Date of Lab 9/27/17 Date of Submission 10/6/17

Laboratory Report

Title Analyzing the Motion of Dynamic Cart with a Spark Timer

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Summary

By using a spark timer, we recorded the acceleration rate of ~~the~~ a Dynamic Cart. First, we recorded the Dynamic Cart with no weights and figured out the acceleration rate. Then we add weight on the Dynamic Cart and recorded it and figured out the acceleration. Next, we change the angle of slope and did same process.
The acceleration rate does not change by mass, but it changes by the angle of slope. Steeper angle increases acceleration rate and gradual angle decreases acceleration rate.

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

Teacher's Comments
Beautiful tables and graphs with clear description in beautiful English.
You must obtain the values of acceleration from the figures, see my comment.

1 Due	2 Summary	3 Intro.	4 Method.	5 Results	6 Table/Fig.	7 Discussion	8 Clearness	9 General
+	++				++	+	+	++

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

2. *Introduction*

Objectives :

1) Record the movement of a Dynamic Cart descending on a slope
2) Investigate the relationship between acceleration and mass of the Dynamics Cart

Hypothesis :

The movement of a cart is constant-acceleration movement.

Safty :

Do not drop a cart on your foot.

3. *Experimental*

Preparation :

Dynamic Cart (500g), Weights (250g),
Track, Scale, Wood board, Cramp,
Scissors, Glue, Graph Paper (x6),
Spark Timer (60Hz), Tape (x4)

Process :

1. Measure the height (h) and length (L) of the track to obtain the angle of the track θ
   tanθ= h/L   θ=tan^-1(h/L)
2. Put the tape through the spark timer and connect it to the Dynamic Cart with no additional weights on the track
3. Put the Dynamic Cart on the top of the slope
4. Turn on the Spark Timer and release the hand
5. When the Dynamic Cart reached to the bottom of the track, turn off the Spark Timer
6. Pull out the tape from the Spark Timer and cut the tape in every 6 dots
7. Paste the tape on the Graph Paper
8. Change the mass of the Dynamic Cart by adding the weights and do the same process
9. Change the angle of the slope and do the same process with the normal Dynamic Cart and the Dynamic Cart with weights
10. Record all data on the same x-t and v-t graph

3. Result

You must obtain the values of acceleration from the slope of the line in graphs; not from only two points in the tables.

<u>Data :</u>

Acceleration (a)=Δv/Δt

① Table 1 : Condition : Mass = 500g, θ = 13.5°

Time [s]	t	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacememt [x 10^-2m]	x	0	0.19	5.50	10.55	17.25	25.35	35.05	46.25	58.85	73.00
Displacememt per 0.100s [x10^-2m]	Δx		1.90	3.60	5.05	6.70	8.10	9.70	11.20	12.60	14.15
Average Velocity [x10^-2m/s]	v		19.0	36.0	50.5	67.0	81.0	97.0	112.0	126.0	141.5
Time as centra point [s]	t		0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85

Acceleration = (141.5-19.0)/(0.85-0.05) = 153.125 ≈ 153.1($\times10^{-2}$m/s^2) = **1.53m/s^2** ←

② Table 2 : Condition : Mass = 1000g, θ = 13.5°

Time [s]	t	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacememt [x 10^-2m]	x	0	1.75	5.05	10.05	16.65	24.85	34.65	45.95	58.95	73.55
Displacememt per 0.100s [x10^-2m]	Δx		1.75	3.30	5.00	6.60	8.20	9.80	11.30	13.00	14.60
Average Velocity [x10^-2m/s]	v		17.5	33.0	50.0	66.0	82.0	98.0	113.0	130.0	146.0
Time as centra point [s]	t		0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85

Acceleration = (146.0-17.5)/(0.85-0.05) = 160.625 ≈ 160.6($\times10^{-2}$m/s^2) = **1.61m/s^2**

③ Table 3 : Condition : Mass = 500g, θ = 9.90°

Time [s]	t	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacememt [x 10^-2m]	x	0	1.40	3.70	6.90	11.05	16.15	22.15	29.05	36.85	45.60
Displacememt per 0.100s [x10^-2m]	Δx		1.40	2.30	3.20	4.15	5.10	6.00	6.90	7.80	8.75
Average Velocity [x10^-2m/s]	v		14.0	23.0	32.0	41.5	51.0	60.0	69.0	78.0	87.5
Time as centra point [s]	t		0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85

Acceleration = (87.5-14.0)/(0.85-0.05) = 91.875 ≈ 91.9 ($\times10^{-2}$m/s^2) = **0.92m/s^2**

④ Table 4 : Condition : Mass = 1000g, θ = 9.90°

Time [s]	t	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacememt [x 10^-2m]	x	0	1.40	3.80	7.15	11.50	16.90	23.25	30.60	38.90	48.25
Displacememt per 0.100s [x10^-2m]	Δx		1.40	2.40	3.35	4.35	5.40	6.35	7.35	8.30	9.35
Average Velocity [x10^-2m/s]	v		14.0	24.0	33.5	43.5	54.0	63.5	73.5	83.0	93.5
Time as centra point [s]	t		0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85

