Physics Lab Report

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Contents

1 Introduction

1.1 Purpose

The objective of the investigation is to figure out is there a valid relationship between the velocity and displacement of a free-falling object.

1.2 Laborartory Apparatuses

1. The falling object
2. Ticker-timer
3. Paper tape
4. A stand
5. A clamp

(a) clamp and paper tape (b) falling object (c) ticker-timer

Figure 1: Instruments

2 Result of the Experiment

2.1 Collected Data

2.1.1 Procedure

I pick eight dots from the tape, between the adjacent two there are three intervals, meaning the time between the two is $0.06s$.

Then I measure the distance from the first to each of the rest ones and carry out the table below.

Time(s)	**Displacement**$(\pm 0.5)(cm)$
0.06	1.4
0.12	5.9
0.18	13.8
0.24	24.9
0.3	39.3
0.36	57.2
0.42	78.4

Table 1: Raw Data Table

2.1.2 Raw Data Table

2.2 Processed Data

2.2.1 Average Instantaneous Velocity

After obtaining the data from the experiment, we can determine their instantaneous velocity with uncertainty.

Given the equation that:

$$v_i = \frac{\Delta d}{\Delta t}$$

The time interval considered to be $0.06s$, and the displacement between intervals can be calculate by using the total displacement from this one to subract the one from the former interval.

Thus we get the instantaneous velocity of the six period to be $23.3cms^{-1}, 75cms^{-1}, 131.7cms^{-1}, 185cms^{-1}, 240cms^{-1}, 298.3cms^{-1} and\ 353.3cms^{-1}$, respectively.

2.2.2 Uncertainty of v_i

Similarly, since the way of determining percentage uncertainty is:

$$Percentage\ Uncertainty = \frac{\Delta u}{\overline{u}} \qquad \Delta v = |Percentage\ Uncertainty| \times \overline{v}$$

all the Δv from the result are approxiamtely $8.3cms^{-1}$.

2.2.3 Processed Data Table

Note: the subsript i here means instantaneous.

2.2.4 Acceleration due to Gravity

The calculation of the acceleration is based on the V-t Graph. Because the gradient of the tangent line of the V-t graph gives the instantaneous acceleration.

From the graph the gradient of the best fit line is $922.5cms^{-2}$.

Time(s)	**Displacement**$_i(\pm 0.5)(cm)$	**Velocity**$_i(\pm 8.3)(cms^{-1})$
0.06	1.4	23.3
0.12	4.5	75
0.18	7.9	131.7
0.24	11.1	185
0.3	14.4	240
0.36	17.9	298.3
0.42	21.2	353.3

Table 2: Raw Data Table

2.2.5 Uncertainty of Acceleration

Similar to above, the maximum and minmum gradient line has $964.7cms^{-2}$ and $874.6cms^{-2}$ as their slope. The maximum difference between them and the best fit line's is $47.9cm^{-2}$.

Therefore, the acceleration with uncertainty is computed to be $922.5 \pm 47.9cm^{-2}$.

