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Date of Lab 9/26 Date of Submission 10/3

Laboratory Report Cover for #1 Lab

Title Analyzing the Acceleration Motion with a Spark Timer

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Summary

The lab was about recording and analyzing the acceleration rate of a dynamic cart descending on a track by using a spark timer and a thermal recording tape. We changed the mass of the cart by putting weights on it, and we also changed the angle of the slope. OK
Through this experiment, we saw that the angle of the slope was influencing the acceleration rate of the dynamic cart. However, the mass of the cart did not affect the acceleration rate. In addition, because the shape of v - t graph (Figure 1) was straight line, it is constant acceleration.
During the lab, some errors like the track moving while the cart is running down the track, and air resistance could be the reason of the acceleration rate had some differences.

・Meet a deadline ・Write logically ・Write clearly ・Write with your own words

Teacher's Comments
Beautiful graphs and tables. Summary is very good. Some problems: method to obtain acceleration rate, "Discussion about "constant-acceleration motion".

1	2	3	4	5	6	7	8	9
Due	Summary	Data copy	Results Tables	Fig. Graphs	Results Summary Table	Discussion & Opinions	Clearness	General

* Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

❖ Experiment

<u>Preparation</u> :

- Dynamic Cart (500g)
- Weight (250g x 3)
- Track
- Scale
- Wood board
- Cramp
- Extension code
- Ruler
- Thermal Recording Tape
- Glue
- Notebook
- Graph paper
- Spark Timer

❖ Result

<u>Table 1</u> - Displacement (x) [x 10^{-2} m], Displacement per 0.100s (Δx) [x 10^{-2} m], and Average Velocity (v) [x 10^{-2} m/s] at Max θ without the weight (only the cart).

Condition : No weight on the cart, Mass = 500g, θ = 13.1°

Time t [s]	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement x	0	1.35	4.15	8.55	14.35	21.7	30.45	40.7	52.35	65.5
Displacement per 0.1s Δx	1.35	2.80	4.40	5.80	7.35	8.75	10.25	11.65	13.15	
Average Velocity v	13.5	28.0	44.0	58.0	73.5	87.5	102.5	116.5	131.5	
Time at central point t [s]	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Acceleration = (131.5-13.5) / (0.85-0.05) = 158.75 (x10^{-2} cm/s^2) ≈ **1.59 m/s^2**

Acceleration rates should be obtained using the slope of v-t graphs

Table 2 - Displacement (x) [x 10^{-2} m], Displacement per 0.100s (Δx) [x 10^{-2} m], and Average Velocity (v) [x 10^{-2} m/s] at Max θ with 3 weights on the cart.

Condition : 3 weights on the cart, Mass = 1250g, θ = 13.1°

Time t [s]	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement x	0	1.75	5.10	10.05	16.60	24.75	34.50	45.85	58.85	73.3
Displacement per 0.1s Δx	1.75	3.35	4.95	6.55	8.15	9.75	11.35	13.00	14.45	
Average velocity v	17.5	33.5	49.5	65.5	81.5	97.5	113.5	130.0	144.5	
Time at central point t [s]	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Acceleration = (144.5-17.5) / (0.85-0.05) = 158.75 (x10^{-2} cm/s^2) ≈ **1.59 m/s^2** ✓

Table 3 - Displacement (x) [x 10^{-2} m], Displacement per 0.100s (Δx) [x 10^{-2} m], and Average Velocity (v) [x 10^{-2} m/s] at Lower θ without the weight (only the cart).

Condition : No weight on the cart, Mass = 500g, θ = 6.6°

Time t [s]	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement x	0	0.39	1.10	2.75	3.57	5.37	7.42	9.93	12.68	15.78
Displacement per 0.1s Δx	0.39	0.71	1.05	1.42	1.80	2.05	2.51	2.75	3.10	
Average velocity v	3.90	7.1	10.5	14.2	18.0	20.5	25.1	27.5	31.0	
Time at central point t [s]	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Acceleration = (31.0-3.90) / (0.85-0.05) = 33.875 (x10^{-2} cm/s^2) ≈ **0.34 m/s^2** ✓

Table 4 - Displacement (x) [x 10^{-2} m], Displacement per 0.100s (Δx) [x 10^{-2} m], and Average Velocity (v) [x 10^{-2} m/s] at Lower θ with 3 weights on the cart.

