Physics 8, Fall 2019, Homework #1.

Due at start of class on Friday, September 6, 2019

Problems marked with (*) must include your own drawing or graph representing the problem and at least one complete sentence describing your reasoning.

One thing to keep in mind throughout this course is **significant digits.** If (for example) all of the inputs to your calculation are given to only three significant digits (e.g. 3.14, 22.1, 0.834), then your answer should not be reported to more than three or four significant digits. Reporting an answer like 2.71828 (6 significant digits) implies a precision of 0.0004%, which would not make sense if your calculation used inputs that were known to only 0.1% (implied by e.g. 9.99) or maybe 1% (implied by e.g. 1.01). You'll generally want to keep extra digits for intermediate results, then round your final answer to the appropriate precision.

1*. Make a rough estimate of the total mass of the Great Pyramid of Giza. Approximate the shape as a solid pyramid whose height is 140 meters and whose base is a square whose sides have length 230 meters. (We're neglecting any passageways, burial chambers, etc.) For such a pyramid, $V = Bh/3$, where B is the area of the base. You'll need to look up a value for the density of stone (e.g. limestone or granite or even modern concrete — all of which are close enough for an estimate).

2. Convert 65 miles per hour (a) to kilometers per hour, (b) to meters per second, and (c) to feet per second. Use the textbook's ratio method and write out your work step-by-step. You can double-check your answer using Google Calculator if you like, but don't just write down an answer without showing the steps.

3. Airplanes commonly fly at an altitude of 38,000 feet above sea level. What is this distance in miles? In meters?

4. If the x component of an object's initial position is $x_i = +6.72$ m and the x component of its final position is $x_f = +4.56$ m, what is the x component of its displacement? Remember to label your answer with the proper units (meters).

5*. You walk 1.5 km from home to a restaurant in 20 minutes, stay there for 1.0 hour, and then walk back home, taking another 20 minutes. (a) What is the total elapsed time for the trip? (b) What is the distance traveled? (c) What is the displacement? (d) What is your average speed for the trip? (e) What is your average velocity for the trip?

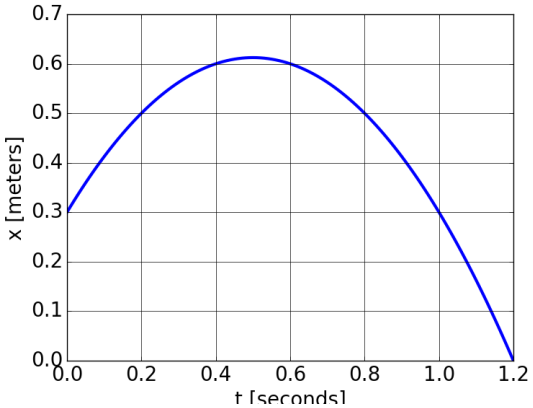
6. (Note that in this problem the x axis points *upward*, as is customary for projectile-motion problems in the early chapters of Mazur's textbook.) The height x above the

ground for a vertically launched projectile is given by $x(t) = pt - qt^2$, with $p = 15$ m/s and $q = 4.9$ m/s^2. (a) At what instant(s) is the projectile at a height of 10 m? (b) What is the meaning of the two solutions to the quadratic expression for $x(t)$ in part (b)? (If you're puzzled by this question, try graphing $x(t)$.) (c) Sketch a graph of the x component of the projectile's velocity as a function of time. (Hint: derivative.)

7*. A husband and wife work in buildings exactly eight (equal-length) blocks apart and plan to meet for lunch. The husband strolls at a leisurely pace of 1.20 m/s, while the wife walks at a much brisker pace of 2.00 m/s. Knowing this, the wife picks a restaurant between the two buildings at which she and her husband will arrive in the same instant if the two of them leave their respective buildings at the same time. In blocks, how far from the wife's building is the restaurant?

8*. You drive an old car on a straight, level highway at 39.0 miles/hour for 13.0 miles, and then the car stalls. You leave the car and, continuing in the direction in which you were driving, walk to a friend's house 2.0 miles away, arriving 40 min after you begin walking. What is your average speed during the whole trip?

9. The figure below shows the x coordinate as a function of time for a moving object. What is the object's x coordinate (a) at $t = 0$? (b) at $t = 0.2$ s? (c) at $t = 1.2$ s? What is the object's displacement (d) between $t = 0$ and $t = 0.2$ s? (e) between $t = 0.2$ s and $t = 1.2$ s? (f) between $t = 0$ and $t = 1.2$ s? What is the distance traveled by the object (g) between $t = 0$ and $t = 0.2$ s? (h) between $t = 0.2$ s and $t = 1.2$ s? (i) between $t = 0$ and $t = 1.2$ s?



10*. For the motion represented in the figure above, calculate (a) the object's average velocity between $t = 0$ and $t = 1.2$ s, (b) its average speed during this same time interval. (c) Why is the answer to (a) different from the answer to (b)?

Remember **online response** at `positron.hep.upenn.edu/wja/jitt/?date=2019-09-06`