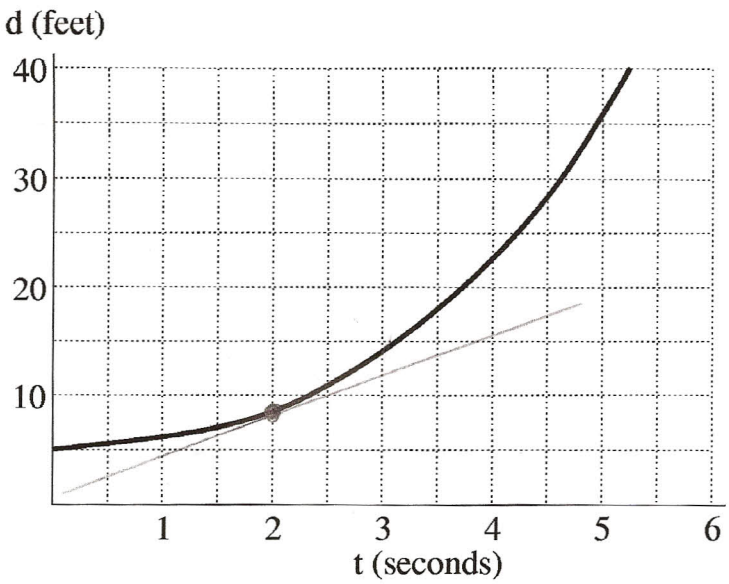
Section 2.1 – How Do We Measure Speed?

1. (a) Given to the right is the graph of the position of a runner as a function of time. Use the graph to complete each of the following.



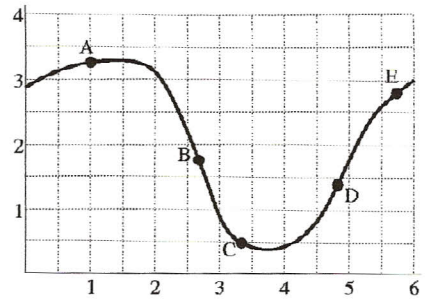
Time Interval	Average Velocity of Runner
$2 \le t \le 5$	$\frac{36-8}{5-2} = \frac{28}{3} \doteq 9.333$
$2 \le t \le 3.5$	$\frac{18-8}{3.5-2} = \frac{10}{1.5} = \frac{20}{3} \doteq 6.667$
$2 \le t \le 2.5$	$\frac{11-8}{2.5-2} = \frac{3}{0.5} = 6$

(b) Estimate the instantaneous velocity of the runner at $t = 2$ seconds.

Look at the slope of the line tangent to the graph at $t=2$. It contains approximate coordinates (2,8) and (1,4).

$\frac{8-4}{2-1} = 4$ ft/s.

2. For the function shown to the right, answer the following questions:



(a) At what points is the slope of the curve positive?

A, D, E

(b) At what points is the slope of the curve negative?

B, C

(c) Rank the slopes at the 5 points in order from smallest to largest.

B, C, A, D, E

3. In a time of t seconds, a particle moves a distance of s meters from its starting point, where $s = f(t) = t^2 + 1$.

(a) Find the average velocity between $t = 2$ and $t = 2 + h$ if $h = 0.1, h = 0.01$, and $h = 0.001$. (That is, compute the average velocity over 3 different time intervals).

$$\frac{(2+h)^2+1-2^2-1}{2-2-h} = \frac{4+4h+h^2+1-4-1}{h} = 4+h$$

So, at $h = 0.1$ avg vel $= 4.1$ m/s
0.01 " " $= 4.01$ m/s
0.001 " " $= 4.001$ m/s

(b) Now, give your best estimate of the instantaneous velocity of the particle at $t = 2$.

If $h = -0.001$, avg vel $= 3.999$. So guess: 4 m/s.

4. The position of a car traveling along a straight east/west highway at various times is shown in the table below. Positive values of d indicate that the car is east of its starting point, while negative values of d indicate that the car is west of its starting point.

t (hours)	1	2	3	4	5
d (miles)	40	-10	20	90	-50

Calculate the average velocity of the car on the following two time intervals: (a) between 1 and 2 hours, (b) between 2 and 4 hours. What does a positive velocity mean? What does a negative velocity mean?

(a) $\frac{-10-40}{2-1} = -50$ mph

(b) $\frac{90-(-10)}{4-2} = 50$ mph

A positive vel. means the car is moving east. A negative vel. means it is moving west.