Condition : 3 weights on the cart, Mass = 1250g, θ = 6.6°

Time t [s]	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement x	0	0.55	1.40	2.78	4.63	6.93	9.68	12.90	16.55	20.65
Displacement per 0.1s Δx	0.55	0.85	1.38	1.85	2.33	2.75	3.22	3.65	4.10	
Average velocity v	5,5	8.5	13.8	18.5	23.3	27.5	32.2	36.5	41.0	
Time at central point t [s]	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Acceleration = (41.0-5.5) / (0.85-0.05) = 33.875 (x10^{-2} cm/s^2) ≈ **0.44 m/s^2** ✓

Table 5 - Relationship of Mass, Angle, and acceleration

Experiment	Angle (°)	Mass (g)	Acceleration Rate (m/s^2)
①	13.1°	500g	1.59 m/s^2
②	13.1°	1250g	1.59 m/s^2
③	6.6°	500g	0.34 m/s^2
④	6.6°	1250g	0.44 m/s^2

❖ Discussion

In Experiment ①, we let the slope of the rail be 13.1°and let the cart run through the rail without any weight and in Experiment ②, we let the cart run through the rail with three weights on it. As you can see in the graph and the data table, the acceleration rate of Experiment ①and Experiment ② are the same. Even though we added the weights on the cart and the mass of these two carts are different, this data shows that the acceleration rate doesn't change.

In Experiment ③, we changed the slope of the track to 6.6° and let the cart descend the track without any weight and in Experiment ④, we let the cart descend the track with three weights on it. As you can see in the graph, there were only 3.4 (0.44-0.34 / 0.34 x 100)% differences between two of the experiment, so we can say that these had the same acceleration rate. From the data table above, we can study that the acceleration rate of the cart changed as the slope changed.

For example, in Experiment ① and Experiment ③ , the cart has no weights so the mass of the cart is the same but the acceleration is different because the slope of the track is different. From these, it shows that the slope of the rail is affecting the acceleration rate of the cart and the mass of the cart is not affecting the acceleration rate of the cart.

In addition, it shows that all motions of the cart observed in Experiment ①, ②, ③, and ④ are constant velocity because the v-t graph (Figure 1)shows four straight lines.

Although the mass of the cart does not affect its acceleration rate, I see a slight differences between the results. In my opinion, this is because of the air resistance and the friction between the tire of the cart and the rail.

good point!

From these, my hypothesis was rejected. Another reason makes these happened is because the slope of the rail changed while the cart was running down the track. During the lab, out track moved so we tried to avoid this, but it may moved a little bit.

"constant-acceleration motion" means that acceleration is constant during a motion.

❖ Conclusion

The mass of the object does not affect the acceleration rate but the angle of the slope affects the acceleration rate. Therefore, my hypothesis that states "the movement of a cart is constant-acceleration motion" is rejected. Because of the air resistance, the tire friction, and some errors that could happen, my result gave a little bit differences between two Experiments, but I could figure out how the mass of the object and the angle of the slope affects its acceleration rate. ← X

❖ Opinions

I learned how to show and check the things that we learned in the class through this lab. In addition, I was surprised that my hypothesis was rejected. I believed that if the mass of the cart changed, its acceleration rate would also change but it did not.

