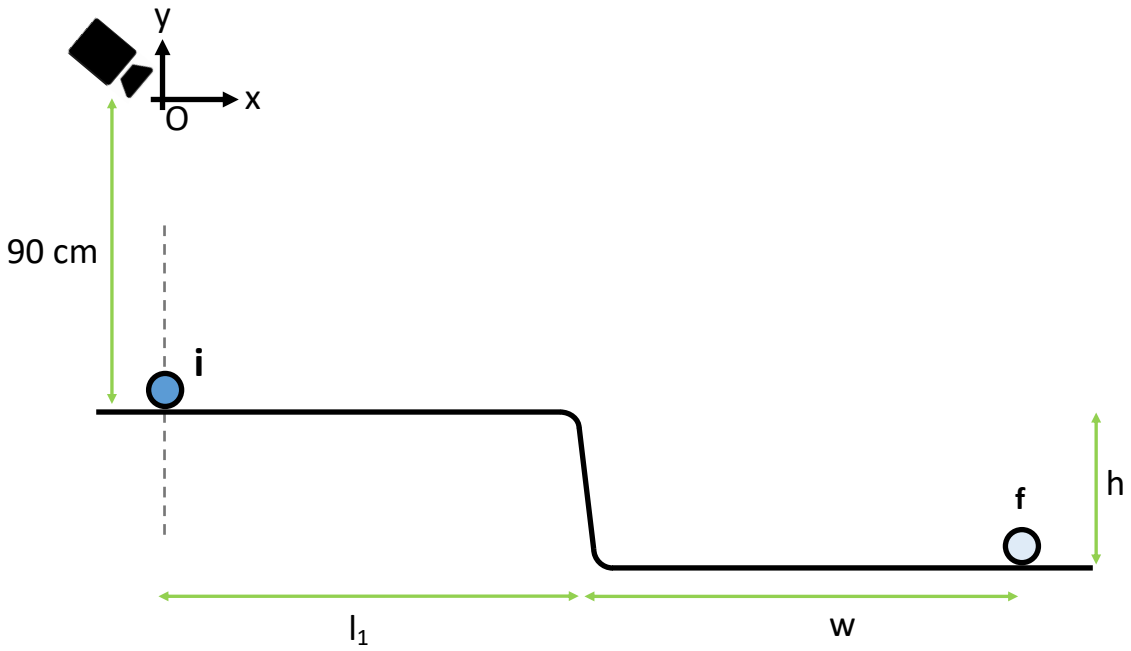
Individual Quizbit 1

PH201, Fall 2022

You are encouraged to discuss these questions with others, but those conversations need to be only in words. Please do not write down steps for others, draw pictures, show math steps, or consult online resources. Any work shown here should be your own thoughts and not copied from any source. You will be graded on the clarity of how well you communicate your steps and reasoning, not on absolute correctness. Hand write your solutions (paper or tablet) and turn your work into Gradescope.

Problem Statement | A ball, initially at point **i** is rolling to the right on a horizontal track at a constant speed. After a distance of l_1, there is a dip in the track and the ball rolls down a near vertical incline, never leaving the track. It then travels a distance **w** on a horizontal portion of track, ending up at point **f**. It is noted that w = l_1 = 1.10 m and the ball is initially traveling at a speed of 7.50 cm/s.



(a) Only one of the following equations could represent the relation between speed (v), distance (x), and time (t). Use that equation to find how long it takes for the ball to travel the distance l_1. Explain what about that equation tells you it could be correct (you can't just say because I know that equation).

$v = \frac{x^2}{t}$	$v = \frac{t^2}{x} + \frac{x}{t}$	$v = \frac{t}{x}$	$v = \frac{x}{t} + t^2$	$v^2 = \frac{x}{t}$	$v = \frac{x}{t}$

(b) Now consider the full journey of the ball, starting at point **i** and ending at point **f**. Draw a physical representation of the initial position vector, the final position vector, and the change in position vector. Use a coordinate system where the origin is at the camera at point O in the diagram, directly above the initial position of the ball.

(c) If h = 0.40 m, determine the x and y components of the initial position vector, final position vector, and change in position vector using the origin O.

