

Mapua Institute of Technology

Department of Physics

**Kinematics**

Experiment 2

PHY10L/B1

Group No. 3-B

Members:

Ponciano, Ezekiel T.

Plaza, Noel N.

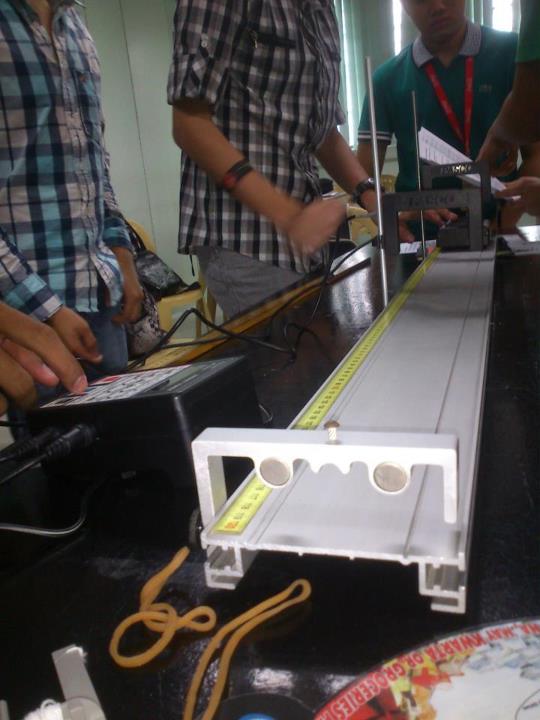
Pastrana, Mikko

Prof. Ryan M. Cabrera

Instructor

** “Introduction”**

It is mainly based on Newton’s second law of motion, which is F=ma, where F is force, m is mass, and a is acceleration. Kinematics is a branch of mechanics that consists of the study of motion without considering the forces that cause or develop the motion





The experiment aims to build in on concepts about objects moving along horizontally, vertically, or at a specified angle. It explains how certain objects move and what are the factors that affects the movement of an object from point a to point b. Finally, after finishing the experiment, one may be able to acknowledge the important role of gravity in kinematics, and the principle of Uniformly Accelerated Motion.

**“Theory”**

Kinematics deals with the motion of an object. In a plane in the x-axis, one can describe the velocity of an object at any given time by the equation:

1. v=vo+at

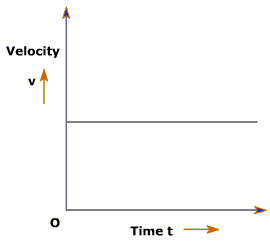
Or the position of an object by:

1. x=xo+vot+at2

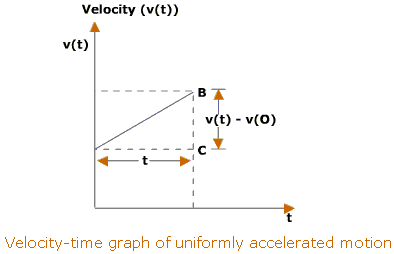
Or the change in velocity by:

1. v2=vo2+2a(x-xo)

The relationship of velocity and time is represented in the graph below:



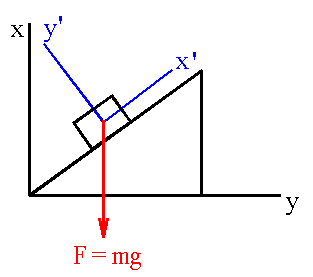
And if there is an angle involved, the velocity will then make a trend that is either increasing or decreasing:



If the track (plane) is inclined, its speed is uniform all throughout that plane. (It is assumed that there is no friction to be considered). The acceleration is then 980 cm/s2, in which it is the acceleration due to gravity. The formula for acceleration is:

1. a=g sin Ɵ

The following shows the relationships:



**“Objectives”**

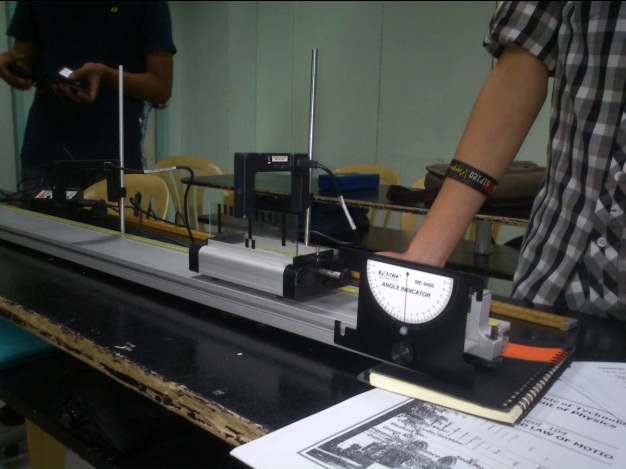
1. To study motion by determining the velocity and acceleration.
2. To determine experimentally the acceleration due to gravity.

