Date of Lab 9/27/2017 Date of Submission 10/6/2017

Laboratory Report

Title Analyzing the Motion of Dynamics Cart with a Spark Timer

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Summary

This lab is about the acceleration of a Dynamic Cart descending on a slope by using a spark timer and a thermal recording tape. We observed how the acceleration is affected by changing the mass of a cart or the angle of the track. Through the experiment we are able to learn that the angle of the track influences on the acceleration while the mass of a cart does not. One mistake was that the cells of the excel charts disappeared suddenly after I print this out.

A good summary.

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

Teacher's Comments

Beautiful tables and figures with clear description.

Some errors in units.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method.	Results	Table/Fig.	Discussion	Clearness	General
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* Use this form as a cover sheet.

* Submit your reports by the seventh day after your lab.

■ Introduction

Objectives

1) Record the movement of a Dynamic Cart descending on a slope

2) Investigate the relations between acceleration and mass

Hypothesis

The movement of a cart is constant-acceleration motion. Acceleration is nothing to do with time and mass.

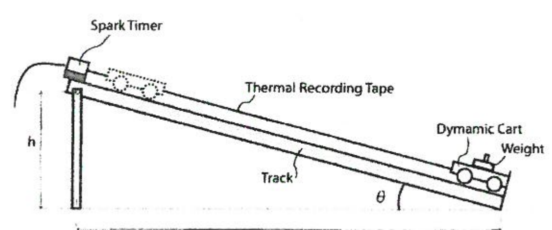
Safety

Do not drop a cart on your foot.

■ Experiments

Preparation

- Spark Timer
- Dynamic cart (500g)
- Weight(250g each)
- Track
- a thermal recording tape
- Scale
- Cramp
- Extension code
- Scissors
- Glue
- Graph paper
- Wood board



~~How to Experiment~~ method

1. Measure the mass of a Dynamic cart and a weight
2. Measure the height(h) and length(L) of the track to obtain the angle of the track θ

   $\tan\theta = h/L$

3. Set the graph paper between the cramp and the spark timer which is turned off.
4. Descent the graph paper from the top of the track right after turning on the spark timer. (Make sure that the frequency of the spark timer is 60Hz)
5. Experiment this for total four times. (in 2 angles and 2 kinds of mass)
6. Decide a start point and make a group of 6 dots and cut at the marked places and seal them onto the graph paper. (the time of 6 dots corresponds to 0.100s (1/60s x6=0.100), and the length corresponds to the displacement)
7. Make a table, and draw *x-t* and *v-t* graphs. Obtain acceleration $a=\Delta v/\Delta t$ from the slope of *v-t* graph.

■ Result

Condition①: Cart(500g) only, height 0.24m, length 1.06m, angle 13°

Time *t* [s]	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacement *x* [x 10-2m]	0	1.79	5.13	10.12	17.00	25.56	35.57	48.60	63.00	79.01
Displacement per 0.100s Δ*x* [x 10-2m]		1.79	3.34	4.99	6.88	8.56	10.01	13.03	14.40	16.01
Average velocity *v* [x 10-2m/s]		17.9	33.4	49.9	68.8	85.6	100.1	130.3	144.0	160.1
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= $\Delta v/\Delta t$=1.78x10²(m/s²)

Condition ②： Cart(500g), weight(250gx2), height 0.24m, length1.06m, angle13°

Time t [s]	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacement x $[x\ 10^{-2} m]$	0	1.80	5.15	10.15	17.03	25.61	35.62	48.65	62.96	79.27
Displacement per 0.100s Δx $[x\ 10^{-2} m]$		1.80	3.35	5.00	6.88	8.58	10.01	13.03	14.31	16.31
Average velocity v $[x\ 10^{-2} m/s]$		18.0	33.5	50.0	68.8	85.8	100.1	130.3	143.1	163.1
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=$1.81x10^2 (m/s^2)$

Condition③: track (500g), height 0.17m, length 1.08m, angle 9°

Time t [s]	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacement x $[x\ 10^{-2} m]$	0	1.13	3.50	7.12	12.38	18.89	26.01	34.23	42.77	53.69
Displacement per 0.100s Δx $[x\ 10^{-2} m]$		1.13	2.37	3.62	5.26	6.51	7.12	8.22	8.54	10.92
Average velocity v $[x\ 10^{-2} m/s]$		11.3	23.7	36.2	52.6	65.1	71.2	82.2	85.4	109.2
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=$1.22\ x10^2 (m/s^2)$

