- worksheet: `positron.hep.upenn.edu/p8/files/ws02.pdf`
- Remember to check in with one of us on your way out (if you leave early) or during the last 10 minutes of class (if you stay to the end), so that we can ask how today's work went for you and perhaps offer you some quick feedback on what you've written down.
- Your group of 3 will share a table with a different group of 3 each time. So your table number will change each day, but your group number will seldom change.
- We have an optional/XC "hands-on" activity today.

Chapter 2: motion in one dimension – key results

x component of displacement: $\Delta x = x_f - x_i$ where "f" is for (f)inal, and "i" is for (i)nitial.

If an object goes from x_i to x_f, changing direction at intermediate points x_a and x_b, then distance traveled (in one dimension) is $d = |x_a - x_i| + |x_b - x_a| + |x_f - x_b|$

x component of (instantaneous) velocity: $v_x = \frac{\mathrm{d}x}{\mathrm{d}t}$

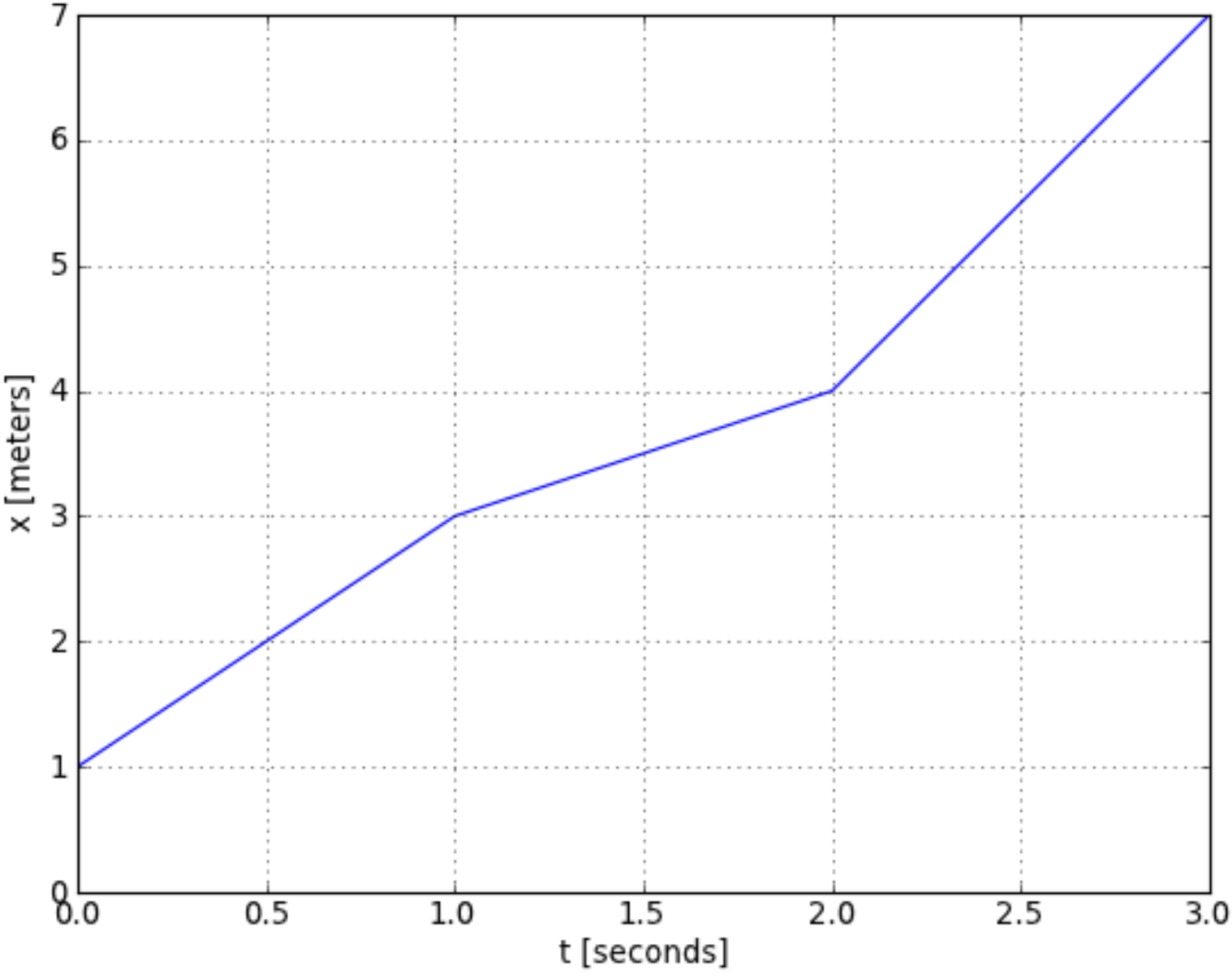
Speed (a scalar) is the magnitude of velocity (a vector). In one dimension, $v = |v_x|$

average velocity $= \frac{\text{displacement}}{\text{time interval}}$ $\qquad v_{x,\text{av}} = \frac{x_f - x_i}{t_f - t_i}$

