Physics 7AW Homework 2 — Motion in 1D

Alejandro Pelcastre
Physics 7AW - WAT 2020 edition

February 28, 2020

Exercise 1. You drop a mic off a cliff from a height H into the ocean. How long does it take for you to hear the splash? Assume speed of sound is v_s

Exercise 2. Suppose two athletes run a race around a circular track of radius R. Suppose you finish the race once you finish a lap and return where you began.

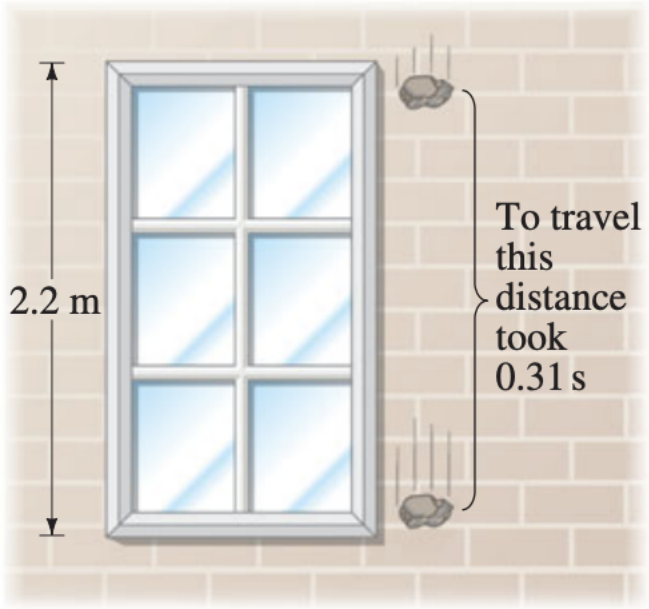
a) What is your displacement immediately finishing the race?

b) What distance did you cover immediately finishing the race?

c) If one athlete finishes with a time of T, how fast must you run the race so that the average time to finish the race between both of you is $\frac{T}{2}$?

Exercise 3. A bowling ball traveling with constant speed hits the pins at the end of a bowling lane L long. The bowler hears the sound of the ball hitting the pins T after the ball is released from his hands. What is the speed of the ball, assuming the speed of sound is v_s?

Exercise 4. A falling stone takes 0.31 s to travel past a window 2.2 m tall (See figure). From what height above the top of the window did the stone fall?



For Questions 5 and 6 you have two days to solve

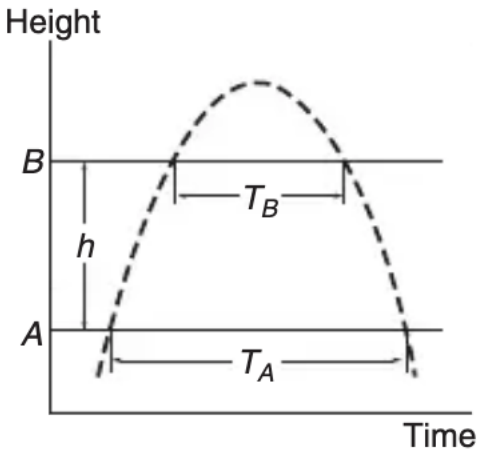
Exercise 5. At t = 0 an object is released from rest at the top of a tall building. At the time t_0 a second object is dropped from the same point.

Ignoring air resistance, show that the time at which the objects have a vertical separation L is given by

$$t = \frac{L}{gt_0} + \frac{t_0}{2} \tag{1}$$

How do you interpret this result for $L < \frac{gt_0^2}{2}$?

Exercise 6. The acceleration of gravity can be measured by projecting a body upward and measuring the time that it takes to pass two given points in both directions.



Show that if the time the body takes to pass a horizontal line A in both directions is T_A, and the time to go by a second line B in both directions is T_B, then, assuming that the acceleration is constant, its magnitude is

$$g = \frac{8h}{T_A^2 - T_B^2} \tag{2}$$

where h is the height of line B above line A (See picture).