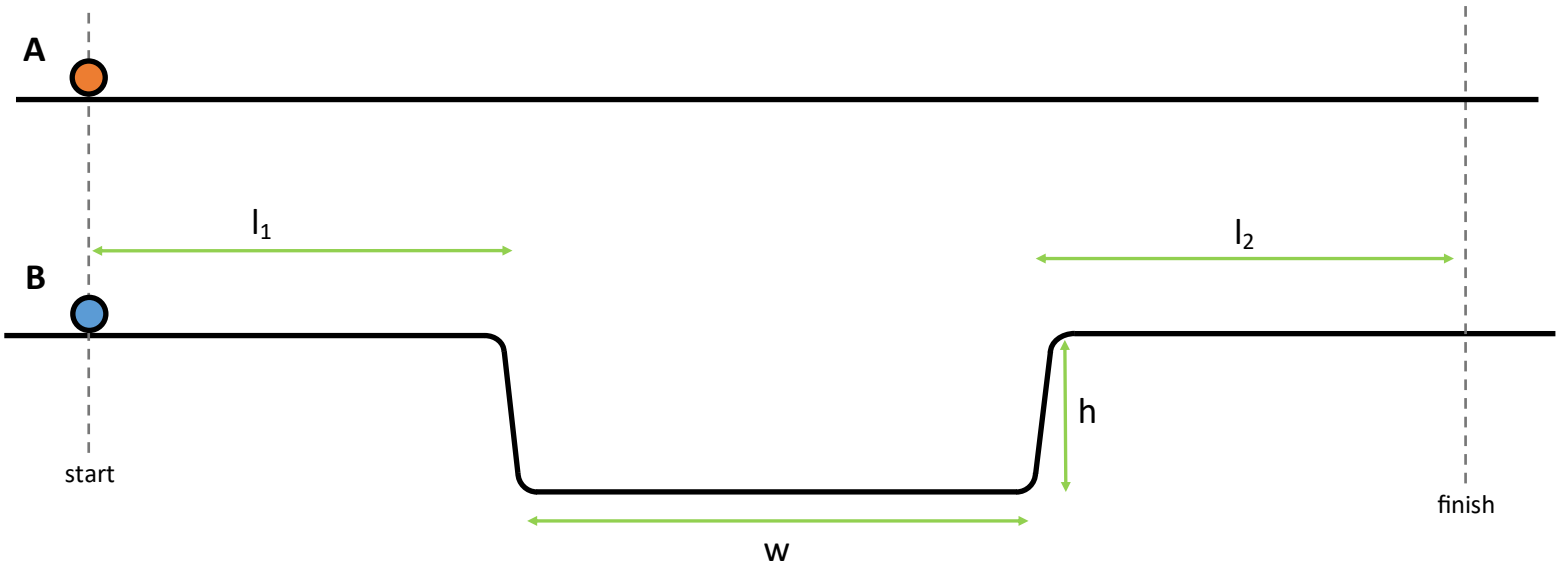
(d) Would you expect the ball to take the same amount of time to travel l_1 as it does w? Explain your reasoning using any combination of words, diagrams, math, etc.

Group Quizbit 1

PH201, Fall 2022

You will be working with your group to create a single solution for these questions. You are encouraged to think about the questions beforehand, and discussing with your classmates is encouraged, but do not bring a solution to your group's working session. You are working to develop a shared solution, with the input and problem solving skills of all your group members. You will be graded on both the clarity of how well you communicate your steps and reasoning, and on absolute correctness.

Problem Statement | Two balls are next to each other rolling at identical speeds to the right on horizontal tracks. Track A remains horizontal the entire time. After traveling a distance of l_1, track B has a dip with nearly vertical walls of height h. The bottom of the dip is horizontal and has a width w. The speed is slow enough that when ball B reaches the dip, it doesn't leave the track. We wish to explore which ball will reach the finish line first.



(a) Let's start by deciding how the length l_1 may affect who wins the race. Which ball travels the initial distance l_1 first? Explain your reasoning using any combination of words, diagrams, math, etc.

(b) If you assume any speed gained while falling down into the dip is lost when the ball rolls back up the other side, ball B is traveling the same speed when it gets out of the dip as when it entered. If that's true, how may l_2 affect which ball wins the race? Assume ball A rolls at a constant speed the entire time. Explain.

(c) To think about the affect of the dip itself, lets use a *special cases sensemaking* technique and make the dip very deep, h >> w*. Imagine the whole track being a few meters horizontally, but h is 100 m deep. Explain which ball would win the race and why.

(d) Now use *special cases sensemaking* on the other extreme, imagine the dip width w >> h. If the whole track is a few meters horizontally, w is 90% of that and h is a few centimeters. Explain which ball would win the race and why.

(e) What is your groups final decision on who wins the race? Explain your reasoning using any combination of words, diagrams, math, etc.

* note: A single greater than (>) symbol means greater than. A double greater than (>>) symbol means ***much*** greater than.