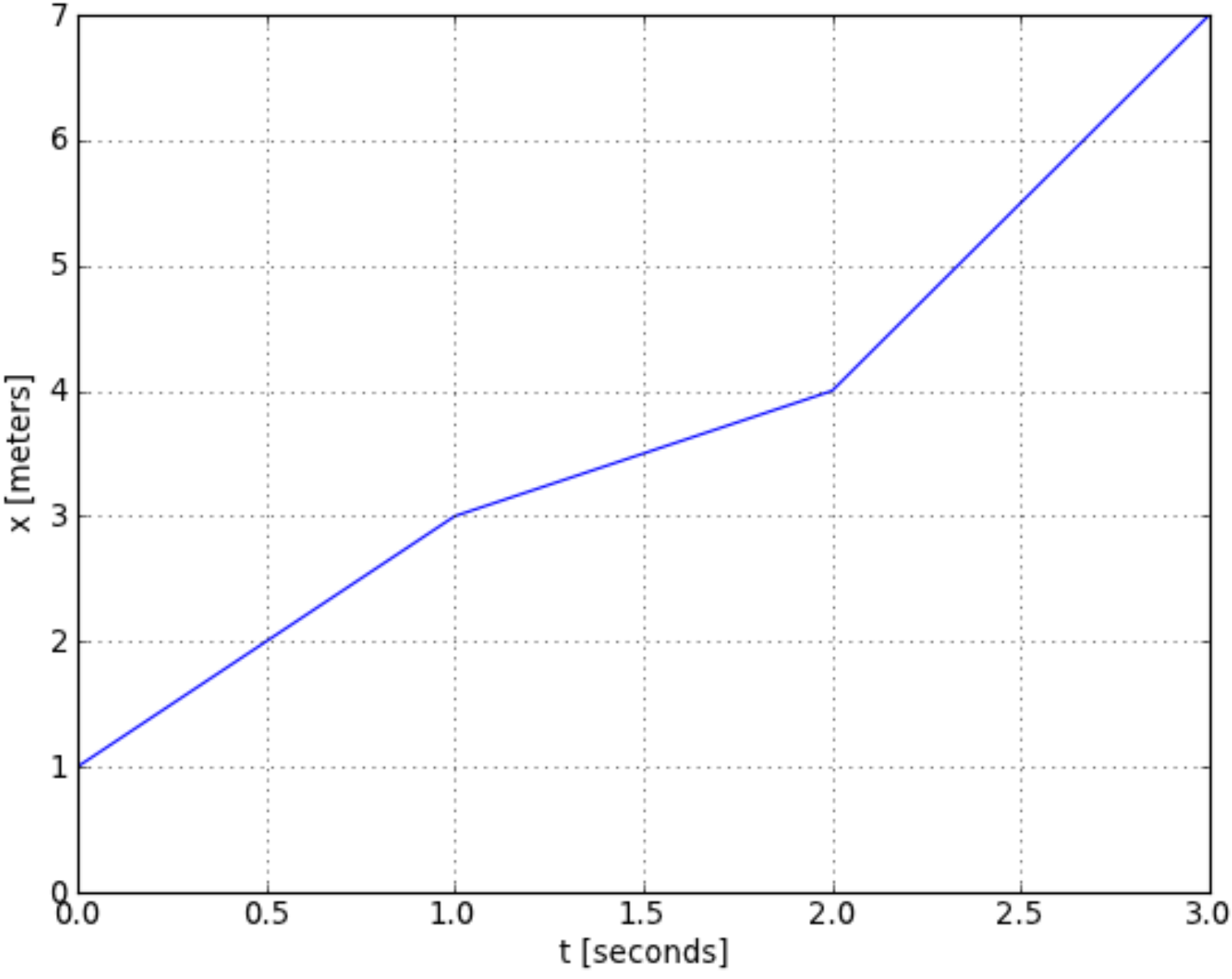
average speed $= \frac{\text{distance traveled}}{\text{time interval}}$

Solving quadratic equations: If $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

