Physics 2010 (Schroeder) Name _____
spring 2004

Problem Set 1

(due Friday, Jan. 16)

1. You probably know your height in feet and inches. Convert this number to meters, using the method described in class (i.e., multiplying by 1 in convenient form).

2. Estimate the floor area of the room you're currently in, in square feet. Then convert this number to square meters, using the method described in class. What is the room's volume, in cubic meters?

3. In physics we normally measure speeds in meters per second (m/s). What is 1 m/s in miles per hour? (Use the conversion method described in class.) What is the speed limit on I-15, in meters per second?

4. For this exercise you need a tape measure and a watch that can measure seconds. Find a space where you can run in a straight line for at least 50 feet (perhaps along a corridor or sidewalk). Measure the distance carefully, then measure the time it takes to walk that distance at a comfortable pace. Calculate your walking speed, in meters per second. Then measure the time it takes you to run the same distance, and calculate your running speed, in meters per second. (Don't feel obligated to run as fast as you can—this isn't a race!)

5. In 1998, the City of Ogden paid a consultant $100,000 to study the feasibility of constructing an aerial tram on the west face of Mt. Ogden. The consultant's preliminary report stated that such a tram would attract 215,967 riders in the first year. Explain why you should be suspicious of this claim.

6. Carry out the following arithmetic operations, paying proper attention to significant figures: (a) the sum of the numbers 756, 37.2, 0.83, and 2.5; (b) the product 3.2×3.563; (c) the product $5.6 \times \pi$; (d) the difference $425,991 - 425,987$.

7. Evaluate the following expression without using a calculator, rounding your answer to an appropriate number of significant figures:

$$\frac{(3 \times 10^{25})(1.4 \times 10^{-23})(350)}{10^5}$$

8. Use a calculator to evaluate the expression in the previous problem. (The purpose of this exercise is to be sure that you know how to enter numbers in scientific notation.)

9. Given the equation $a = b + c\,t$, find an expression for t. Justify each algebraic step in your solution.

10. Given the equation $\dfrac{1}{p} + \dfrac{1}{q} = \dfrac{1}{f}$, find an expression for q. Justify each algebraic step in your solution.

11. Give an example to show that $(a + b)^2$ is not (usually) equal to $a^2 + b^2$.

12. Give an example to show that $\dfrac{1}{a+b}$ is not (usually) equal to $\dfrac{1}{a}+\dfrac{1}{b}$.

13. Explain in your own words the definitions of position, distance, and displacement, and how these concepts differ from each other.

14. An automobile travels on a straight road for 40 km at 30 km/hr. It then continues in the same direction for another 40 km at 60 km/hr. Take the direction of travel to be the $+x$ direction.

    (a) What is the average velocity of the car during this 80 km trip? (Hint: This is a trick question.)

    (b) Sketch a graph of x vs. t, and indicate how the average velocity is found on the graph.

    (c) Sketch a graph of v_x vs. t.

15. A basketball is dropped from a few feet off the floor, then bounces straight up and down several times. Sketch a graph of position vs. time for the basketball, taking the positive x direction to be upward. Then sketch a graph of velocity vs. time for the same motion. Place one graph above the other so that corresponding times line up.

Study Guide

You should know the SI units of distance, time, and speed, and have some intuitive feel for their magnitudes.

Given a number in one system of units and the appropriate conversion factor(s), you should be able to convert the number to another system of units.

You should understand how all measurements are approximate, and hence why it is important to express results using an appropriate number of significant figures. You should be able to judge how many significant figures to keep when rounding off the final result of a calculation.

You should be able to express numbers in scientific notation, and manipulate such numbers both with and without a calculator.

You should understand and be able to use the basic rules of algebra, as summarized in Section 1.7 of your textbook.

You should understand the concepts of position, displacement, distance, velocity, and speed.

You should be able to sketch graphs of position and velocity vs. time for any type of one-dimensional motion, and/or given either graph, verbally describe the motion.

You should know and be able to correctly use the formula for velocity,

$$v_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}.$$