

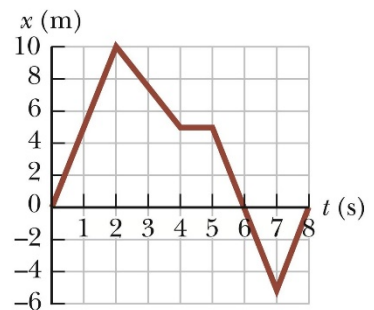
University Physics I

Homework Set 3

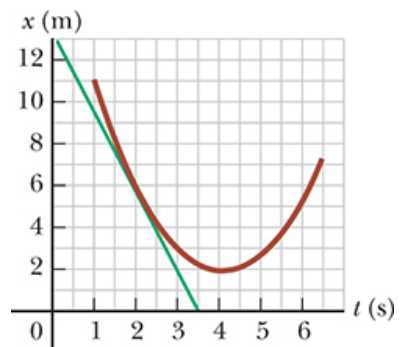
- ** The speed of a nerve impulse in the human body is about 100 m/s . If you accidentally stub your toe in the dark, estimate the time it takes the nerve impulse to travel to your brain.
- A particle moves according to the equation $x(t) = 10t^2$, where x is in meters and t is in seconds.
 - Find the average velocity for the time interval from 2.00 s to 3.00 s .
 - Find the average velocity for the time interval from 2.00 s to 2.10 s .
- The position of a pinewood derby car was recorded at various times. The results are summarized in the following table. Find the average velocity of the car for:
 - The first second (0 to 1 s).
 - The last 3 seconds (2 to 5 s).
 - The entire period of observation.

$t \text{ (s)}$	0	1.0	2.0	3.0	4.0	5.0
$x \text{ (m)}$	0	2.3	9.2	20.7	36.8	57.5

- A car travels North at 30.0 m/s for 10.0 min . It then travels South at 40.0 m/s for 20.0 min . What are the total distance and displacement the car travels (*in km*)?
- Running around a 50 m by 40 m rectangular track, you complete one lap in 100 s . What was your average velocity?
- ** The x - t graph for a certain particle moving along the x -axis is shown in the figure at right. Find:

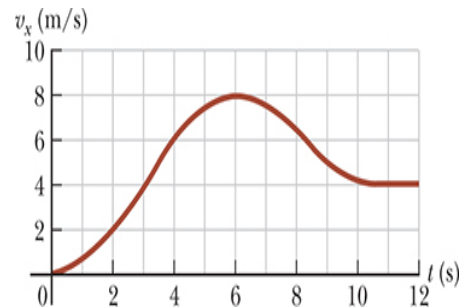


- The average velocity in the time intervals
 - 0 to 2 s
 - 0 to 4 s
 - 2 s to 4 s
 - 4 s to 7 s
 - 0 to 8 s
 - The instantaneous velocity of the particle at
 - $t = 1.0 \text{ s}$
 - $t = 3.0 \text{ s}$
 - $t = 4.5 \text{ s}$
 - $t = 7.5 \text{ s}$
- The x - t graph for a particle moving along the x -axis is shown at right.
 - Find the average velocity in the time interval $t = 1.50 \text{ s}$ to $t = 4.00 \text{ s}$.
 - Determine the instantaneous velocity at $t = 2.00 \text{ s}$ by measuring the slope of the tangent line shown in the graph.
 - At what value of t is the instantaneous velocity zero?



8. A Honda Civic is stopped at a traffic light. It then travels along a straight road such that its distance from the light is given by $x(t) = bt^2 - ct^3$, where $b = 2.40 \text{ m/s}^2$ and $c = 0.120 \text{ m/s}^3$.
- Calculate the average velocity of the car for the time interval $t = 0$ to 10 s .
 - Calculate the instantaneous velocity of the car at $t = 0, 5 \text{ s}$, and 10 s .
 - How long after starting from rest is the car again at rest?
9. The position of a particle moving along the x -axis is given by $x(t) = 3.0t^2 - 2.0t^3$, where x is in meters and t is in seconds. What is the position of the particle when it achieves its maximum speed in the positive x direction?
10. The North American and European tectonic plates on the Earth's surface are drifting apart with a relative speed of about 25 mm/yr . Take the speed as constant and find when the rift between them started to open (*in yrs*) to reach the current separation distance of $2.9 \times 10^3 \text{ mi}$.

11. ** The figure at right shows a graph of v_x - t for the motion of a motorcyclist as he starts from rest and moves along the road in a straight line.



- Find the average acceleration for the time interval $t = 0$ to 6.00 s .
 - Estimate the time at which the acceleration has its greatest positive value and the value of the acceleration at that instant.
 - Is the acceleration ever zero? If so, where?
 - Estimate the maximum negative value of the acceleration and the time at which it occurs.
12. The trajectory of an object is given by the equation
- $$x(t) = (4.35 \text{ m}) + (25.9 \frac{\text{m}}{\text{s}})t - (11.79 \frac{\text{m}}{\text{s}^2})t^2$$
- At what time is the displacement a maximum?
 - What is the value of the displacement at this time?
 - What is the value of the instantaneous velocity at this time?
 - What is the value of the instantaneous acceleration at this time?
13. The following table shows test data for the Bugatti Veyron Super Sport, the fastest street car made. The car is moving in a straight line (the x -axis):

Time (s)	0	2.1	20.0	53
Speed (mph)	0	60	200	253

- Sketch the v_x - t graph of this car's velocity. Is the acceleration constant?
- Calculate the car's average acceleration (in mph/s and m/s^2) between
 - 0 and 2.1 s
 - 2.1 s and 20 s
 - 20 s and 53 s

Are these results consistent with your graph in part (a)?

Before you decide to buy this car, it might be helpful to know that only 300 will be built, it runs out of gas in 12 minutes at top speed, and it costs more than \$1.5 million!

14. On October 30th, 2011, in an NFL football game between the Detroit Lions and the Denver Broncos, Lions left cornerback Chris Johnson intercepted a pass 1 yard behind the goal line, ran down the entire length of the football field in a straight line, and scored a touchdown. Video analysis of this scoring play showed the following approximate times (*listed in the table below*) for him to cross the indicated yard lines painted on the field.

- What was his average speed (*in yds/s*) from the time he caught the ball until he reached midfield (the 50 yard-line)?
- What was his average speed (*in yds/s*) from the time he crossed midfield until he came to a stop 1 yard behind the opposite goal line?
- What was his average acceleration (*in yds/s²*) during the entire run?
- Graph *yards (y-axis) vs time (x-axis)*. Is there a range in which the velocity is constant during the return?

HINT: For distances past the 50 yard line, just keep adding 5. (55, 60, 65....)

Yard (yds)	-1	0	5	10	15	20	25	30	35	40	45
Time (s)	0.00	0.23	1.16	1.80	2.33	2.87	3.37	3.87	4.33	4.80	5.27

50	45	40	35	30	25	20	15	10	5	0	-1
5.73	6.20	6.67	7.17	7.64	8.14	8.67	9.20	9.71	10.34	11.47	12.01

15. A particle starts from rest and accelerates as show in the figure at right. Determine:

- The particles speed at $t = 10.0$ s.
- The total distance traveled in the first 20.0 s.