Toshi

Figure 1 v-t graph

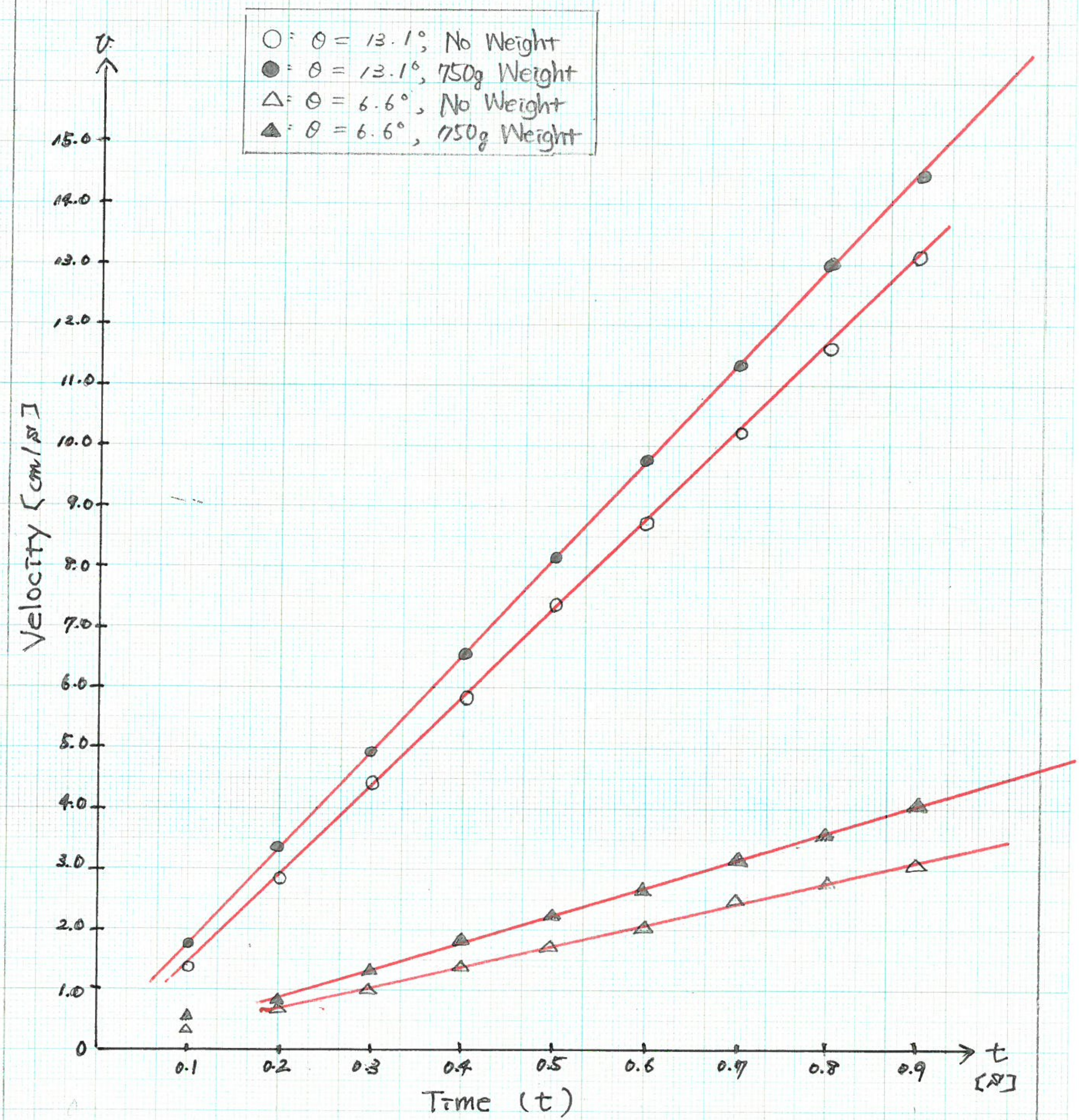

Figure 2 x − t graph

