**Session 8: Uniformly Accelerated Rectilinear Movement**

**ASSESSED CRITERIA: C**

### OBJECTIVE:

Determine the acceleration of an object falling along an inclined plane by different methods.

### BACKGROUND INFORMATION:

 An object falling along an inclined plane moves with a constant acceleration according to a Uniformly Accelerated Rectilinear Movement (UARM). This happens because of the parallel to the plane component of gravity.

 As **s = ½·a·t2**, acceleration, **a = 2s/t2**, can be obtained from the distances travelled and the times lasted, and its value must be, within a range, approximately constant.

On the other hand, final velocities can be obtained from

**v = a·t**

substituting the former acceleration

**v = (2s/t2)·t = 2s / t**

Final velocity is hence inversely proportional to time, while distance is proportional to the square of time.

### MATERIALS:

* Aluminium rails
* Wood pieces
* Marbles
* Measuring tape
* Stopwatch
* Marker
* Video camera (mobile phone)
* Video analysis software (Logger Pro, Tracker… Check [RESOURCES](#_ai68jduhy5oj))

### PROCEDURE:

1. Put the rail over the wood pieces with some angle.
2. Make seven marks regularly spaced on the rail, from where marbles will be let fall
3. Measure with the measuring tape the distances from the marks to the end of the rail.
4. Let the marble fall from the marks and measure the time it lasts to the end of the rail. Repeat the measurements at least three times from each mark.
5. Record the whole process on video and use the video analysis software (Logger Pro )

### TASKS:

1. Make a table with the raw data, leaving blank space for processed data.
2. Calculate the average time for each distance and their squares, and put them into the table.
3. Calculate the final velocities using the formula from the introduction and put them in the table as well.
4. Calculate the acceleration of the marble and put them in the table. Calculate also the average acceleration and put it in the table as well.
5. Plot the distance vs time.
6. Plot distance vs squared time. Work out the slope of the line fitted to this graph; The double of the slope is equal to the acceleration.
7. Plot the final velocity vs time. Work out the slope of the line fitted to this graph; its value is also the acceleration.
8. Comment the three graphs, comparing them with the predictions of the theory.
9. Evaluate the accuracy of the measured times by considering their dispersion. Evaluate the precision of the data by considering the fitting of the data.
10. Compare the three values of acceleration amongst them. Evaluate the accuracy of each of them considering the way in which they have been obtained.
11. Evaluate the procedure in respect to precision and accuracy of the results. Indicate weaknesses and sources of error and improvements for them.

### RESOURCES:

1. Logger Pro video analysis Software: Tutorials

<https://www.youtube.com/watch?v=nmKuPz5O2KM>

<https://www.youtube.com/watch?v=NbPcEI8jpcQ>

<https://www.youtube.com/watch?v=shNPrswj_kA>

<https://www.youtube.com/watch?v=jyHrK6Z8FSg>

1. Tracker video analysis software (Freeware)

 <http://physlets.org/tracker/>

Tutorials

<http://www.compadre.org/osp/search/search.cfm?qc=Tracker>

Video tutorials

 <https://www.youtube.com/watch?v=DO-MQIECvbA>

<https://www.youtube.com/watch?v=ibY1ASDOD8Y>

<https://www.youtube.com/watch?v=RqJZwdU-D-0>

<https://www.youtube.com/watch?v=EUIcedlBmWM> (silent movie)