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10.2

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**Galileo Projectile Motion Experiment Lab Report**

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**Introduction**

a. General Information

When something is falling down vertically, it’s only have the vertical motion. But, when it’s falling down with some velocity from the straight line, it has both motion, the vertical and the horizontal motion that mix well. That’s what we called projectile motion.

b. Research Question

What is trajectory?

**Variables**

a. Independent

* **For experiment 1.**

Horizontal distance

* **For experiment 2.**

Horizontal distance

* **For experiment 3.**

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* **For experiment 4.**

Horizontal distance

* **For Experiment 5.**

Height of the ramp

b. Dependent

* **For experiment 1.**

Time to reach the ground

* **For experiment 2.**

Parabolic motion

* **For experiment 3.**

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* **For experiment 4.**

Distance to reach the ground

* **For Experiment 5.**

Distance to reach the ground

c.Control : Length of the ramp, height of A to B, mass of the marble.

**Experiment Design**

a. Materials and Equipments

 - Marbles (approx. 5)

 - Ramp

 - Ink

 - Tennis Ball

 - Camera

 - Big Paper

 - Pencil

 - Measuring tape

b. Procedures

Experiment 1 : We need the ramp and 2 marbles in this experiment.

Steps : - Measure how long is the ramp

 - Drop the ball on the top of the ramp

 - When the ball reach the end of the ramp, drop another ball without any horizontal speed at the end of the ramp.

 - We will see or hear that both marbles reach the ground at the same time. If we still not sure enough, we can record it with the camera

Experiment 2: We need big paper, the ramp and marbles ( approx. 5)

Steps : - With the measured ramp before, glide approx 5 marbles closely

 - When the marbles drop at the end of the ramp, we will see that the the marbles are making semi parabolic motion.

 - If you can’t see it clearly, you can ask somebody to hold a paper beside the end of the ramp so there will be a contrast of colour and you can record it to see it more clearly.

Experiment 3: We need tennis ball.

Steps : - Throw the ball upward and let it fall down so we can see the parabolic motion.

 - Record it so we can see it clearly and analyze it with the tracker software

 - Analyze it with the tracker software.

Experiment 4 : We need marbles, measuring tape, pencil, ink and the big paper.

Steps : - Make some points on the ramp that have the same distance from one point to the other point.

 - Drop the marbles into the ink.

 - Prepare the big paper on the ground at the end of the ramp.

 - Glide the marble from the first point. Do 3 times from the same point.

 - When the marble falls down, it will leave a spot on the big paper. The spot is the exactly place where the marble reach the ground for the first time.

 - Measure how far is the spot from the end of the ramp on the ground.

 - Do same thing with the other points.

Experiment 5 : We need big paper, marble, ink and the protractor.

Steps : - Change the angle by changing the height of the ramp.

 - Glide the inked marble

 - When the marble falls down, it will leave a spot on the big paper. The spot is the exactly place where the marble reach the ground for the first time.

 - Measure how far is the spot from the end of the ramp on the ground.

 -Do the same thing with the other angle.

**Data Collecting & Processing**



**For experiments one and two**:

A to B: 71 cm

B to C: 97 cm

C to D: 153 cm

C to E: 303.5 cm

D to E: 150.5 cm

E to G: 58 cm

D to F: 30 cm

**For experiments four and five:**



A to B: 84 cm

B to C: 97 cm

C to D: 153 cm

C to E: 303.5 cm

D to E: 150.5 cm

Experiment four: E to G: 63 cm

Experiment five: E to G varies

**Results:**

1. Whether we release the ball at point B or D, the ball with both vertical and horizontal motions and the ball with only vertical motion will both reach the ground at the same time.
2. They do make a parabolic motion
3. –

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| --- | --- | --- | --- | --- | --- |
| Horizontal distance (how far up the ramp?) | 283.5 cm | 263.5 cm | 243.5 cm | 223.5 cm | 203.5 cm |
| Trial 1 distance | 94 cm | 92.7 cm | 96.8 cm | 90 cm | 86.5 cm |
| Trial 2 distance | 90 cm | 91.5 cm | 97.2 cm | 91.2 cm | 88.9 cm |
| Trial 3 distance | 95.8 cm | 96.5 cm | 97.1 cm | 91.1 cm | 86.3 cm |
| Average | 93.267 cm | 93.567 cm | 97.033 cm | 90.767 cm | 87.233 cm |

5.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Vertical Distance (how high is the first point of the ramp?) | 81 cm | 69 cm | 65.3 cm | 54 cm |
| Trial 1 distance | 122.5 cm | 115.5 cm | 103 cm | 104 cm |
| Trial 2 distance | 124 cm | 117 cm | 118.5 cm | 110 cm |
| Trial 3 distance | 125 cm | 118 cm | 119 cm | 112 cm |
| Average | 123.833 cm | 116.833 cm | 113.5 cm | 108.667 cm |

**Analysis**

**Experiment 1.**

It turns out that both still reached the ground at the same time, since the sound of them hitting the ground was at the same time. Even though we moved the starting point and the distance changed, the time taken to reach the ground for the ball that have both horizontal and vertical motion, and the time taken for the ball that have only vertical motion when released from the same point at the same time will be the same. The problem that we have is sometimes, it’s hard to drop the marble at the same time when the marble that glide from the ramp fall down

**Experiment 2.**

We released the balls quite closely to each other so that we can get a few balls following each other in a parabolic motion in the camera. They do make a semi- parabolic motion when released from the ramp (because a parabolic motion will only be made if we throw a ball and not just release it from a ramp.) The problem is it’s hard to make the perfect distance between one marble and the other marble.

**Experiment 4.**

As we release the ball closer to the end of the ramp, and so have less initial velocity, the distance of the ball increased then decreased. For each try, we decreased 20 centimeters in horizontal distance from the last point. We started with a point 20 centimeters from the top. For the first three points, the distance where the ball hit the ground increased, then it suddenly decreased for the last two points. This might be because until the third point, the initial velocity is roughly the same, but the ball gets closer to the end every time, meaning that it will lose less initial velocity. Then for the last two points, it gets to a point where the initial velocity decreases significantly. The problem is sometimes the marble doesn’t leave any spot at all so we have to repeat it.

**Experiment 5.**

As we decrease the height of the ramp, which means we decrease the angle, and will have less initial velocity, the distance decreased as well. In overall, it kept on decreasing, which proves that it the lower the starting point, the smaller the angle, the less initial velocity, the less the distance of where the ball touches the ground. The problem is the same with the experiment 4.

**Conclusion**

 The conclusion is what we get on each experiment. For example, we know that horizontal speed doesn’t give any effect if the vertical speed is still the same.