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العدد سبعة وأربعون
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"Determination of free Falling Acceleration Gravity by using Simulations and Practical Methods"

Researchers:

Zainab Ali Bu sinnah

Mathematics department, University college at Nairiyah, University of Hafer Al batin.

Siham Muhammed

Physics department, University college at Nairiyah, University of Hafer Al batin.

Physics department, Peace University, Alfula, Sudan

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Abstract:

One of the difficulties related to the COVID-19 pandemic is the shifting from face-to-face to distance teaching. Both schools and universities had suddenly to organize on-line lectures. To perform laboratory practice even in this period, easily accessible materials, smartphones physics apps, on-line tools and devices can be used. In this paper a method to measure the gravitational acceleration studying the free falling body using the methods of simulating and experimental in the undergraduate laboratory analyze. The data and interpreting the results by simulation the value free fall acceleration were equal 9.64 10.88 m/s2 and 10.47 m/s2, respectively.

Another way of finding the experimental value of , the acceleration due to gravity (g) the apparatus is easy to set up and the reading is easier to perform and compared to other popular experoment and simulation result that were agreed with practical methods.

Keyword: Free fall accleratin gravity – Simulation and Pratical methods.

1.1.Introducton

Effects of air on its flight, you would find that the object accelerates downward at

a certain constant rate.That rate is called the free-fall acceleration, and its magnitude is represented by g. According to Gallilo free fall acceleration is independent of the object's characteristics, such as mass, density, or shape; it is the same for all objects [1]. The motion of falling objects is the simplest and most common example of motion with changing velocity. If a coin and a piece of paper are simultaneously dropped side by side, the paper takes much longer to hit the ground. However, if you crumple the paper into a compact ball and drop the items again, it will look like both the coin and the paper hit the floor simultaneously. This is because the amount of force acting on an object is a function of not only its mass, but also area,[2] The average acceleration due to gravity on Earth is 9.8 m/s^2 . This value is also often expressed as a negative acceleration in mathematical calculations due to the downward direction of gravity.

2. Theory

An object is said to be at free fall if its falling under the influence e of gravity g [3], from y distance at initial time t = 0. The position of the object along the distance is described by the variable y. The position of the object l at a time t is given by

$y(t) = y(0) + v_0 t + ½gt^2$………………..(1).

If the ball is released from rest, the initial velocity is zero: v0 = 0.

Therefore

$y(t) = y(0) + ½ gt^2$…………………. (2),

$y(t) = ½ gt^2$ (y is distance, g is gravity, and t is time) [3],

$g = 2 y/t^2$ m/s^2………………. (3).

The acceleration due to gravity varies slightly, depending on the latitude

and the height above the earth's surface. According to reference [4].

3. Simulation methods

Simulation is mathematical and physical system are broadly applied as fundamental tools to simulate study in this research we are using simulates method to determine the free fall of an object (ball). This simulation gives the ability to measure the acceleration of gravity by taking successive shots of the falling object with recording the time of each shot and measuring the coordinate y for each shot. It also enables us to check the famous free fall equation: $y = (1/2) gt^2$. This simulation is designed by using Gfortran programing language and the results are shown in Table (1) and Figure (2).

Table (1) illustrates the result of height against T

H	**T**	$\mathbf{T^2}$	$\mathbf{G = \frac{2H}{T^2}}$
0.200000003	0.202999994	4.12E-02	9.70661831
0.300000012	0.246000007	6.05E-02	9.91473293
0.400000006	0.286000013	8.18E-02	9.78042889
0.5	0.32100001	0.103041008	9.70487404
0.600000024	0.351999998	0.123903997	9.6849184
0.699999988	0.375999987	0.141375989	9.90267181