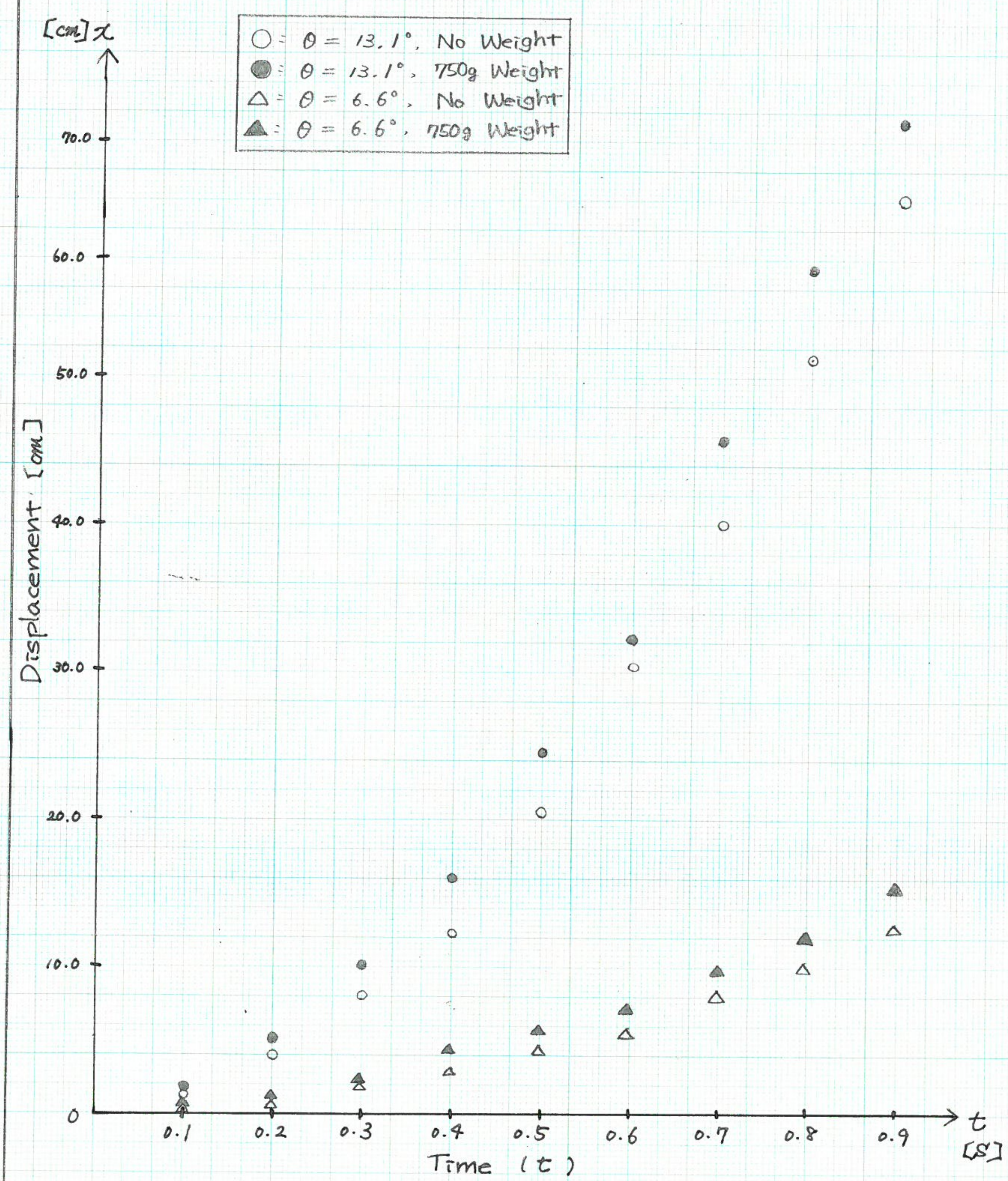

Figure 3 Graph of the acceleration rate of the cart with Max θ (13.1°) without weight