Acceleration = (93.5-14.0)/(0.85-0.05) = 99.375 ≈ 99.4 ($\times 10^{-2}m/s^2$) = **0.99m/s²**

Table 5

<Relationship of Mass, Angle, and Acceleration>

Test	Mass (g)	Angle (°)	Acceleration (m/s^2)
①	500	13.5	1.53
②	1000	13.5	1.61
③	500	9.90	0.92
④	1000	9.90	0.99

6. *Discussion*

The acceleration did not change by the mass. As shown in the Table 1 and 2, and Figure 1 and 2, the Dynamic Cart with no weight and the Dynamic Cart with additional 500g weight, small error was produced, but they had same range of acceleration rates which were 1.53 m/s^2 and 1.61 m/s^2 and the graph has similar patterns.

The acceleration changed when the angle of the track was changed. When the angle was changed to a smaller value, the acceleration rate had dropped. As shown in the Table 1 and 3, and Figure 1 and 2, the acceleration dropped from 1.53 m/s^2 to 0.92 m/s^2 because the angle of track changed from 13.5° to 9.90°. Therefore, the angle of slope has a great affect towards the acceleration of the Dynamic Car. Steeper slope causes the acceleration rate greater and gradual slope causes the acceleration rate small.

7. Conclusions

The acceleration does not change by the mass of the Dynamic Cart. The acceleration is affected by the angle of the track which is the slope of the track. This down movement is constant-acceleration movement.

8. Opinion

It was interesting to use spark timer and I had very good time in this lab. I thought the heavier object falls faster than lighter object before this lab, but through the lab, I learned that the mass of the object does not matter. Also, the lab taught me a lot of things. I learned how to write a graph with very small number. I could use [10^-2] and make the graph easy to see.