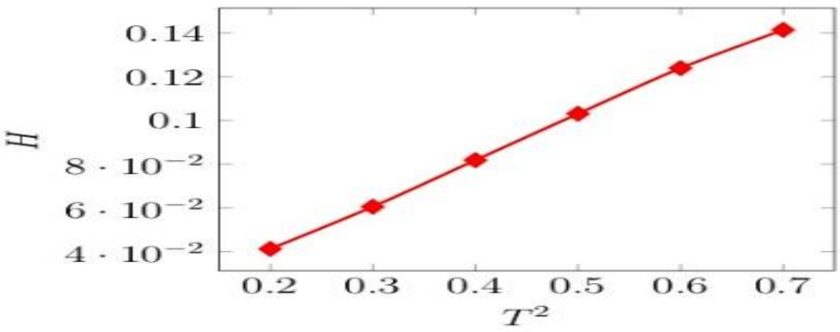

Figure2: Show the relation between the height **H** and time T^2

Table (2) illustrates the result of height against T

H	**T**	$\mathbf{T^2}$	$\mathbf{G = \frac{2H}{T^2}}$
1.20000005	[illegible]	[illegible]	[illegible]
1.29999995	[illegible]	[illegible]	[illegible]
1.60000002	[illegible]	[illegible]	[illegible]

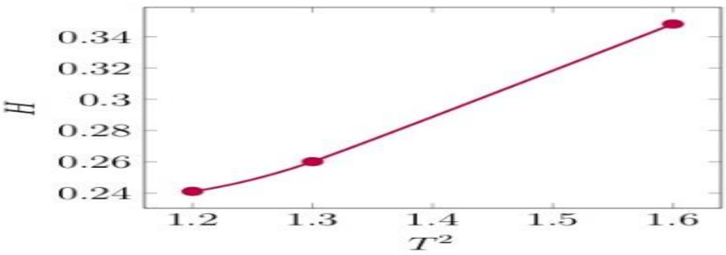

Figure 3:The relation between the different heights **H** and times T^2 at accelerations close to 9.6

H	**T**	$\mathbf{T^2}$	$\mathbf{G = \frac{2H}{T^2}}$
1.20000005	0.490999997	0.241080999	9.95516109
1.70000005	0.600000024	0.360000014	9.44444466
2.29999995	0.699999988	0.48999998	9.38775539

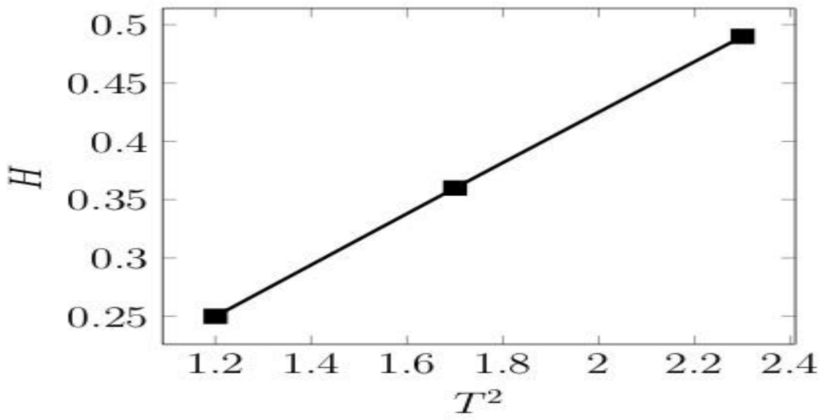

Figure3: The relation between the different height **H** and time T^2

3.Experimental part

3.1 Equipment

The setup, depicted in Fig. 1, is composed of the following parts:

- steel ball,
- contact plate
- ruler,
- electronic timer
- release mechanism

Fig.4, show free fall apparatus

3.1 Procedure

The experimental set up is shown in figure (4). First, the steel ball manually was insert in released mechanism let the distance between the contact plate and released mechanism is 0.30m then the still ball push button and timer starts when the ball hits the strike plate the timer stops the electronic time is measurement ,then the step repeated three times in measured time at this distance then average of time and square calculated, the experiment should be repeated using various value of fall height and the time measured for all different height, average of time and square calculated then the graph between the height (m) in x- axis and t^2 (s^2) along the y axis plotted , the slope calculate from best fit straight line. Then we use the equation 3 to calculate experimental due to gravity.