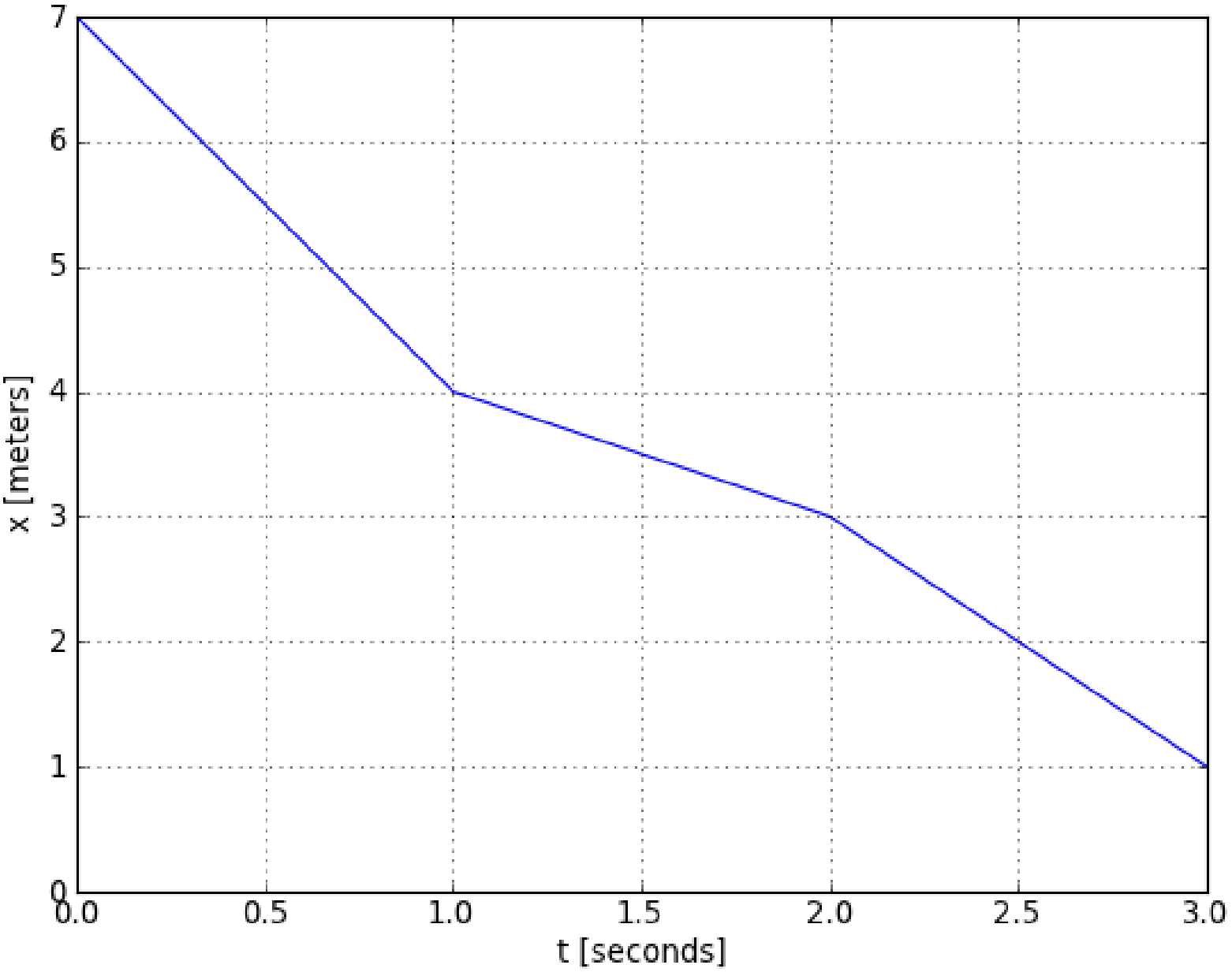
What is the distance traveled from t=0 to t=3s?