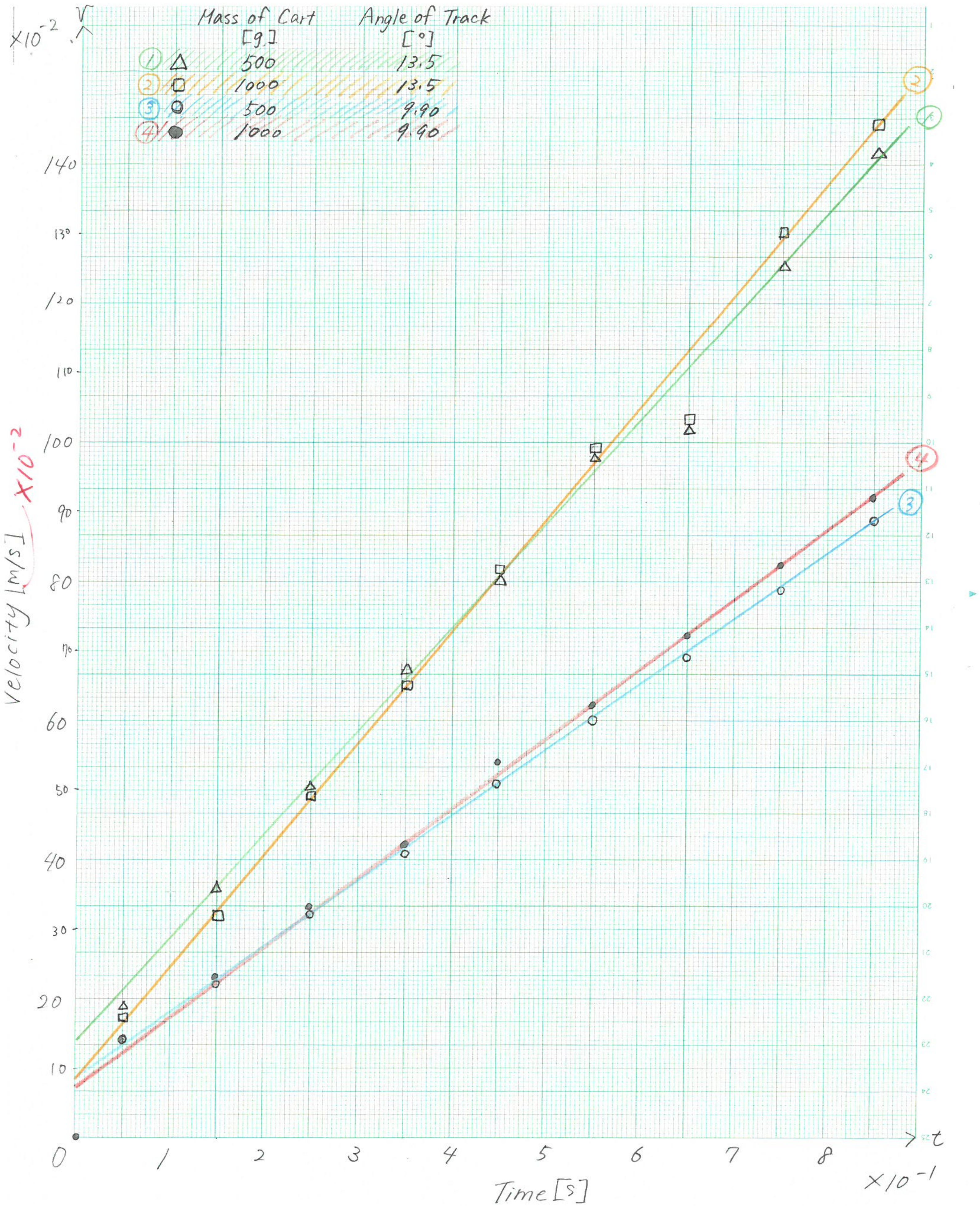

Fig. 1 v-t Graph

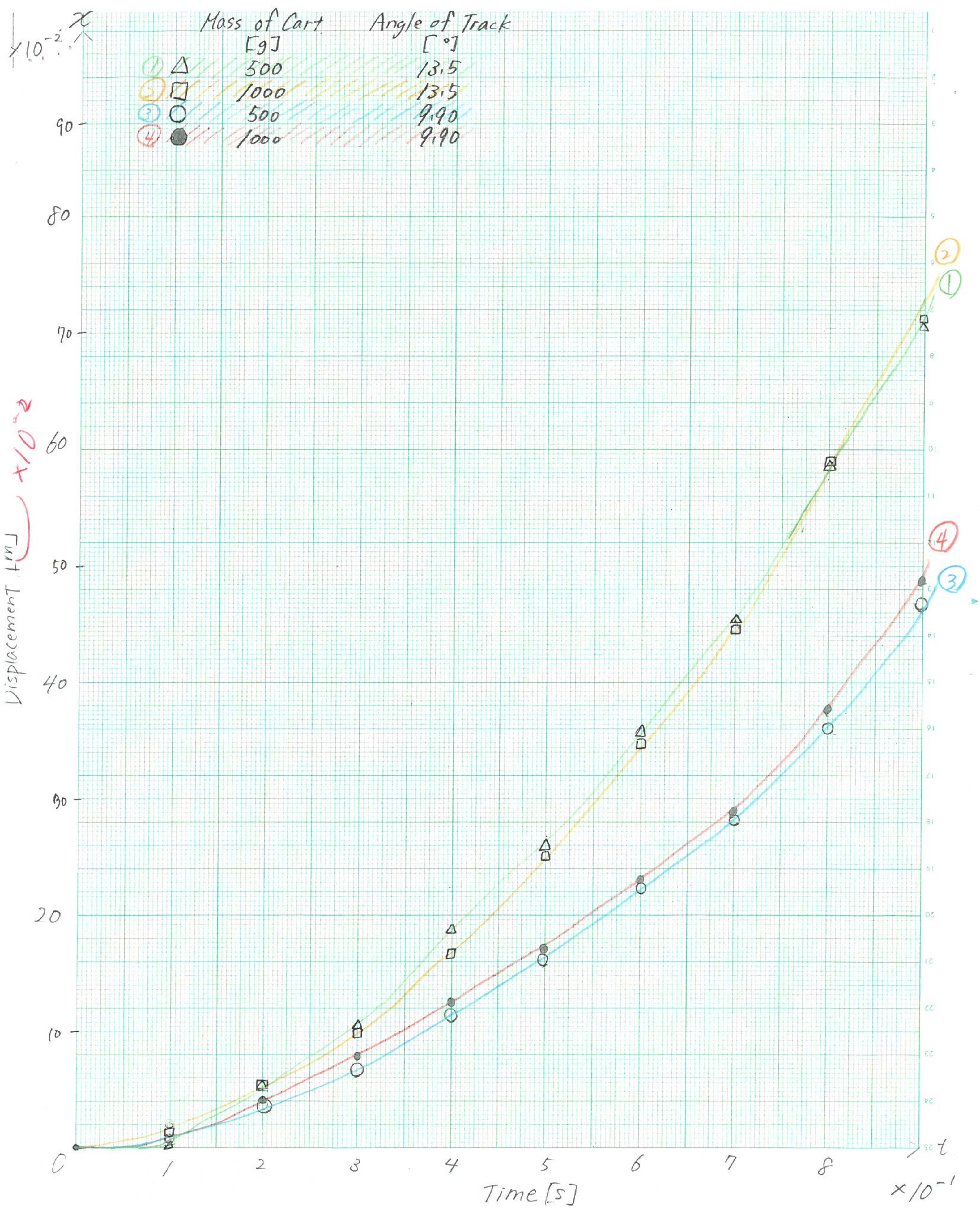

Fig. 2 x-t Graph