Date of Lab 27/09/2017
Date of submission 06/10/2017

Physics Lab Report

Title: Recording Motion with a Spark Timer

Author Class: 11-E Name: Sota Watabe
Co-worker: Kinnosuke Ichiyama

Summary:
The purpose of this experiment was to investigate how the acceleration changes when we change the weight and steepness of a slope. We used a Spark Timer to record the time of a cart takes to going down the slope. We measured four times with changing the weight of the cart and the steepness of the slope.

Teacher's comment.
No x-t graph attached.
Good tables and figures! Also good discussion
Use the common cover sheet next time.

Due	Table/Fig	Discussion	Clearness	General
+	++−	++	+	+

Introduction

Objective:
The purpose of this experiment is to learn about acceleration. We use Spark Timer to record the time of a cart which goes down a slope on a rail to see how a property moves with an acceleration.
We investigate how the conditions of the slope and the cart affects the acceleration and this time we changed the steepness of the slope and the weight of the cart.

Theory and the Past knowledge:
We can use the equation of the acceleration.
$\mathbf{a=\Delta v/\Delta t=(V_f-V_i)/(t_f-t_i)}$
a: acceleration
$\mathbf{V_f}$: final velocity
$\mathbf{V_i}$: initial velocity
$\mathbf{T_f}$: Final time
$\mathbf{T_i}$: initial time

Hypothesis:
I think weight does not affect the acceleration. However heavier weight might cause more friction between the rail and the tyre of the cart, therefore we might see the cart going with lower acceleration.
The change in slope will affect the acceleration in my opinion. A cart on the steeper slope will result in greater acceleration in my opinion.

Experiment

Materials used:
- Dynamic cart
- Spark timer
- Slope
- Weights (250g x 2)
- Recording tapes
- Scale
- Scissors

Independent value: Length of the Slope, Spark Timer's Frequency (60Hz)

Dependent value: Weight of the Dynamic Cart, Angle of the Slope

Experimental Method

① Set a rail in a certain angle.
② Find the angle in between the rail and the ground by measuring any two sides of the triangle.
③ Place Dynamic Cart on the rail and put known amount of weights on it.
④ Place Spark Timer at the end of the rail(upper side), and insert tape and tight it at the end of the cart.
⑤ You may turn on the Spark Timer and hold it fir a while to make the starting point clear and then let the cart go down the rail.
⑥ When it goes to the other end, turn off the timer and measure the length in between each point.

Results

Charts

Condition: 13° 0g

Time- t (s)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement- x (10^{-2}m)	0	0.98	3.30	7.25	11.2	19.9	30.4	42.3	55.8	70.9
Displacement per 0.10s- Δx (10^{-2}m)	0.98	2.32	3.95	5.60	7.20	8.60	10.4	11.9	13.5	
Average Velocity- V (10^{-2}m/s)	9.8	23.2	39.5	56.0	72.0	86.0	104	119	135	
Time at central point- t (s)	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Condition: 13° 500g

Time- t (s)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement- x (10^{-2}m)	0	1.35	4.50	8.90	15.3	24.1	33.8	45.2	58.2	74.6
Displacement per 0.10s- Δx (10^{-2}m)	1.35	2.90	4.40	6.40	8.80	9.70	11.4	13.0	16.4	
Average Velocity- V (10^{-2}m/s)	13.5	29.0	44.0	64.0	88.0	97.0	114	130	164	
Time at central point- t (s)	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Condition: 7.8° 0g

Time- t (s)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement- x (10^{-2}m)	0	0.50	2.35	4.90	8.20	12.2	16.9	22.4	28.6	35.5
Displacement per 0.10s- Δx (10^{-2}m)	0.50	1.85	2.55	3.30	4.00	4.75	5.45	6.20	6.90	
Average Velocity- V (10^{-2}m/s)	5.00	18.5	25.5	33.0	40.0	47.5	54.5	62.0	69.0	
Time at central point- t (s)	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Condition: 7.8° 500g

Time- t (s)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Displacement- x (10^{-2}m)	0	1.10	2.93	5.63	9.03	13.2	18.2	24.0	30.7	37.9
Displacement per 0.10s- Δx (10^{-2}m)	1.10	1.83	2.70	3.40	4.17	5.0	5.8	6.7	7.2	
Average Velocity- V (10^{-2}m/s)	11.0	18.3	27.0	34.0	41.7	50.0	58.0	67.0	72.0	
Time at central point- t (s)	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	

Finding Accelerations

Equation: $a=v_f-v_i/t_f-t_i$

① 150.5-0/0.85-0= 177.059 →177.1cm/s^2

② 164-0/0.85-0= 192.94 →192.9cm/s^2

③ 69-0/0.85-0= 81.18 →81.8cm/s^2

④ 73.2-0/0.85= 86.12 →86.12cm/s^2

Discussion

In experiment 1 to 2 and 3 to 4, we only changed the weight of the cart. As you can see in the graph, the acceleration obtained in 1 and 2, and 3 and 4 is almost identical. I showed it in the calculation below.

Difference between 1 and 2: 192.9-177.1/177.1=0.0892 →8.92%

Difference between 3 and 4: 86.12-81.8/81.8=0.0528 →5.28%

As you can recognise from these calculations, both of them are identical with less than 10% error.

