

Average to Instantaneous Velocity Worksheet

Name _____

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Offier Tom “Tommy Boy” Hopkins and his long-time adversary and evil brother Mike, known throughout the country as “Angry Mike,” are having another one of their disputes. Angry Mike decides to show off his love for lawlessness by speeding past the police station, but unbeknownst to him, Tommy Boy has set up an elaborate system of invisible laser beams and timing devices along the road passing the police station. As a result, Tommy Boy and his colleagues are able to construct a graph of Angry Mike’s distance traveled as a function of time.

Alas, the case of Hopkins vs. Hopkins goes to trial, and you’re playing the part of the prosecution’s start witness.

1. Compute the average velocities (in miles per hour) on each of the following intervals.
 - (a) $0 \text{ seconds} \leq t \leq 2 \text{ seconds}$
 - (b) $2 \text{ seconds} \leq t \leq 4 \text{ seconds}$
 - (c) $4 \text{ seconds} \leq t \leq 6 \text{ seconds}$
 - (d) $6 \text{ seconds} \leq t \leq 8 \text{ seconds}$
 - (e) $8 \text{ seconds} \leq t \leq 10 \text{ seconds}$
 - (f) $10 \text{ seconds} \leq t \leq 12 \text{ seconds}$
2. In opening arguments, Angry Mike’s defense attorney looks at the data on the graph and says that his client traveled less than 1190 feet in 12 seconds, giving a top possible velocity of under 68 miles per hour. He therefore, claims that his client was traveling cautiously below the speed limit for the entire 12-second period. Is the attorney’s claim accurate? Explain, based on your own calculations.
3. Estimate Angry Mike’s maximum velocity during the 12-second interval. Explain how you got this number. How can you tell **from the graph** where Angry Mike is traveling the fastest?

4. The defense attorney, in response to your testimony, claims that since all your velocity calculations are averages over time intervals, rather than instantaneous velocities, that you can't prove that Angry Mike was speeding at any one given time. How would you respond to this statement? How would you justify your position to the jury?
5. Finally, suppose (just this once!) that you're working for the defense attorney's team. As part of the closing argument, to show what a decent, law-abiding, courteous, and cautious citizen Angry Mike is, give your best estimate (as low as you can make it from the data) of his velocity (in miles per hour) at $t = 12$ seconds. Explain why you think your answer is a good estimate of his velocity right at $t = 12$ seconds.