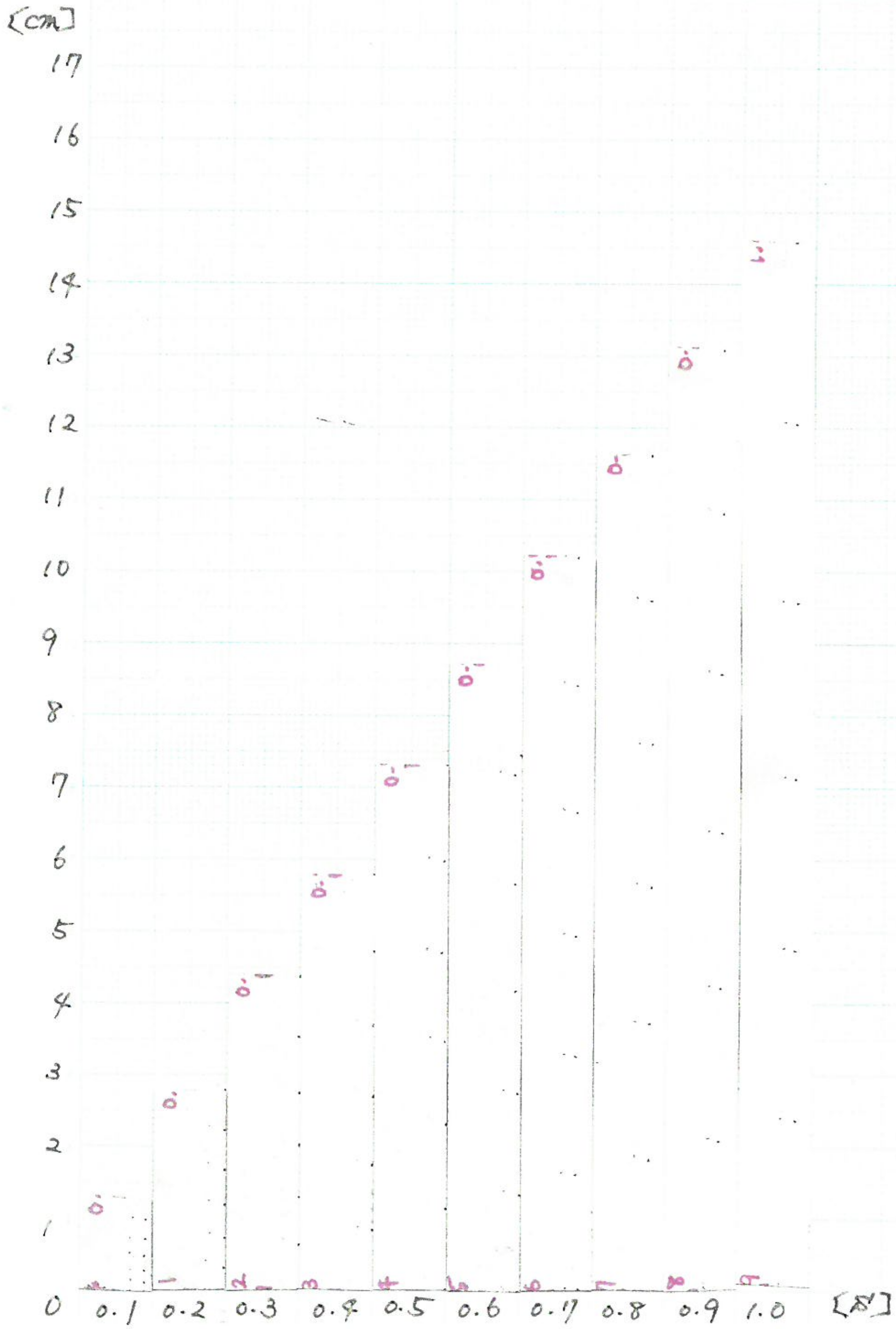

Figure 4 Graph of the acceleration rate of the cart with Max θ (13.1°) with 3 weights on the cart

