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Projectile Targeting NetID: jw853

In this activity we want to explore a theoretical calculation and use it to make a prediction. There are two parts: you should complete part A and get a signature before starting on part B.

Part A: 10 points

Construct a ramp with the long aluminum rail, the black steel corner bracket, and some masking tape. The end of the ramp should be on the long arm of the bracket, and the bracket should be taped down so that it won't move. You must have the identical setup for part A and part B! If you roll the ball down from the top of the ramp, it should roll across the table for approximately 10 cm before falling onto the floor. You can tape some paper to the floor so that the ball lands on the paper. You should **always** have someone to stop the ball from rolling awy; you will not be given a replacement ball! Your task is to always release the ball from the rest from the top of the ramp, and then determine the horizontal velocity of the ball when it leaves the table. You are **not** allowed to use a timer or stopwatch. You are allowed to use a tape measure, and the fact that the acceleration of free fall is $g = 9.81\ \mathrm{m/s^2}$. Some things that you might want to measure include: the length of the ramp, the height of the ramp where the ball is released, the length of the table that the ball rolls on, the height of the table above the floor, the horizontal distance between the edge of the table and where the ball lands.

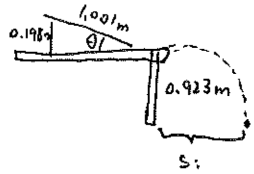
Determine what you want to measure, and construct a data table. Sketch a diagram that clearly shows what you are measuring. Make at least six measurements, and from you data, calculate the horizontal velocity v_x of the ball at the instant it leaves the table.

You will need to show at least one sample calculation that illustrates how you find v_x.

Table Height = 92.3 cm = 0.923 m = h

Track Height = 19.8 cm = 0.198 m

Track Lenght = 100.1 cm = 1.001 m



In Theoritical (no friction)

Two approachs: ① $v_{x1}^2 = 2ax$, where $x = 1.001\,m$.

$a = g\sin\theta = 9.81\ m/s^2 \times \frac{0.198}{1.001} = 1.94044\ m/s^2$.

$v_{x1} = \sqrt{1.94044\,m/s^2 \times 2 \times 1.001\,m} \approx 1.97\ m/s$.

②.

measurement	S_i (m)
1	0.571
2	0.570
3	0.568
4	0.571
5	0.570
6	0.570

$\bar{s} = \frac{1}{6}\sum_{i=1}^{6} s_i = 0.570\,m$

$s = v_x t$

$h = \frac{1}{2}gt^2$.

$v_{x2} = \frac{s}{t} = s\sqrt{\frac{g}{2h}} \approx 1.31\ m/s$

Instructor Initials:

As $v_{x2} << v_{x1}$, we infer it's not thooritical

i.e. fraction force matters here.

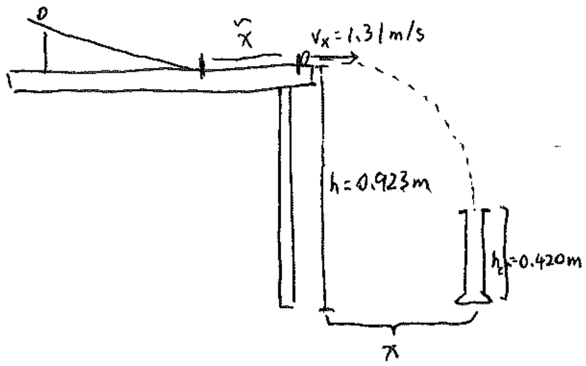
so we take $\boxed{v_x = v_{x2} = 1.31\ m/s}$

Part B: 10 points

After you have found v_x, ask for permission to measure the height of the target (a graduated cylinder). Using this measurement, calculate the location where you will place the target so that the ball, if rolled down from the top, will land exactly in the opening of the target, effectively catching the ball. Once you have determined where you will place the target, call the lab instructor, and they will let you place the cylinder. If you get it on the first try, your maximum score for this section will be 10 points, and you are done. If you require two tries, your maximum score for this section will be 8 points, and you are encouraged to check your part A result before doing a second try. If you require three tries, your maximum score for this section will be 5 points.

Below, you must show your calculations about where to place the cylinder, as well as a diagram that clearly shows what you measured and what variables you used to find the position.

$h_{cylinder} = h_c = 42.0\text{ cm} = 0.420\text{ m}.$



$x = V_x t.$

$y = h - h_c = \frac{1}{2} g t^2.$

$t^2 = \frac{2y}{g}$

$x = V_x \sqrt{\frac{2y}{g}} = \boxed{0.420\text{ m}}$

How many tries before getting the ball in? If it is more than one, you must also clearly show where and how your computation changed above. Remember: No Erasing!

1 time.

Explain, in words, why trying to use a stopwatch to determine v_x would not be an effective method.

In my understanding using stop watch means measure time $\hat{t}$ the ball used to trave $\hat{x}$. then $V_x \approx \frac{\hat{x}}{\hat{t}}$. however, as $\hat{x} \approx 0.1$ m is relatively small, and the measurement of $\hat{t}$ can lack accuracy. as it's ~~inter~~ influenced by human reading and hard to catch the exact moment. also, fraction forces matters. V_x can be smaller than $\hat{V_x}$

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