Comparing Average Velocity and Instantaneous Velocity

The student will need to obtain one of the accelerated motion graph sets. In this exercise we will only be using the position versus time graph. Let us review some definitions.

Average velocity is defined as the ratio of a particle's displacement Δx to the time interval, Δt .

$$\overline{\mathrm{v}} = \frac{\Delta x}{\Delta t}$$

Graphically, the average velocity is equal to the slope of a line segment having two points of intersection with the position versus time graph.

The instantaneous velocity, v, is defined to be the limit of the ratio $\frac{\Delta x}{\Delta t}$ as $\Delta t \to 0$

$$\mathrm{v} = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$

Graphically, the instantaneous velocity at some time is equal to the slope of the line tangent to the position versus time graph at that time.

Now let's begin the graphically exercise.

1) Draw a line segment through the position versus time graph for the time interval, $1 \le t \le 5$. Calculate the slope of this line segment and provide the correct units to your answer. Show your work clearly.

2) Draw a second line segment through the position versus time graph for the time interval, $1 \le t \le 4$. Calculate the slope of this line segment and provide the correct units to your answer. Show your work clearly.

3) Draw a third line segment through the position versus time graph for the time interval, $1 \le t \le 3$. Calculate the slope of this line segment and provide the correct units to your answer. Show your work clearly.

4) Draw a fourth line segment through the position versus time graph for the time interval, $1 \le t \le 2$. Calculate the slope of this line segment and provide the correct units to your answer. Show your work clearly.

5) Draw a tangent line to the position versus time graph at the time, t = 1 second. Calculate the slope of this tangent line and provide the correct units to your answer. Show your work clearly.

5) In steps 1) through 4), the time interval is becoming smaller and smaller. If this trend continued with an ever smaller time interval, one could say that the time interval approaches zero. This can be expressed with $\Delta t \to 0$. Discuss what is happening to the average velocity as the time interval becomes smaller and smaller. Provide a thorough explanation.