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3.4: Result and discussion

"By simulation method The free acceleration due to gravity calculated by equation (3) in table

(1,2,3) was 9.64 m/s^2, this values is close to theoretical value 9.8m/s^2 corresponding to reference [5]". Another way of finding the experimental value of, the acceleration due to gravity (g) from free fall was determined the data collected given in table 4 represent the measurement done at 7 different vertical length 0.30 m, 0.40m ,0.50m ,0.60m ,0.70m .0.80m .0.90m against the times of falling for all length reading from counter taking three times for specific length and then average of time calculate and t^2, seen in table (4) . the slope of the graph between the period square motion and height of the string of the contact plate and small the steel ball was shown in figure 4. the slope calculate from the graph finally the acceleration for free fall can be calculate via equation (3) to be equal 9.55 m/s^2 is close to theoretical value 9.8m/s^2 agreed with reference [6].

Table (4) illustrates the T^2 (s ^{2}) against h(m)

No	height (m)	T_1/s	T_2/s	T_3/s	Avarge T /s	T^2 /s^2
1	0.30	0.2040	0.2043	0.2035	0.203	0.041
2	0.40	0.2456	0.2462	0.2468	0.246	0.060
3	0.50	0.2872	0.2859	0.2855	0.286	0.081
4	0.60	0.3222	0.3214	0.3223	0.322	0.103
5	0.70	0.3626	0.3519	0.3523	0.352	0.124
6	0.80	0..3798	0.3788	0.3701	0.376	0.141
7	0.90	0.4050	0.4055	0.4062	0.405	0.157

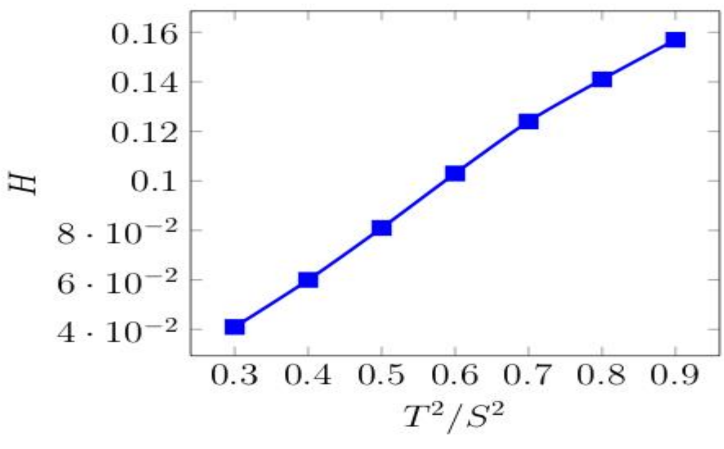

Figure 5: show T^2 vs height.

Conclusions

In this paper it has been shown a technique to measure the gravitational acceleration using two methods, by simulation the results showed that the acceleration results due to gravity values of free fall equal 9.55,9.65 and 9.75 m/s2 respectively, the article goal is to encourage teachers to propose the experiment to their students in order to carry on the laboratory practice even in this pandemic period, The values of the gravitational acceleration experiments were determined, the results showed that the acceleration results due to gravity values of free fall and simulating approximately equal.

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References:

Halliday, D., Resnick, R., & Walker, J. (2013). Fundamentals of physics. John Wiley & Sons..

science buddies ,(2013) showing science :watch object in free falling

Temiz, B. K. (2014). Designing a simple apparatus for measuring kinematic variables. Physics Education, 49(5), 574.

Casaburo, F. (2021). Teaching physics by Arduino during COVID-19 pandemic: the free falling body experiment. Physics Education, 56(6), 063001.

Suwanpayak, N., Sutthiyan, S., Kulsirirat, K., Srisongkram, P., Teeka, C., & Buranasiri, P. (2018, December). A comparison of gravitational acceleration measurement methods for undergraduate experiment. In Journal of Physics: Conference Series (Vol. 1144, No. 1, p. 012001). IOP Publishing.

Faller, J. E. (1963). An absolute interferometric determination of the acceleration of gravity. Princeton University.