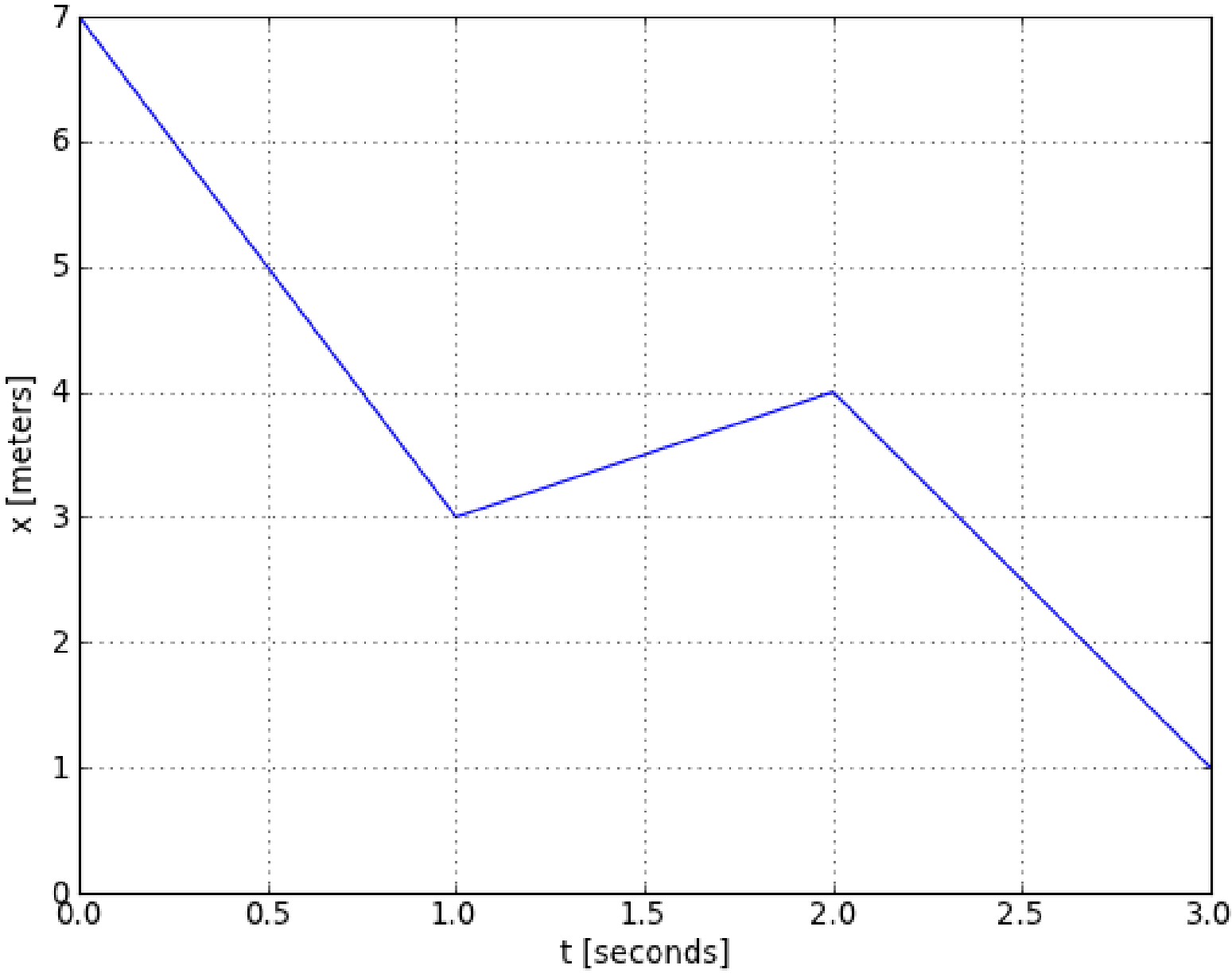
What is the x component of displacement?



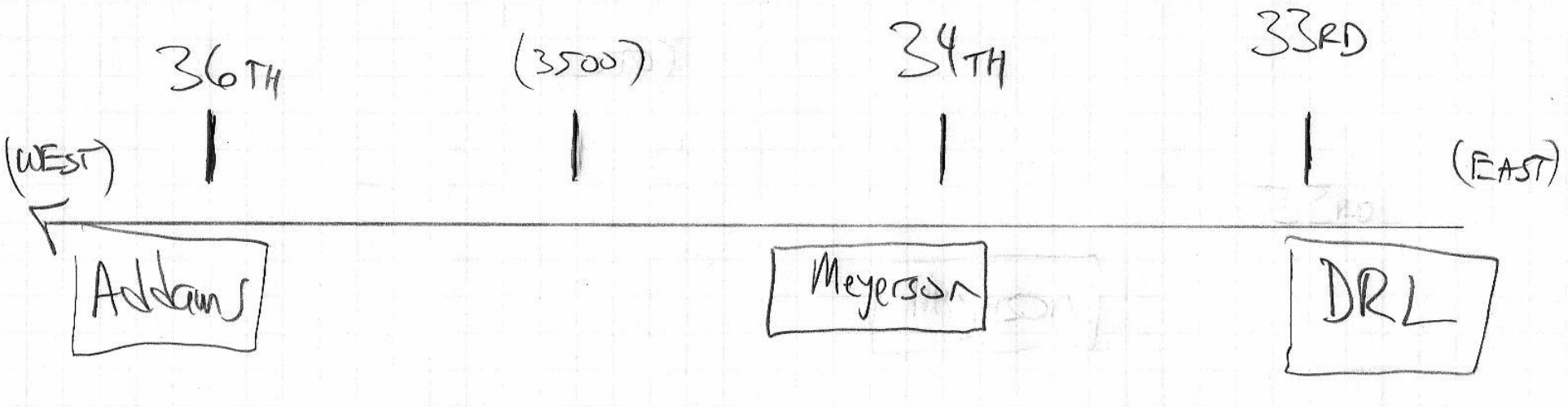
Now what is the x component of displacement?