Condition④: cart(500g), weight(250x2), height 0.17m, length 1.08m, angle 9°

Time t [s]	0	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900
Displacement x [$\times 10^{-2}$m]	0	1.22	3.61	7.24	12.68	19.01	26.44	34.95	43.72	54.60
Displacement per 0.100s Δx [$\times 10^{-2}$m]		1.22	2.39	3.63	5.44	6.33	7.43	8.51	8.77	10.88
Average velocity v [$\times 10^{-2}$m/s]		12.2	23.9	36.3	54.4	63.3	74.3	85.1	87.7	108.8
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=1.21×10^2 (m/s^2)

■ Discussion

Comparing condition①and condition②, or condition③and condition④, the only difference is the weight. However, their accelerations are 1.78×10^2 (m/s^2) and 1.81×10^2(m/s^2), and 1.22×10^2(m/s^2) and 1.21×10^2 (m/s^2), and do not differ ~~at all~~. This means that the mass of the cart has no ~~connection~~ ~~with~~ acceleration.

Now comparing condition① and condition③, or condition②and condition ④, the angle of the track is different. ~~As~~ sharper the slope, faster the acceleration. On the other hand, as gentler the slope, as slower the acceleration.

■ Conclusion

The speed of the cart is constant, therefore **the movement of the**

cart is constant-acceleration motion. The mass of weight does not influence on the acceleration but the angle of the track does.

■ Impression

It was the first time for me to measure acceleration by using some interesting tools such as a spark timer and a thermal recording tape. It is much more fun to learn physics by doing labs than just sitting and taking notes in class. I learned that a small mistake makes a big result in labs.

