

Simple Problems in Classical Mechanics

Forward

Mechanics is one of the oldest and most familiar branches of physics. It deals with bodies at rest and in motion and the conditions of rest and motion when bodies are under the influence of internal and external forces. Easiest to describe are the motions of a particle, that is, an object whose size and internal structure are negligible for the problem with which we are concerned. In what follows, we will be content to sketch briefly two simple problems in classical mechanics.

- Note: This session will be the simplest one, in order to teach students how to master *Mathematica* to solve and simulate physical problems.

Problem 1

A ball is thrown vertically up .The ball's height as a function of time is given by:

$$y(t) = 6 + 50t - 16t^2 \tag{S.0.1}$$

where t is in seconds and y is in feet.

- Plot this function (y vs. t) to see if it is reasonable.
- Plot the derivative with respect to time. What does this represent when is it positive, zero and negative? Is this what you would expect for the vertical component of the velocity?
- How long does the ball take to reach its highest point?
- What is the total time the ball is in the air?

1.1 Programming

- Define the height as a function $y[t_0]$, and plot y vs. t for a suitable range.
- Find the derivative and plot it against t (use the built-in function $D[]$).
- Recall the condition for maximum height, and solve the equation for t .
- Use the symmetry of the path of the ball as it goes up and then falls down.

1.2 Questions

- What is the shape of the trajectory? What type of motion does it represent?
- In this problem we assumed that the ball takes the same time to fall from its greatest height as to rise to that height. In reality, however, will the ball have a constant acceleration? Why?

Problem 2

Choose a similar simple problem from one of the following two books:

- Serway, R. A. 2000. *Physics for Scientists and Engineers with Modern Physics*, Saunders, Philadelphia.
- Tipler, P. A. 1999. *Physics for Scientists and Engineers*, W. H. Freeman and Company/Worth Publishers, New York.

Solve the problem using *Mathematica* in full details.

Attach with your solution the formulation of the problem and your reference (the book and the page).

Final Word

You have to submit a self-contained report for this session, even though it is simple.

Do not forget to give physical meaning for every point.

Mention your suggestions, if available.