MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X   Fall Term 2001

PROBLEM SET 1

Handed out: September 7
Due: September 14 at 5 pm in 4-339B.

Please write your name, subject, recitation number, and the name of the recitation instructor on the top right corner of the first page of your homework solutions. The solutions should be placed in the appropriate box in room 4-339B.

Problem 1:

Briefly explain why the following statements are true or false.

a. The average velocity and instantaneous velocity are never equal.

b. If the average velocity is non-zero during a specific time interval, then the instantaneous velocity is never zero during this interval.

c. If the average velocity is zero during a specific time interval, then the instantaneous velocity must go to zero at some time during the interval.

Problem 2:

Hare and Tortoise begin a 10 km race at time $t = 0$. Hare runs at 4 m/s and quickly overtakes Tortoise, who runs at 1 m/s (this is a special Olympic-level tortoise). After running for 5 minutes, Hare decides to take a nap. He naps for 130 minutes, then awakens and again runs at 4 m/s, but loses the race.

a. Plot displacement vs time for both Hare and Tortoise.

b. Plot velocity vs time for both Hare and Tortoise.

c. At what time does Tortoise pass the napping Hare?

d. How far behind is Hare when Tortoise crosses the finish line?

e. How long can Hare nap and still win the race?

Problem 3: Fermi Estimation Problems

To solve these problems, you will have to make some assumptions. State your assumptions as carefully as you can. If numbers are not given, just guess something reasonable that will give you an answer within an order of magnitude.

a. Approximately how many square yards of pizza are eaten by MIT undergraduates every semester?

b. Suppose that gold can be beaten into a sheet 100 atoms thick. The density of gold is about 19.3×10^3 kg/m^3. The size of a gold atom is about 3 nm. Approximately how many life-size busts of Newton could be gilded with the gold from a solid gold apple?

c. Create and solve your own Fermi problem.