Now what is the distance traveled?



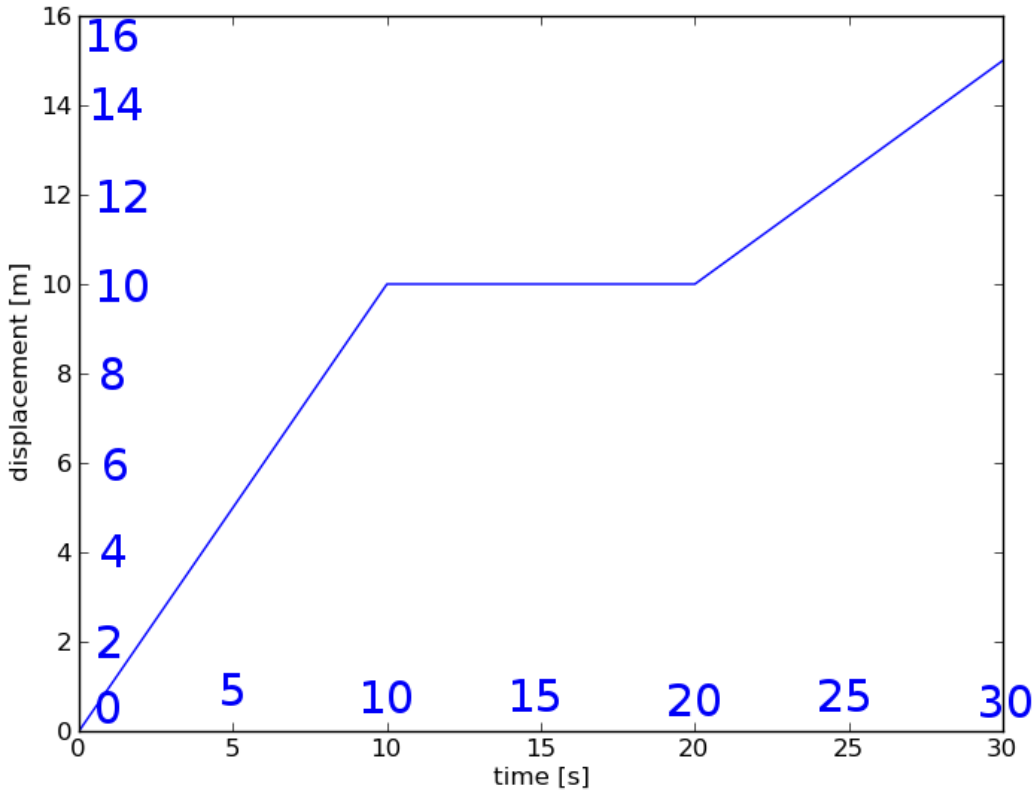
To keep the math simple, let's pretend that every city block is exactly 100 meters long.



- If I bike directly from DRL to Addams in 100 seconds, what is my average speed?
- What is my average velocity?
- If I walk directly from DRL to Addams in 200 seconds, then bike directly back from Addams to DRL in 100 seconds, what is my average velocity for the journey?
- What is my average speed for the journey?

Instantaneous velocity

What is the x component, v_x, of my instantaneous velocity at time $t = 5$ s? At time $t = 15$ s? At time $t = 25$ s?



Slope of the x(t) curve

The slope of the curve in the x coordinate of position vs. time graph (graph of $x(t)$ vs. t) for an object's motion gives