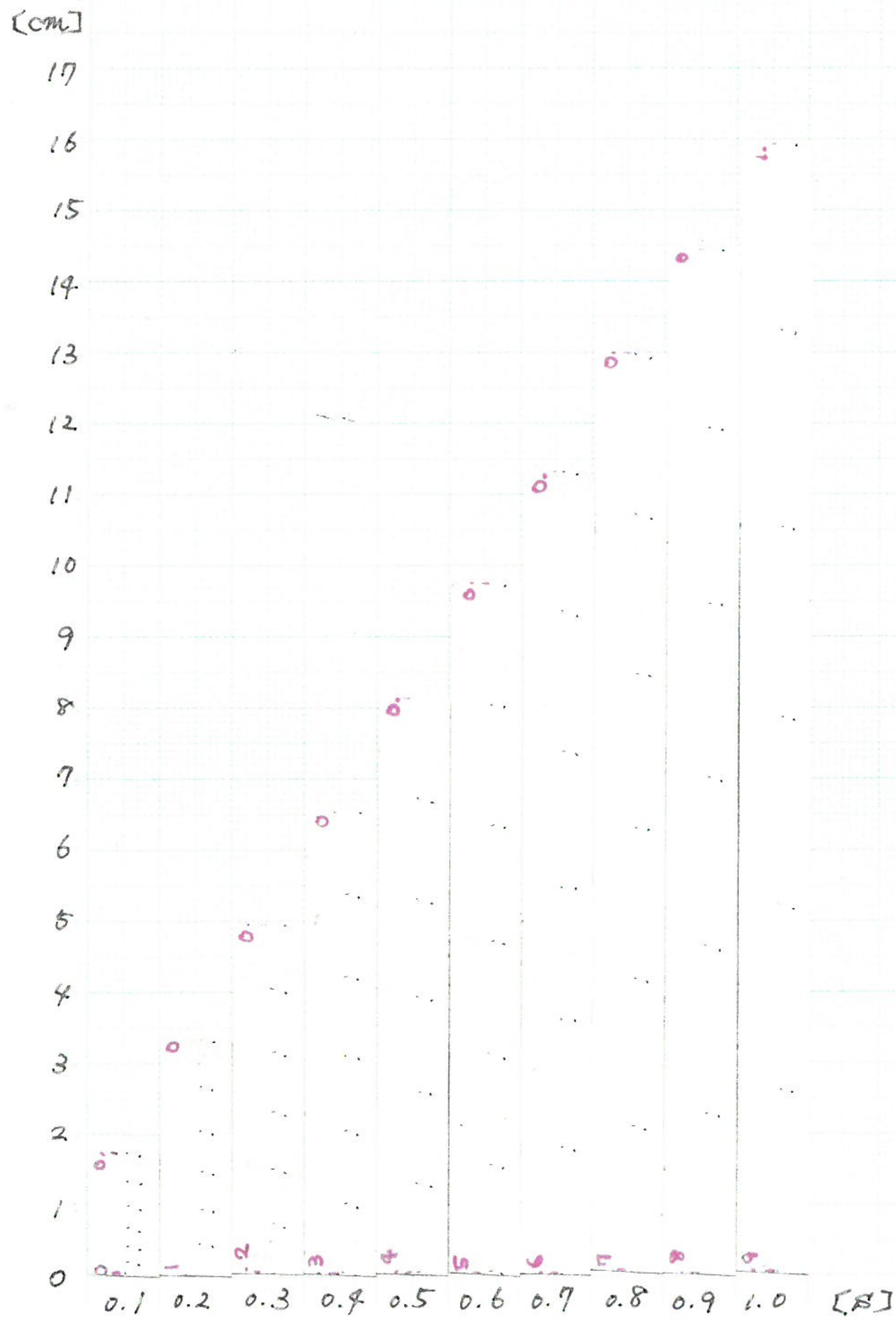

Figure 6 Graph of the Acceleration Rate of the cart with Lower θ (6.6°) without weight