3 Graphs

3.1 S-t Graph

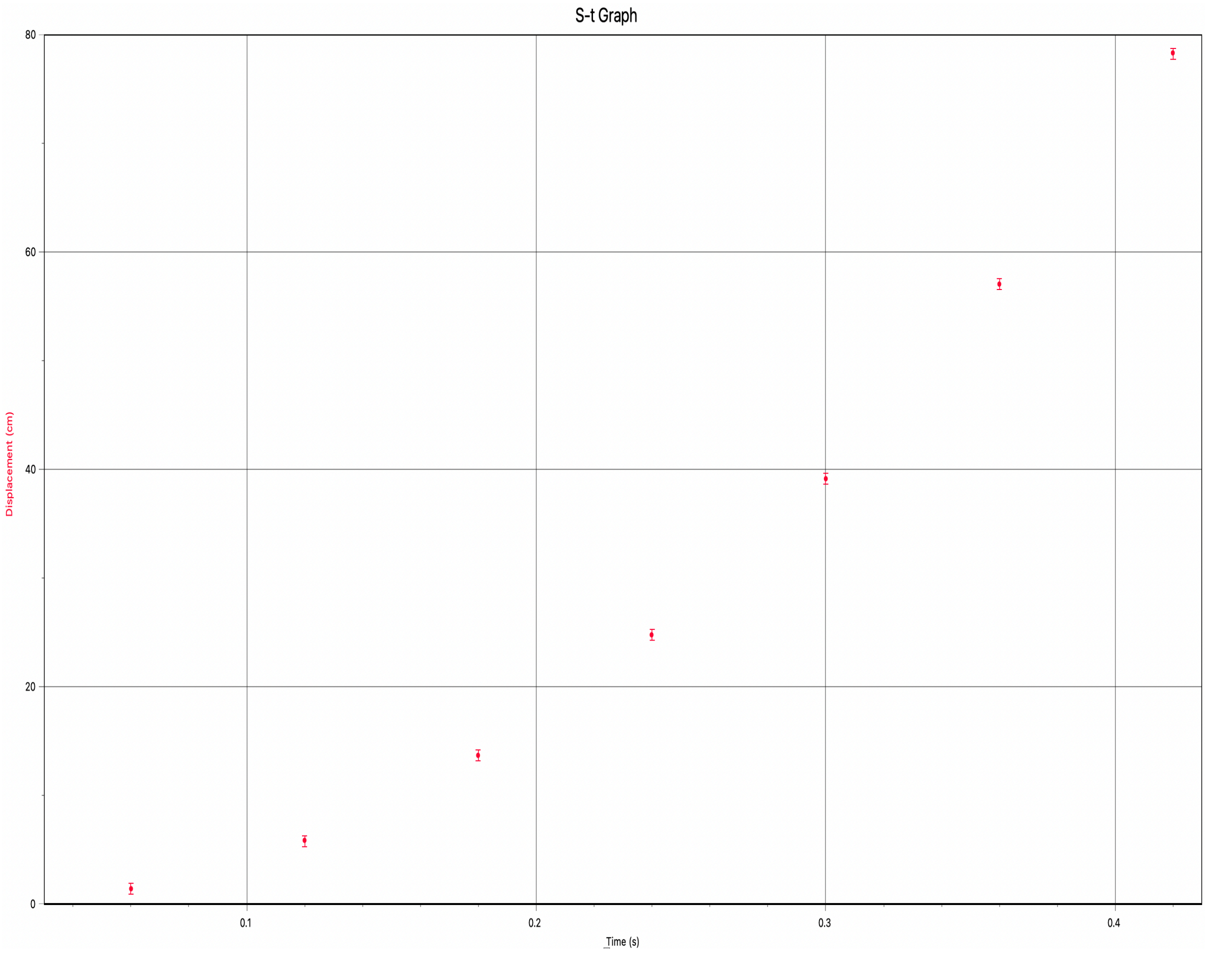

Figure 2: S-t Graph

3.2 S-t^2 Graph

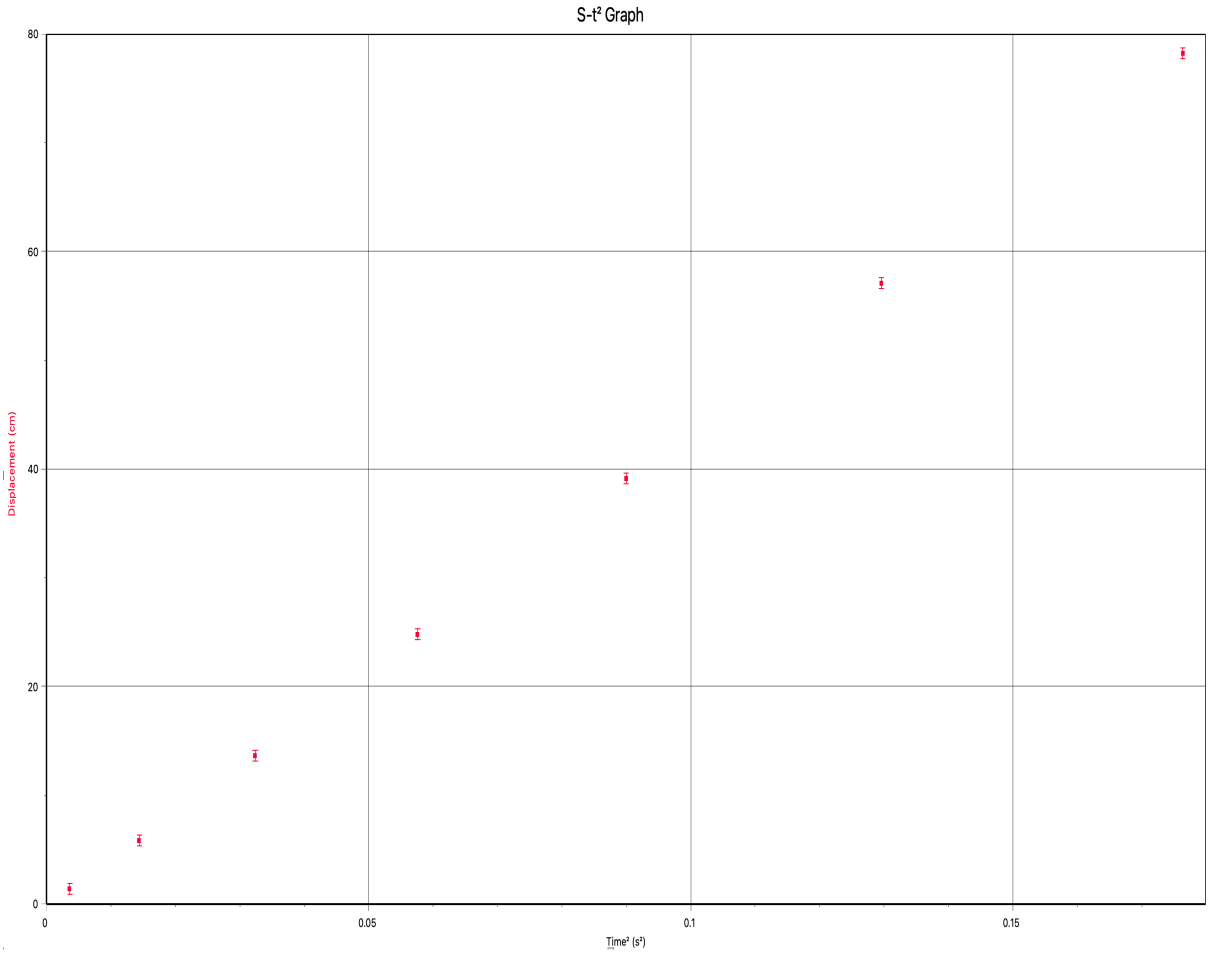

Figure 3: S-t^2 Graph

3.3 V-t Graph

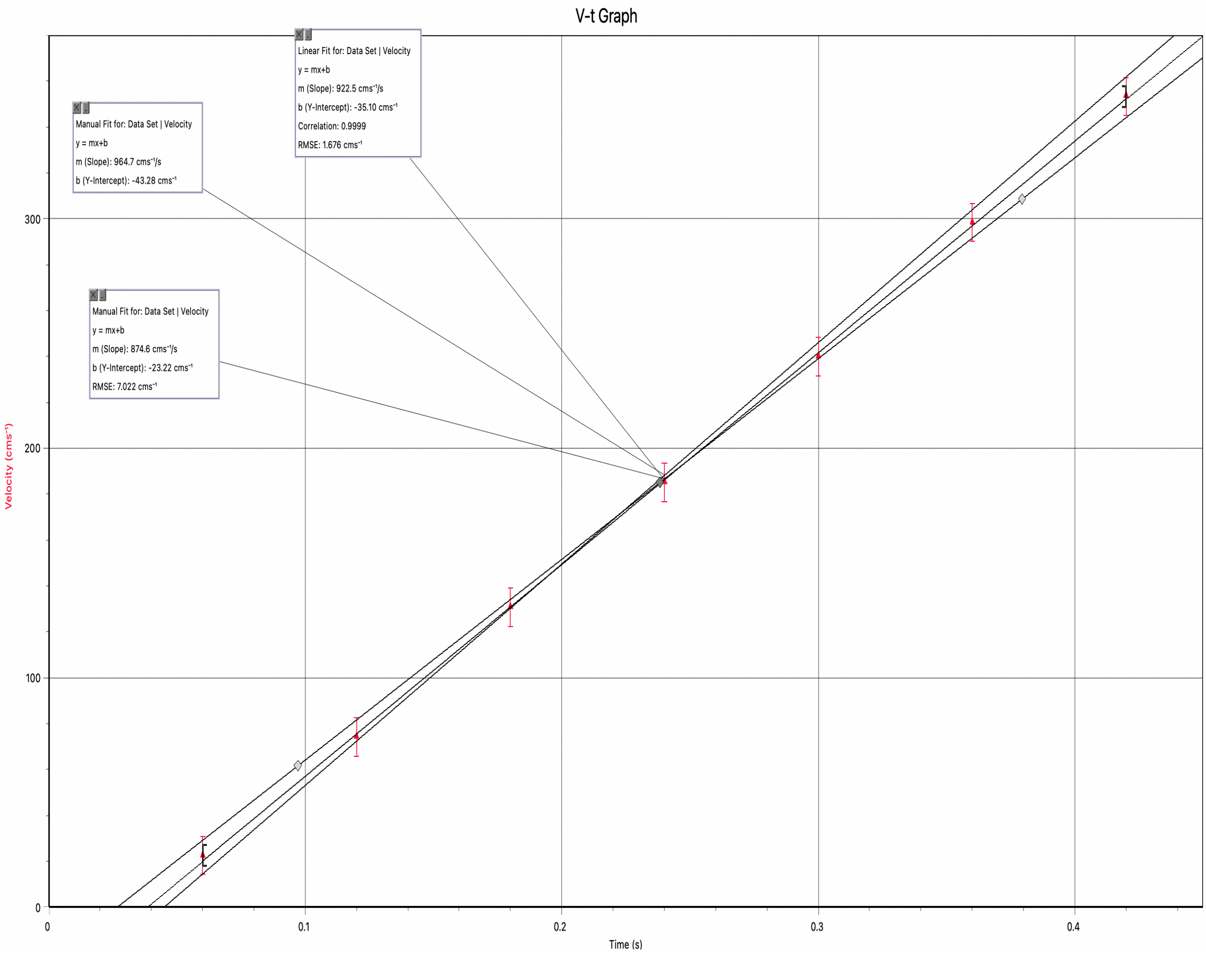

Figure 4: V-t Graph

4 Conclusion and Evaluation

4.1 Therotical Value

After searching for some information online, I know that the gravitational acceleration should be close to around $981cm^{-2}$. And because gravitational acceleration on earth is constant, the instantaneous velocity of an falling object should be proportional to the time spent falling.

4.2 Experimental Result

The data from my result however shows that g, the gravitational acceleration is $922.5 \pm 47.9cms^{-2}$. The actual value is apparently out of this range.

4.3 Reflection

After the whole investigation, I come up with several possible reasons that cause the difference between my result and the therotical one.

A possible one is maybe due to the limit of tools. The meter I use is not precise enough for the measuring the distances between dots, leading to the inaccurate conclusion.

Perhaps another one is on account of the ievitable random error. I only measured once throughtout the experiment. So there is possiblitiy that the raw data I get is not that precise.

I will try my best to avoid the problems above in the next investigation so as to work out a more precise conclusion.