Experiment: Projectile Motion

Abstract

In this experiment, we had to make a guess on two identical balls on which one would land first while one was being thrown and the other one was being launched at the same time, we also tried predicting the landing distance of a ball being launched horizontally. For the exploration part of the lab the TA, showed us a simultaneous fall apparatus that would let us see one ball being launched and another one dropping straight down. We had to guess on which ball would drop first, I predicted both balls would land at the same time, and they did. For the experiment section of this lab we calculated the ball's horizontal velocity, then we got the balls vertical drop distance and flight time. Then we calculated what the prediction of the horizontal distance would be. Our horizontal distance prediction is .51 meters. We got this by multiplying the balls horizontal velocity by the balls flight time. Then we tested our prediction and got the percent errors, we did four trials and all four distances were greater than the predicted distance, therefore our percent of error was higher.

Introduction

For this experiment, we, predicted the motion where a steel ball would land if it was being launched. Some real-life examples would be, A baseball player throwing a curved pitch. With finding projectile motion they would be able to find the flight path of the ball. We calculated the horizontals velocity and then we predicted the horizontal distance of the flight of the ball which was, .51 meters. Used that to figure out the percent of error by subtracting predicted distance by actual distance, dividing by actual distance and multiplying by 100.

Apparatus

In this experiment we used:

- Simultaneous fall apparatus and 2 steel balls
- Launch ramp with photogate timer and table clamp
- ½" steel ball
- Vernier caliper
- Plump-bob and a two-meter stick

Experimental procedures

In this lab we started off by determining the balls horizontal velocity, using a photogate timer operation, first we measured the width of the steel ball with the Vernier, and got 1.5 cm. We used the photogate to let the ball be released from the top, to roll down to get the time it took. We did this a total of three times so we could get enough info to calculate the average time which was .0127 seconds. Then we calculated the velocity going horizontal, first in centimeters then converting to meters equaling 1.1811 m/s. The vertical dropping distance the time it took it to drop. We got the distance to be 95.5 cm and convert it to meters which would be .955 m. To

get the time it took to land on the floor we used the equation y=1/2 gt^2, using the gravitation force of 9.78 m/s^2, which was .44 seconds.

Then we calculated the horizontal distance prediction of the flight of the ball, hence we are figuring out when the ball is falling down, but it is going horizontally. We used the balls horizontals velocity of 1.1811 and times it by .44 getting .51 meter to get the predicted horizontal distance then did four actual attempts to get the actual distance and calculated the percent of error. When trying to figure out the width of the steel ball we were reading the Vernier wrong and the measurement we had gotten first threw off our calculations when the TA checked it. Since that threw us off the whole experiment we had to go back and re read the width of the steel ball and re do all the equations. Once we figured that out it was mostly just plugging in the numbers in the right spot. When we got to the percent of error calculation, we kept forgetting to multiply by a 100 so our answers were not correct.

Data

Measurements:

- Steel balls width 1.5m
- Trial photogate time:
- Trial 1 0.0139 s
- Trial 2 0.0123 s
- Trial 3 0.0119 s
- Ball’s horizontal velocity
- Horizontal velocity (v=d/t) 1.1811 m/s

Test predictions

Test Attempt Predicted Distance Actual Distance Percent of Error

1. 51 m .81 m 37.03%
2. 51m .8 m 36.25%
3. 51m .79m 35.44%
4. 51m .8m 36.25%

Calculations and graphs

Getting photogate timer average

Adding all three of the times and dividing it by the amount of times you had

- 0.0139+0.0123+0.0119=0.0381
- 0.0381/3=.0127

The horizontal velocity of the ball

The horizontal velocity is found by dividing the time it took for the ball to go down the photogate with the width of the ball.

- V=d/t
- V=1.5/.0127
- 118.11cm/s=1.5/.0127
- =1.1811 m/s

Time it took for the ball to fall on the ground

- Y=1/2gt^2
- .955= (1/2)9.78t^2
- t^2=.955/4.89 m/s^2
- t=.44 s

Horizontal distance prediction

Horizontal distance is by multiplying the velocity with the time

- X=v x t
- X=1.1811(.44)
- X=.51 meters

Computing percent error

Percent error is |predicted Distance-Actual distance| / Actual distance and multiplied by 100.

• Test 1:

.51 - .81/ .81 x 100% = 37.03% of error

• Test 2:

.51 - .8/ .8 x 100%= 36.25% of error

• Test 3:

.51 - .79/.79 x 100%= 35.44% of error

• Test 4:

.51 - .8/.8 x 100%= 36.25% of error

Discussions of results and Error analysis

Looking back at this experiment, our percent of error was pretty high. There could be some improvement for this. For example, better equipment would help tremendously to decrease our percent of error. When we were trying to determine the balls horizontal velocity, we needed we had to use a photogate timer but the numbers we were getting were not working out as well as it should have. When we were supposed to find the distance of where they were landing, we only had meter sticks on the floor, and we had to eyeball where they supposedly landed and

sometimes, we would all get different numbers of where it landed. Our percent of error from the four test attempts we did were 37.03%, 36.25%, 35.44%, 36.25% these numbers were high, the suggestions I made could help decrease those and improve this experiment.

Conclusion

In this lab we determined projectile motion and how dropping two balls at the same time one being launched horizontally and another one being dropped vertically land at the same time on the ground. After all the calculations we did, we tested for the percent of error and found out that the results were higher than we expected them to be, but the theory was correct because the equation we used was accurate on finding the distance they will be traveling. For this experiment to work better I believe that we need better equipment, and to not rely too heavily on just seeing where it would be landing. Human error could be avoided if we had better equipment for the experiment.