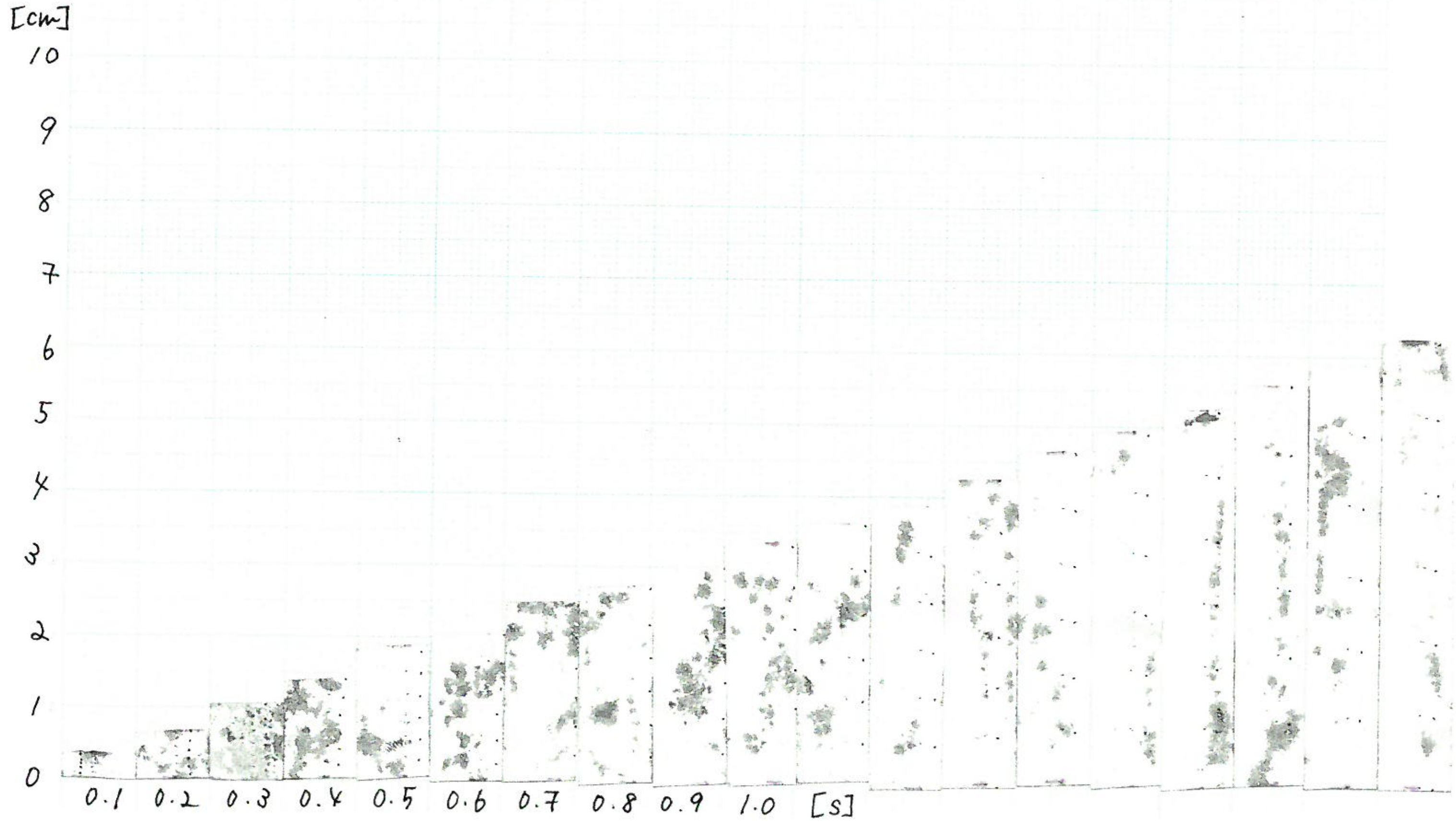

Figure 5 Graph of the Acceleration Rate of the cart with Lower θ (6.6°) with 3 weights on the cart