Totani

■ Bibliography

- スパークタイマーによる加速度運動の解析　by 長谷川凌
- 啓林館　「物理」by　高木　堅志郎、植松　恒夫　編

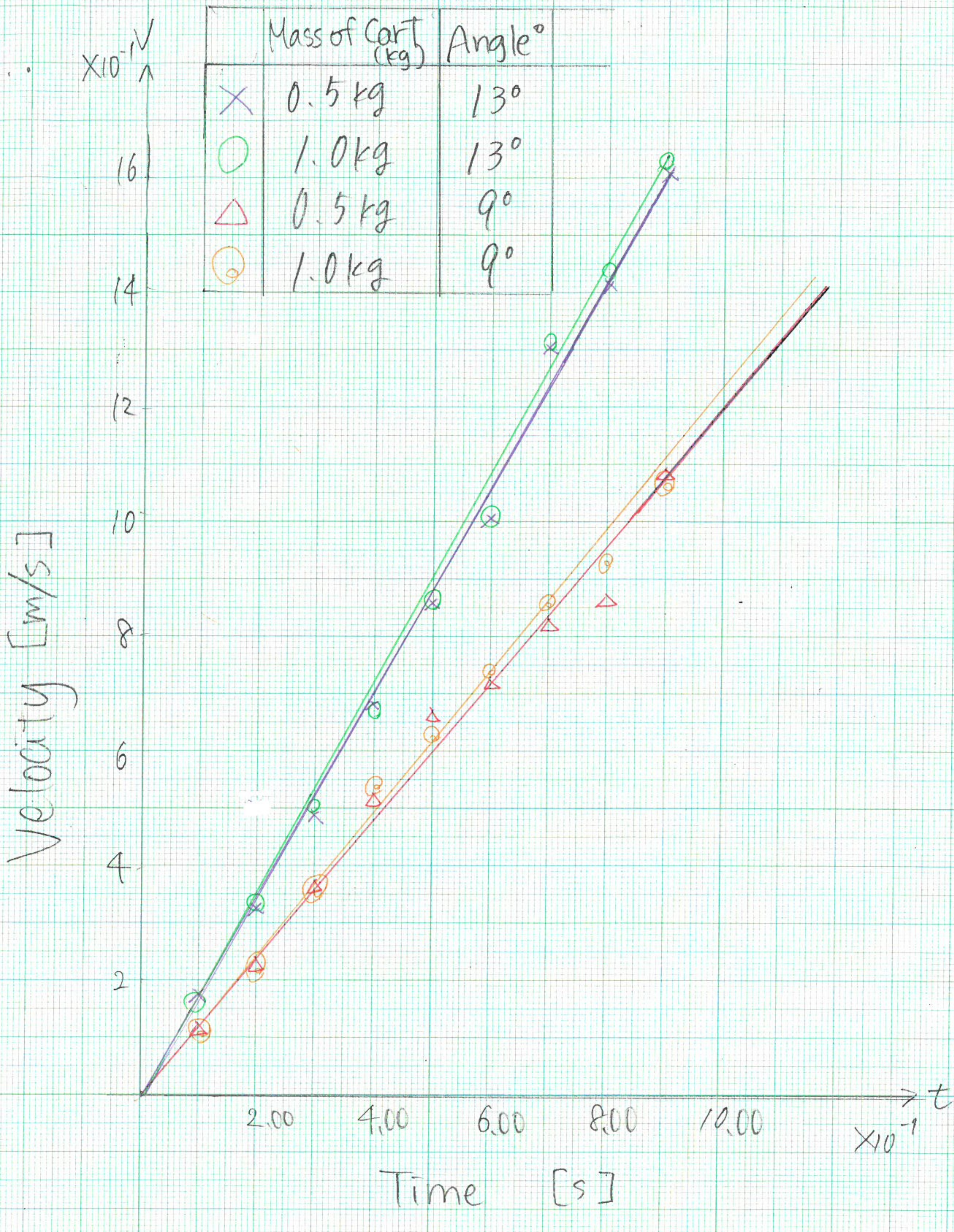


Fig.1 V-t graph

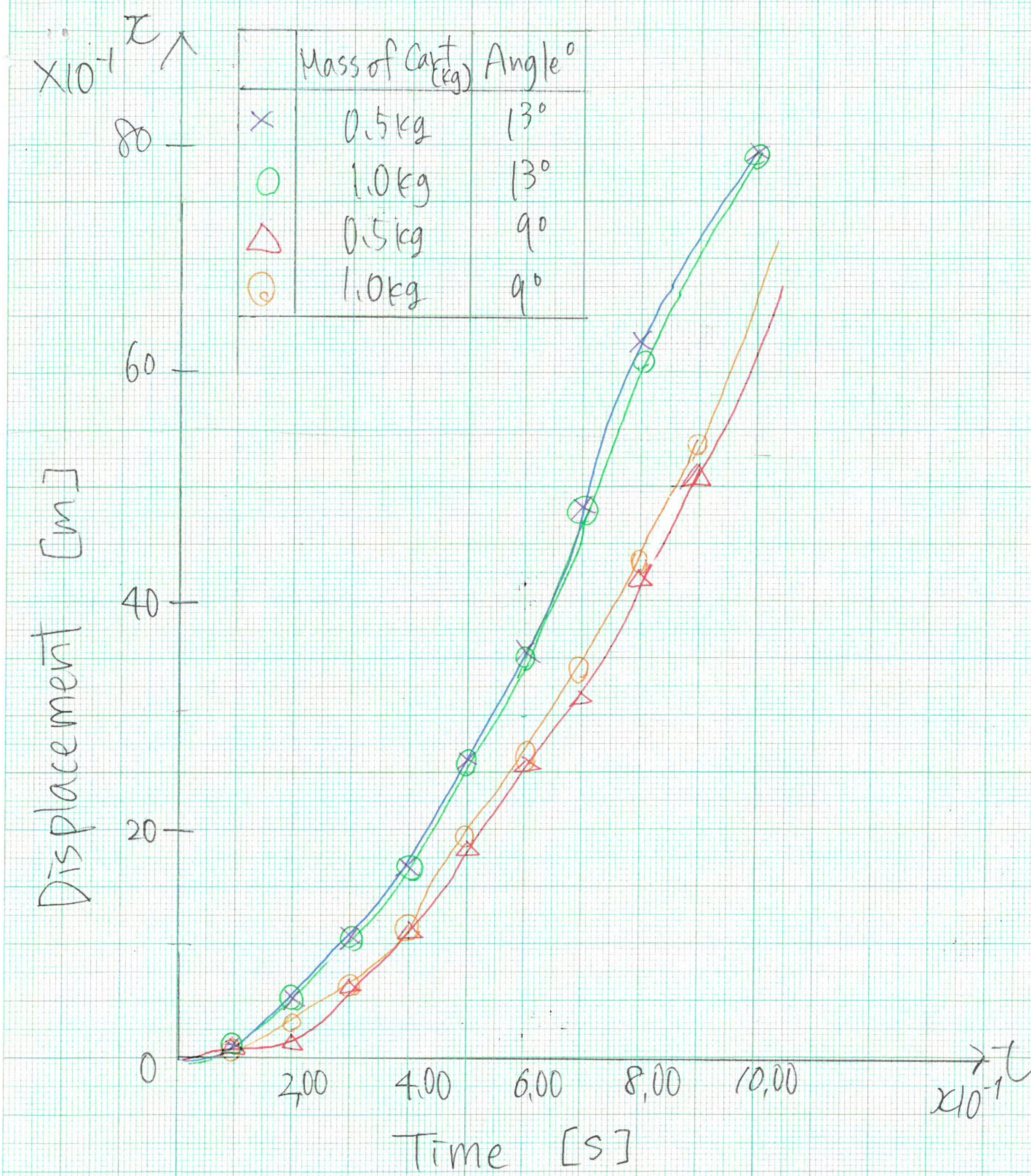


Fig 2. x-t graph