PHYS20161 1st assignment: Bouncy Ball

August 20, 2021

Your first task is to write a programme that can make a series of calculations regarding a bouncy ball bouncing above some minimum height.

1 Analytic approach

We can calculate the number of bounces analytically using conservation of energy. At height h the ball will have a potential energy of mgh, where the symbols have their usual meanings. After one bounce the ball reaches a height $h\eta$ $(0 < \eta < 1)$ where η takes into account energy lost during the bounce (an efficiency if you will). After a second bounce the ball will reach a height $h\eta^2$, and so on.

We can find the number of bounces above some minimum height, $h_{\text{min.}}$, by examining the energy loss:

$$mgh_{\text{min.}} = mgh\eta^n, \tag{1}$$

where n represents the number of bounces.

2 Expectations

Given user input for the initial height, minimum height of interest, and η; we expect your code to be able to calculate the following:

- The number of bounces **over** $h_{\text{min.}}$, n, where $n \geq 0$.
- How many seconds it takes to complete the bounces.

As an example consider the case illustrated in figure 1. Here, the ball makes two bounces over $h_{\text{min.}}$ and the time taken to complete these, t, is slightly below 5 seconds.

We will also be marking you on programme style and expect your code to contain:

- A clear header with title, author, date and purpose of the code.
- Useful functions that break up the calculations and make the code modular.
- Unambiguous variable and function names.
- Results outputted clearly; the number of seconds should be quoted to two decimal places and the number of bounces is an integer.

We will award additional marks based on how well written the submission is and if it can provide any additional information. For instance, does it validate any of the input variables? Does it validate them well? Can it calculate anything else? Can the user decide this? Does the code get a positive linter score?

More detail on how the mark is split can be found in the rubric on BlackBoard.

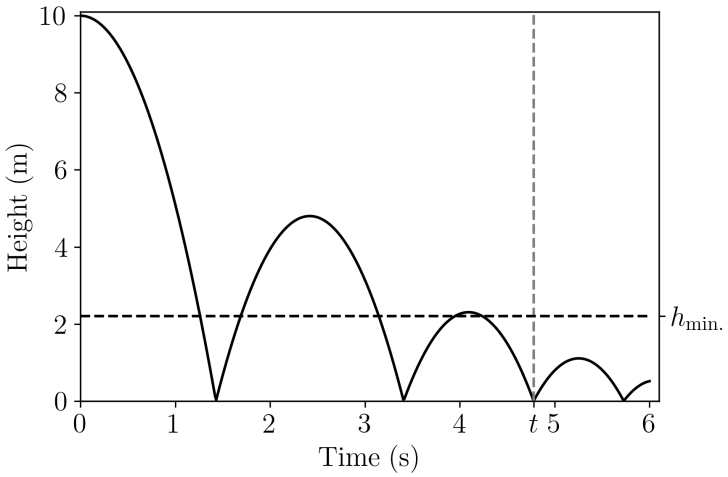

Figure 1: Height vs time for a bouncy ball dropped from 10 m. A possible minimum height, $h_{\text{min.}}$, has been included with associated time taken, t.