

# Problem Set 1 – Fundamentals

Stuyvesant Physics Team

September 2019

## Problem 1

3 runners start running in the same direction on the starting line of a circular track with length 44 m. The runners have speeds of  $3\frac{m}{s}$ ,  $4\frac{m}{s}$ , and  $5\frac{m}{s}$ . If they start running at time  $t = 0s$ , when is the next time they meet up again at the starting line?

## Problem 2

The distance between the Earth and the Sun is approximately  $1.5 \times 10^8$  km. Assuming a circular orbit and a 365 day year, what is the velocity of the Earth orbiting the Sun in km/s?

## Problem 3

Hydraulic engineers in the US often use, as a unit of volume of water, the *acre-foot*, defined as the volume of water that will cover 1 acre of land to a depth of 1 ft. A severe thunderstorm dumped .1 in. per minute of rain for 30 min on a town of area  $26 \text{ km}^2$ . What volume of water, in acre-feet, fell on the town? Use google for unit conversions.

## Problem 4

Suppose that, while lying on a beach near the equator watching the sun set over a calm ocean, you start a stopwatch just as the top of the Sun disappears. You then stand, elevating your eyes by a height  $H = 1.70m$ , and stop the watch when the top of the Sun again disappears. If the elapsed time is  $t = 11.1s$ , what is the radius  $r$  of the Earth?

## Problem 5

You drive on Interstate 10 from San Antonio to Houston, half the *time* at 55 km/h and the other half at 90 km/h. On the way back you travel half the *distance* at 55 km/h and the other half at 90 km/h. What is your average speed (a) from San Antonio to Houston, and (b) from Houston back to San Antonio, and (c) for the entire trip?