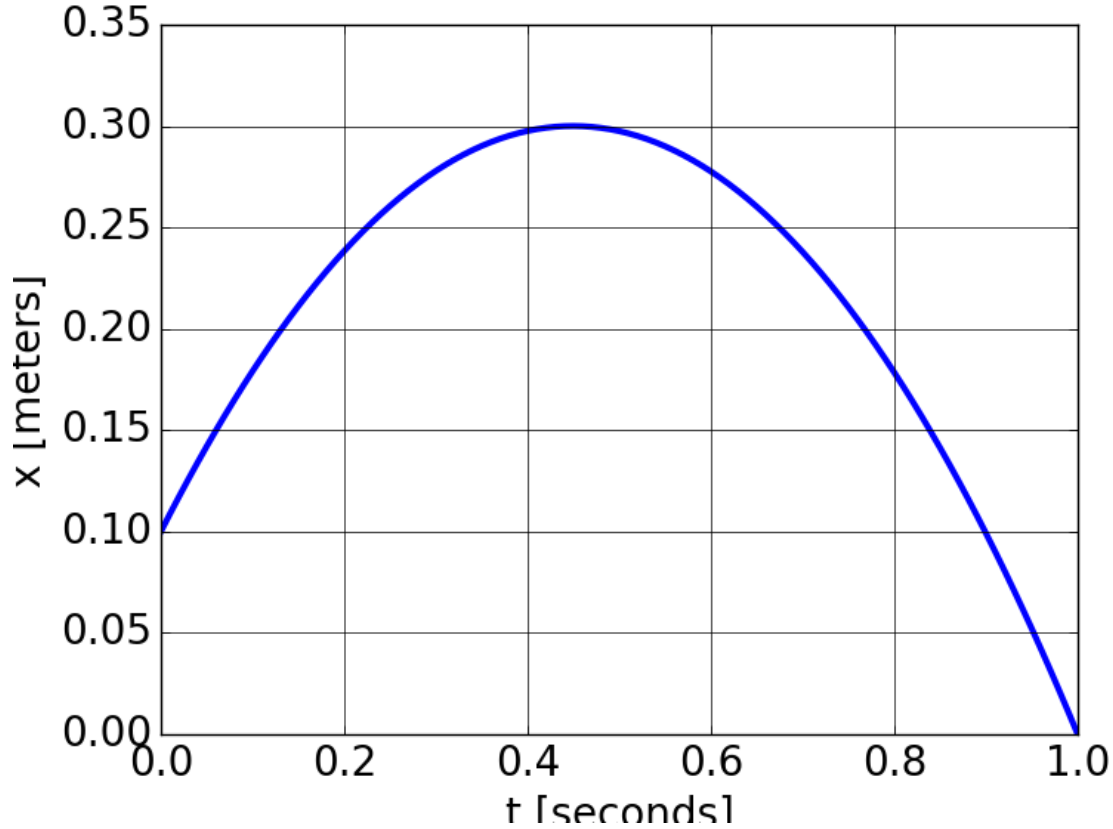
(A) the object's speed

(B) the object's acceleration

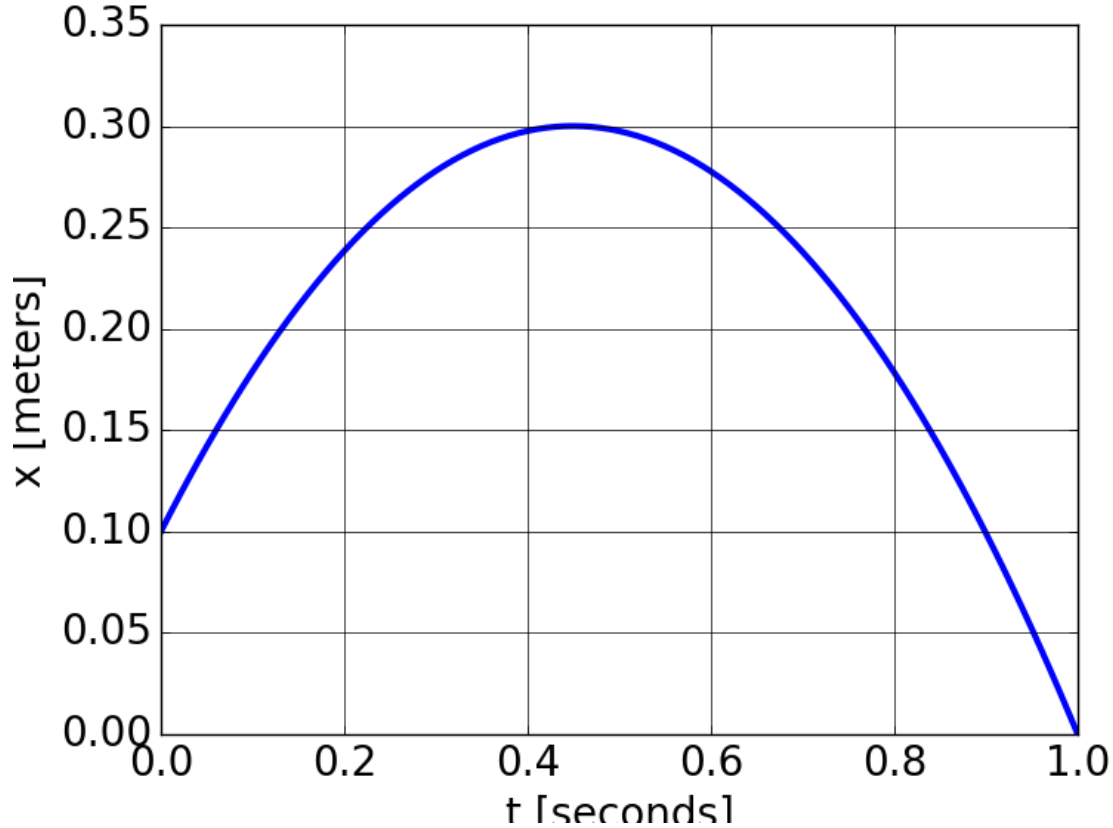
(C) the object's average velocity

(D) the x component of the object's instantaneous velocity

(E) not covered in today's material



- Where is the object moving forward?
- Where is the object moving backward?
- Where does the speed equal zero?
- Where is the speed largest?
- Where is v_x (the x component of velocity) largest?



For the motion represented in the figure above, what is the object's average velocity between $t = 0$ and $t = 1.0\,\mathrm{s}$?

