

# Free Fall Gravitational Field Constant

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## **Abstract**

Free fall is a very common phenomenon in our daily lives. In the case of the Guenette statue, we can consider birds perched at certain heights on the statue. For a person lying down beneath the statue, it is important to know whether you will be subject to bird droppings. This is an application of free fall. In this experiment, we prove that the gravitational field is constant ( $9.8m/s^2$ ) for any height. By experimentally determining the height and the time of an object in free fall, we can calculate the acceleration due to gravity ( $a = \frac{2d}{t^2}$ ) and compare it to the constant.

# 1 Introduction

In about 1600, Galileo discovered that any free-falling object near the surface of the Earth accelerates with the same constant  $9.8m/s^2$ [1]. Here we conduct an experiment to analyze the effect of varying the height on the Guennette statue (from which an object is dropped) on the value of the gravitational field constant. This paper confirms Galileo's discovery on the nature of free-falling objects.

## 2 Materials and Methods

A ball is dropped from diverse points on the statue, such that there is a variety in height values. The distance from the ground to the point where the ball is dropped is measured in meters (m) using a ruler. The time it takes the ball to reach the ground is then observed using a stopwatch and recorded in seconds (s).



### 3 Results and Discussion

The acceleration (a) was calculated based on the equation of free fall:

$$a = \frac{2d}{t^2} \quad (1)$$

height(m)	time (s)	acceleration $m/s^2$
0.6	0.35	9.796
1.35	0.53	9.612
1.68	0.58	9.988
2.03	0.64	9.912
2.59	0.73	9.720

Table 1: Table of the height, time, and acceleration calculated.

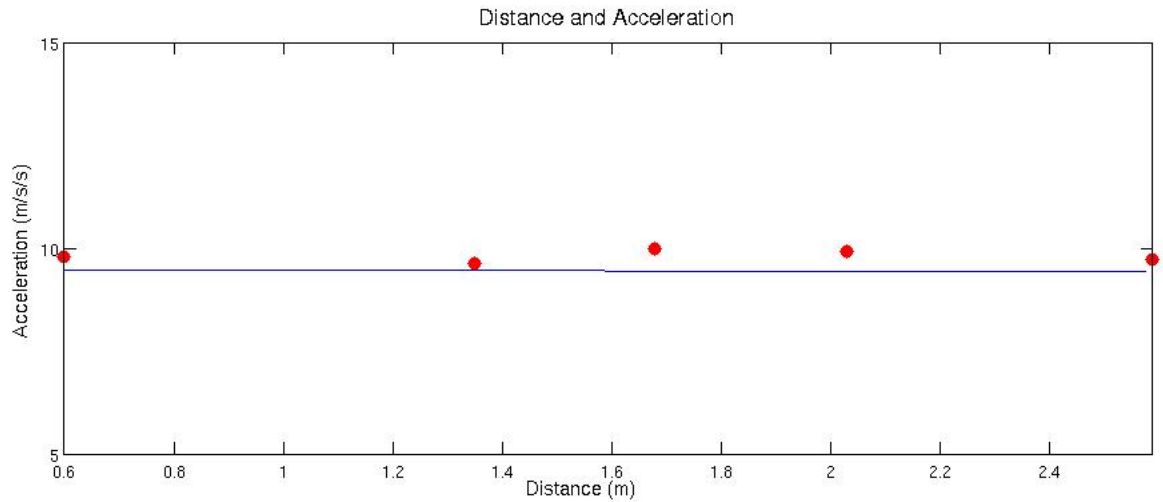


Figure 1: Distance and Acceleration

Figure 1 shows the values of acceleration as calculated in the experiment (points). The line of slope zero represents the gravitational field constant, also the line of best fit of the set of data (line). The reaction time should be taken into consideration in the case of such an experiment. As expected, the accelerations are not fully equivalent to the gravitational

field constant due to experimental errors. The variation ( $v$ ) in the values can be calculated to demonstrate that there is little difference between the calculated values of acceleration and Galileo's constant.

$$v = \frac{\sum (y_i - \text{mean})^2}{n - 1} \quad (2)$$

The calculated variation is approximately 0.0224. The variation in the acceleration values is so small that we can assume the gravitational field constant.

## 4 Conclusion

This experiment proves that the gravitational field strength is constant in all cases of free-fall. The height from which an object is dropped and the time of fall do not affect its acceleration. By comparing the obtained acceleration values with the constant value, we are able to account for the experimental errors. We can therefore conclude that the acceleration due to gravity is  $9.8m/s^2$ .

## 5 Acknowledgments

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## References

- [1] J. Stanbrough. Free fall from rest. [http://www.batesville.k12.in.us/physics/phynet/mechanics/kinematics/ff\\_velocity\\_acc.htm](http://www.batesville.k12.in.us/physics/phynet/mechanics/kinematics/ff_velocity_acc.htm).