Since 1 to 2 and 3 to 4 are identical, we can say that weight DOES NOT effect the acceleration.

However, if you compare 1 to 3 or 2 to 4, it is pretty obvious that as the angle between the slope and the ground decreases, the acceleration decreases.

Comparison with my hypothesis

In my previous hypothesis, I wrote weight does not affect the acceleration, and I got it right.

I also wrote that heavier cart cause more friction and that cause the acceleration little bit lower, but that wasn't right.

In addition I wrote stepper slope will result in greater acceleration and I got it right for this one.

Doubts

In the above, I concluded the difference in between 1 to 2 and 3 to 4 as an error, however, in both of them heavier ones tend to have greater acceleration. I wonder why this happens. I do not know if it is just an error or not, but I wonder if it is related to gravity. Because if the difference was the result of friction, heavier object should have lower acceleration, so it does not make sense. Air friction might be the reason, but I cannot clarify this in here.

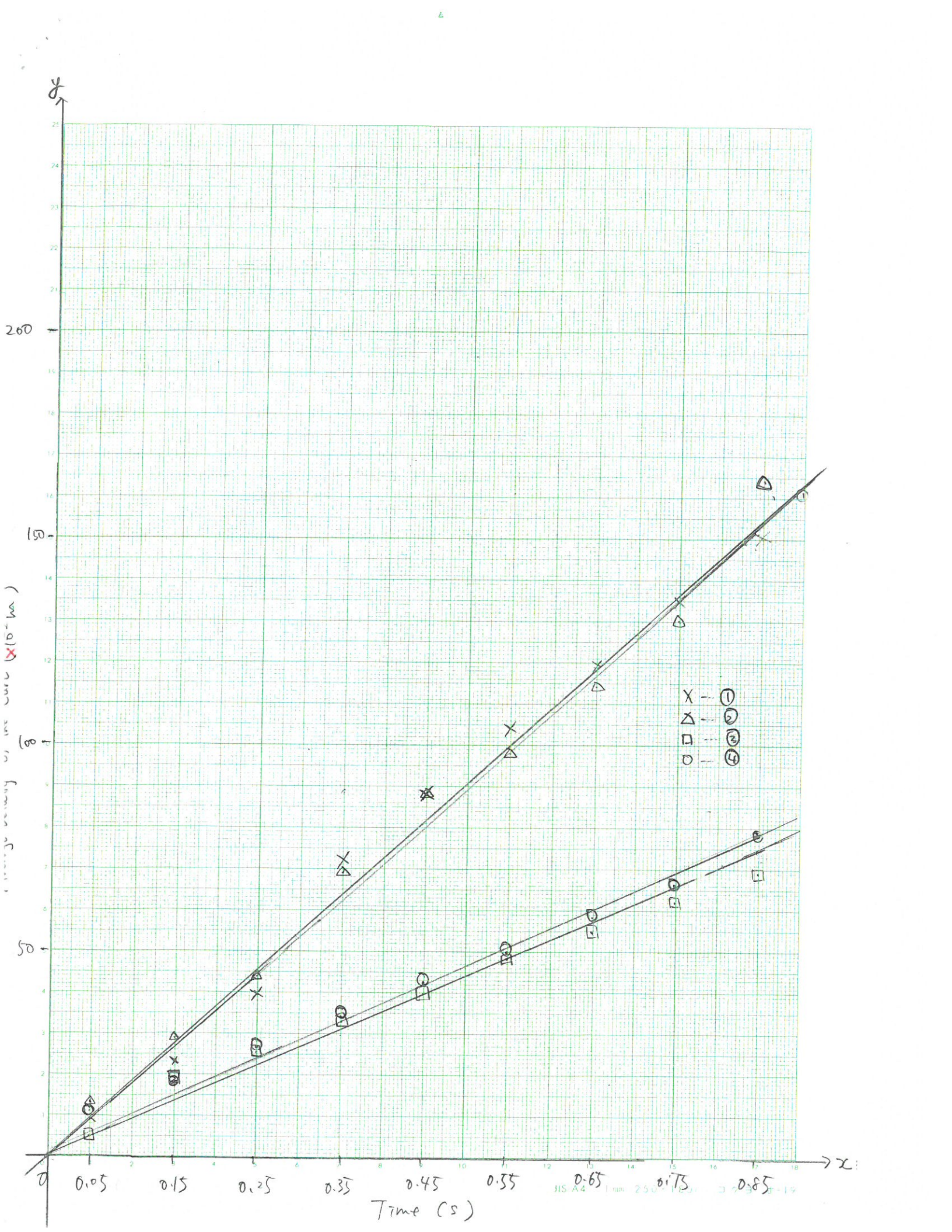
Conclusion

The acceleration does not relate to weight.

The acceleration increases when the slope(angle in between the slope and the ground) gets steeper.

Opinions

This time I could see some errors throughout the experiment. If it is possible I want to do in a place without air and friction, so that other than weight and steepness all of the conditions are the same. This experiment without error will led more precise result in my opinion.


y
x
200
150
100
50
0
0.05
0.15
0.25
0.35
0.45
0.55
0.65
0.75
0.85
Time (s)
X --- ①
△ --- ②
□ --- ③
○ --- ④