What is its average speed during this same time interval?

Why is the average speed, for this motion, different from the magnitude of the average velocity?

Physics 8, Fall 2023, Worksheet #2.

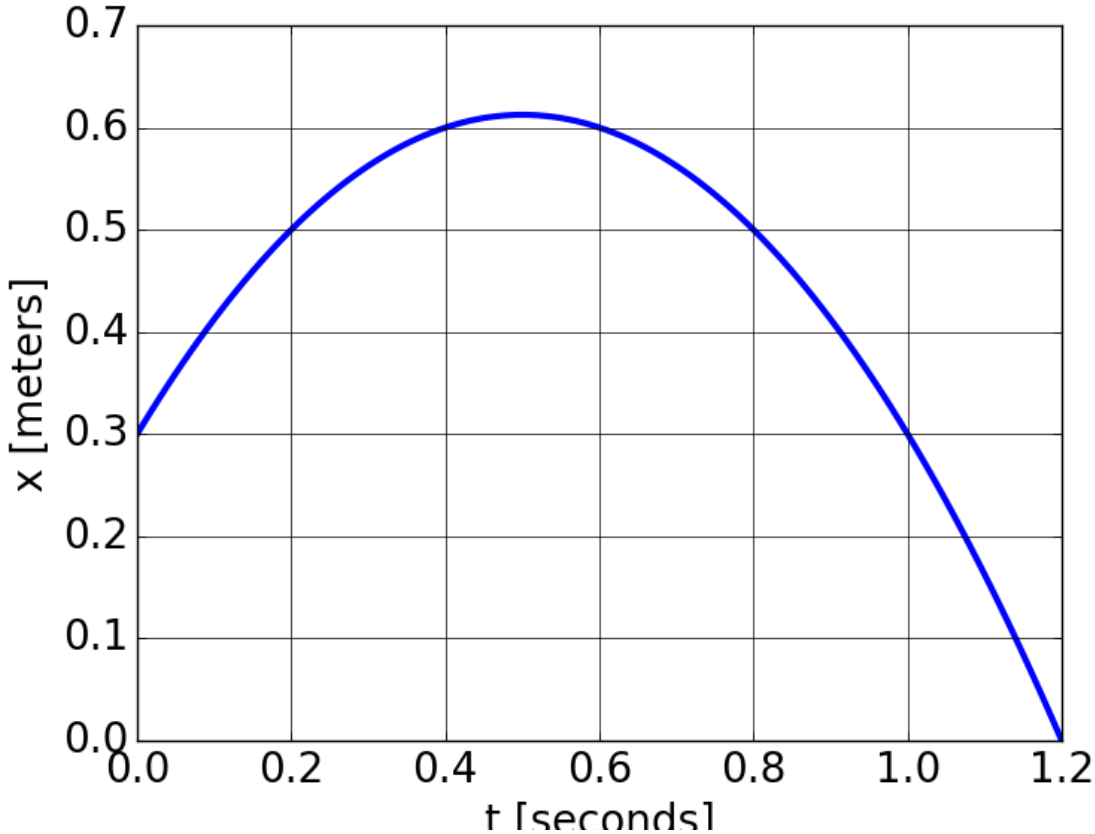
Optional/XC hands-on activity: Dr Batkie will set up one copy of an optional activity, that involves your walking in such a way that the graph of your motion produced by the computer's range-finder mimics a desired graph. Details will be written on the board. If you do this, write it up on the back page of your worksheet or on a blank sheet of paper.