****

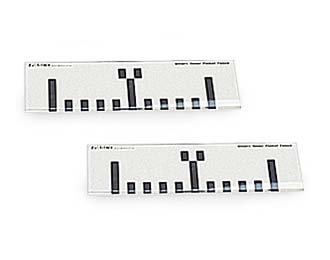
**“Materials”**

1. Dynamics Cart 3. Dynamics track w/

Angle indicator and end stop



1. Photogate 4. Smart timer

5. Photogate mounting bracket 6. Smart timer picket fence



7. Meter stick 8. Stand



**“Procedure”**

In the first part, test the concept of constant acceleration by using the dynamics cart and the track in a horizontal position. To make sure that it is in a flat surface, you need to use the angle indicator or try to place the cart and see if it is moving. The setup below shows how it is done.

It is all based on the cart’s spring mechanism and the measurements by the smart timer based on the photogate’s readings. Smart Timer’s setting should be in acceleration. We used two gates in this experiment





Next, we test the acceleration in an inclined plane. Therefore, an angle is given and it is considered in calculating the acceleration. Smart timer’s setting should be in acceleration. We used two gates here too.



In the last part of the experiment, we test acceleration due to gravity by free-falling the picket fence and making it pass through the photogate. The setting in the smart timer again is acceleration. We only used one gate in this experiment.



We then recorded the results again and compared it with the acceptable figure of acceleration due to gravity that is 980 cm/s2

Result and Discussion:

In the first experiment, the results should be directly proportional to each other, that is, as the time increases, the displacement also increases.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial | Position of photogate | Cart’s displacement | Time (Timer’s reading) | Average speed |
| 1 | 65 cm | 40 cm | 0.5480 s | 72.99 cm/s |
| 2 | 75 cm | 50 cm | 0.7325 s | 68.26 cm/s |
| 3 | 85 cm | 60 cm | 0.8536 s | 70.29 cm/s |
| 4 | 95 cm | 70 cm | 0.9696 s | 72.19 cm/s |
| 5 | 105 cm | 80 cm | 1.1992 s | 66.71 cm/s |

In the second experiment, the results show that as the angle of elevation of the track increases, the acceleration increases too. Therefore the angle Ɵ is proportional to the acceleration.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial | Height of track | Acceleration | sinƟ=H/L | G=a/ sinƟ | Time=√2x/a |
| 1 | 10 cm | 72.3 cm/ s2 | 0.0813 | 889.30 cm/ s2 | 1.29 s |
| 2 | 15 cm | 110.06 cm/s2 | 0.1220 | 902.13 cm/ s2 | 1.04 s |
| 3 | 20 cm | 149.94 cm/s2 | 0.1626 | 922.14 cm/ s2 | 0.89 |
| 4 | 25 cm | 185.43 cm/s2 | 0.2033 | 912.10 cm/ s2 | 0.80 |
| 5 | 30 cm | 229.70 cm/s2 | 0.2440 | 941.93 cm/ s2 | 0.72 |

In the third experiment, the results of the acceleration should be identical to 980 cm/s2 since all objects when dropped should accelerate on that rate.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Trial | 1 | 2 | 3 | 4 | 5 | Average | %error |
| Acceleration (α) | 958.80 | 961.10 | 972.70 | 984.80 | 985.80 | 972.62 | 0.75 % |

“Conclusion”

The experiment proved that the direct proportionality of velocity versus time and the angle of elevation versus acceleration are indeed true. But, in order to achieve optimal results in the experiments, one must perform the experiment more than what it is needed in the trials, it is because sometimes the smart timer may malfunction or some of the sensitive materials (like the photogate), may not get the results that accurately if there is even a small interference with the devices. A small nudge or change in the position of the apparatus may change the result dramatically, thereby drastically increasing the percentage error.

In order to limit the error, one has to be careful in handling the materials, calculate the equations properly and try to get closer to the accepted value.