'g' BY DROPPING METHOD

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Introduction

I have provided two methods for finding the value of 'g' (acceleration due to gravity). Both of these are my original ones. One is based on the principle of projectile(Verma, M.L.,2015) and other on the free dropping of bullet from height 1.23 m.

'g' by Dropping Method

This experiment is very useful for lower class students. They can easily perform this experiment. They can easily understand the concepts of acceleration due to gravity and gravitational force. This experiment gives us accurate value of g. The performance of this experiment is very simple and easy. There is no costly apparatus used to perform this experiment. The errors of simple pendulum and bar pendulum are totally removed by this experiment.

Principle

We Know that

$$h = ut + \frac{1}{2}at^2$$

But if initial velocity, u=0 and a=g

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

Or $g = \frac{2h}{t^2}$

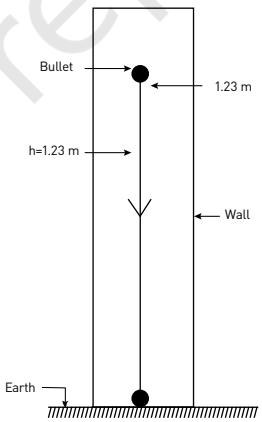
Method

Now, knowing the values of h and t, we can easily calculate the value of 'g'.

A line is marked on the wall at height 1.23 meters from the earth as shown in the figure.

1. Dropping of One Bullet

Observing the watch carefully, one bullet is dropped from the height 1.23 meters to the earth, when the second hand of watch reaches at the sign 12. Also time is noted when bullet hits the earth, In other words, we observe or measure the time taken by bullet to reach the earth, suppose it is t sec.



Generally, I have seen that second hand of watch takes $\frac{1}{2}$ second in the rest position and

$\frac{1}{2}$ second in jumping. Thus, completed one second.

Observations and calculation

Height is fixed in this experiment and that is 1.23 meters

or h =1.23 meters.

and time taken, $t = \frac{1}{2}$ sec.

Now, we know that:

$$g = \frac{2h}{t}$$

Putting the values of hand t we get:

$$g = \frac{2 \times 1.23h}{\left(\frac{1}{2}\right)} = 2.46 \times 4$$

or g= 9.84 metre/sec^2

2. Dropping of Ten Bullets

Dropping of ten bullets is more suitable than one bullet. It is easy to perform the experiment. Observing the watch carefully, when the second hand of the watch reaches at the sign 12, then one bullet is dropped. The second bullet is dropped after 5 seconds from the dropping of the first bullet, similarly all remaining 8 bullets are dropped getting the same time interval of 5 seconds.

Now observing the time of 10th bullet's collision on the earth, it is noted:

Now suppose total time in this process is T second, number of bullets dropped is N and time interval taken after one bullet dropping is n. Therefore, time taken by one bullet to reach the surface of the earth,

$$t = \frac{T - (N-1)n}{N} \text{sec}$$

Observations and calculation

I get the readings in this experiment which is given below:

1. T = 50 second
2. N = 10
3. n = 5sec.
4. h = 1.23 meters

$$\therefore t = \frac{5(10-1) \times 5}{10} = \frac{50 - 9 \times 5}{10} = \frac{5}{10}$$

$$\therefore t = \frac{1}{2} \text{sec.}$$

Now we know:

if u = 0

Then $g = \frac{2h}{t}$

Now, putting the values of hand t

We get, $g = \frac{2 \times 1.23}{\left(\frac{1}{2}\right)} = 2.46 \times 4 = 9.84 m/\text{sec}$

Sources of Error and Precautions

1. The time should be noted carefully because accuracy depends on it.
2. Ten bullets are suitable for this experiment.
3. First bullet should be dropped when the second hand of watch reaches at the sign of 12 marked at the dial.
4. Second and other 8 bullets should be dropped when second hand of watch completing 5 second's sign marked on the dial.
5. Time should be noted carefully when the 10th bullet impacts on the earth.

References

VERMA, M. L. (2015). 'g' by Projectile Method. *School Science*, Vol. 53. No. 3. (September),NCERT