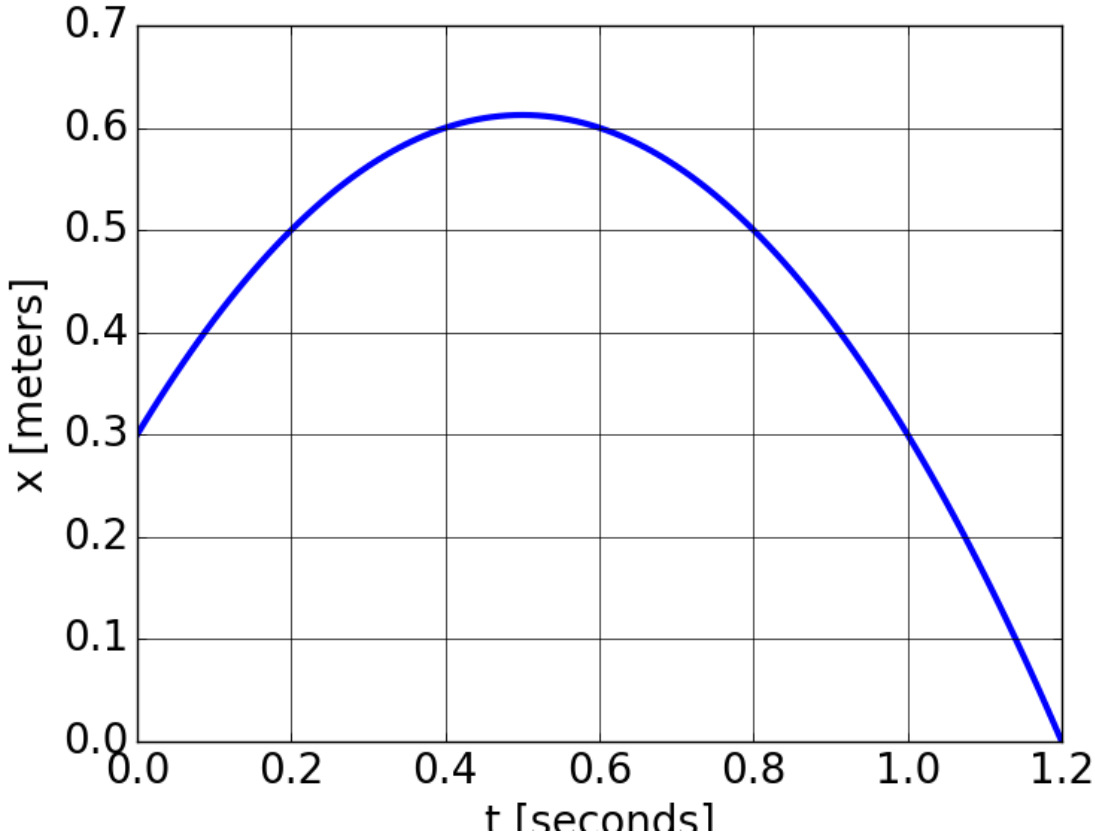
1. If the x component of an object's initial position is $x_i = +6.57\,\text{m}$ and the x component of its final position is $x_f = +4.23\,\text{m}$, what is the x component of its displacement? Remember to label your answer with the proper units (meters).

*. You walk 1.25 km from home to a restaurant in 20 minutes, stay there for an 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?

3*. You drive an old car on a straight, level highway at 45.0 miles/hour for 10.0 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 30 min after you begin walking. What is your average speed during the whole trip?

4. 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 $t = 0.2\,\text{s}$? (c) at $t = 1.2\,\text{s}$? What is the object's displacement (d) between $t = 0$ and $t = 0.2\,\text{s}$? (e) between $t = 0.2\,\text{s}$ and $t = 1.2\,\text{s}$? (f) between $t = 0$ and $t = 1.2\,\text{s}$? What is the distance traveled by the object (g) between $t = 0$ and $t = 0.2\,\text{s}$? (h) between $t = 0.2\,\text{s}$ and $t = 1.2\,\text{s}$? (i) between $t = 0$ and $t = 1.2\,\text{s}$?





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

Rubric: 4 points per problem: 2 for effort, 2 for correctness.

- 4 points = correct or very nearly correct
- 3 points = minor mistake
- 2 points = major mistake
- 1 point = you haven't convinced us that you put in much effort to try to solve the problem
- 0 points = nothing or very little of substance written down
- For some problems (such as today's hands-on bridge model), it may be unreasonable for us to look for "correctness," so instead all 4 points will be for effort.
- 4 additional overall points for presenting your work clearly, with adequate reasoning. So if n is the number of problems, the total points will usually be $4n + 4$.