Motion Analysis HW Part 1 Due 2/24/14 Name: _____

If $x(t)$ represents the position of a particle along the x-axis at any time t, then the following statements are true.

1. "Initially" means when _____ = 0.
2. "At the origin" means _____ = 0.
3. "At rest" means _____ = 0.
4. If the velocity of the particle is positive, then the particle is moving to the _____.
5. If the velocity of the particle is _____, then the particle is moving to the left.
6. To find average velocity over a time interval, divide the change in _____ by the change in time.
7. Instantaneous velocity is the velocity at a single moment (instant!) in time.
8. If the acceleration of the particle is positive, then the _____ is increasing.
9. If the acceleration of the particle is _____, then the velocity is decreasing.
10. In order for a particle to change direction, the _____ must change signs.
11. One way to determine total distance traveled over a time interval is to find the sum of the absolute values of the differences in position between all resting points. Here's an example: If the position of a particle is given by:

$$x(t) = \frac{1}{3}t^3 - t^2 - 3t + 4,$$

find the total distance traveled on the interval $0 \le t \le 6$.

Example 1 (numerical).

The data in the table below give selected values for the velocity, in meters/minute, of a particle moving along the x-axis. The velocity v is a differentiable function of time t.

Time t (min)	0	2	5	6	8	12
Velocity $v(t)$ (meters/min)	-3	2	3	5	7	5

1. At $t = 0$, is the particle moving to the right or to the left? Explain your answer.

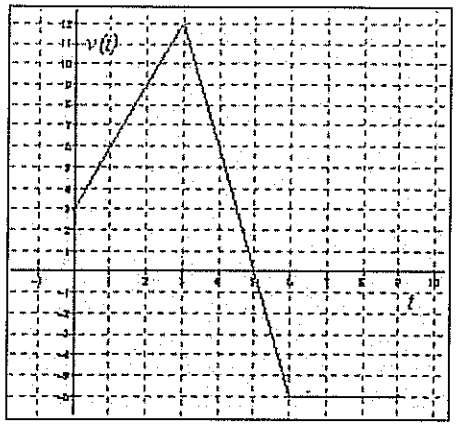
2. Is there a time during the time interval $0 \le t \le 12$ minutes when the particle is at rest? Explain your answer.

3. Use data from the table to find an approximation for $v'(10)$ and explain the meaning of $v'(10)$ in terms of the motion of the particle. Show the computations that lead to your answer and indicate units of measure.

4. Let $a(t)$ denote the acceleration of the particle at time t. Is there guaranteed to be a time $t = c$ in the interval $0 \le t \le 12$ such that $a(c) = 0$? Justify your answer.

Example 2 (graphical).

The graph below represents the velocity v, in feet per second, of a particle moving along the x-axis over the time interval from $t = 0$ to $t = 9$ seconds.



1. At $t = 4$ seconds, is the particle moving to the right or left? Explain your answer.

2. Over what time interval is the particle moving to the left? Explain your answer.

3. At $t = 4$ seconds, is the acceleration of the particle positive or negative? Explain your answer.

4. What is the average acceleration of the particle over the interval $2 \le t \le 4$? Show the computations that lead to your answer and indicate units of measure.

5. Is there guaranteed to be a time t in the interval $2 \le t \le 4$ such that $v'(t) = -3/2$ ft/sec^2? Justify your answer.

6. At what time t in the given interval is the particle farthest to the right? Explain your answer.

Example 3 (analytic).

A particle moves along the x-axis so that at time t its position is given by:

$$x(t) = t^3 - 6t^2 + 9t + 11$$

1. At $t = 0$, is the particle moving to the right or to the left? Explain your answer.

2. At $t = 1$, is the velocity of the particle increasing or decreasing? Explain your answer.

3. Find all values of t for which the particle is moving to the left.

4. Find the total distance traveled by the particle over the time interval $0 \le t \le 5$.