

## **Experiment 1: Calculation of the acceleration due to gravity using a bouncing ball & finding the coefficient of restitution**

Refer to the uploaded AJP article by Guercio & Zanetti.

You are required to find the acceleration due to gravity. To do this, you will have to measure the time ( $t_n^*$ ) for  $n$  bounces, as described in the article, from which you can obtain  $t_1$ , the time for a single bounce. You will also need, for this purpose, to find the coefficient of restitution  $e$ , defined as the ratio of the height of the first bounce to the initial height of the ball,  $h_1/h_0$ .

- You can use the PhyPhox app to make measurements, by using the acoustic stopwatch to time bounces.  
In case you are unable to get this option to work, state it in your report, and use the stopwatch option in your phones to make measurements.
- Heights should be measured off using a metre-scale or tape, and the coefficient of restitution calculated. Compare the reported results obtained with that from the Inelastic collision measurement option in the phyphox menu, and report these. (Caution: this might not always work for slower phones).
- Calculate the coefficient of restitution.
- Obtain the time required for the first bounce from the time you measure for  $n$  bounces. (From past experience, this is most likely to be  $n=3$ , but it depends upon the ball you use and the surface it bounces from).
- Calculate  $g$ .
- Also report the acceleration due to gravity as reported by the sensors on your smartphone & which can be read off from the relevant option in phyphox.
- Note down the least-counts for all your measuring devices or meters.
- Error-analysis is required. Also show how error propagation occurs in the final result (i.e. calculate the error in your calculated  $g$  and report it appropriately).
- **Readings should be taken several times (at least 5 to 10 times) to minimize errors on average.**

**The report for each group should be a pdf file uploaded by any one member and should have:**

**1<sup>st</sup> (title) page:** name of experiment, group number & group-members.

**2<sup>nd</sup> page:** Aim, equipment used, short summarized theory & procedure (common for the whole report)

**3<sup>rd</sup> pages onwards:**

- **Observation tables for the readings taken, from each individual group member**
- **Calculations & results with error-analysis, from each group-member**
- **Sources of error (summarized for the whole group)**

**Reports should be neatly and systematically presented.**

**Due date for submission: no later than 19 September 2021, 00:30 am.**

