Class Activities: Velocity

Today we'll start by working through parts of Activity 1.1 in Section 1.1, followed by a quick debrief. Then we'll do the following, which is a remixed version of Activity 1.3.

Consider the function $s(t) = 64 - 16(t-1)^2$, which gives the position of an object at time t.

1. Calculate the value of $s(2)$.

$s(2) = 64 - 16(2-1)^2 = 64 - 16 = 48.$

2. Calculate the expression $s(2+h)$ and simplify completely.

$s(2+h) = 64 - 16((2+h)-1)^2$
$= 64 - 16(h+1)^2$
$= 64 - 16(h^2+2h+1)$
$= 64 - 16h^2 - 32h - 16$
$= -16h^2 - 32h + 48.$

3. Calculate the value of $s(2+h) - s(2)$ and simplify completely, including factoring out any common factors.

$s(2+h) - s(2) = -16h^2 - 32h + 48 - 48$
$= -16h^2 - 32h.$

4. Set up and simplify the expression for the average velocity of an object with position $s(t)$ on the interval $[2, 2+h]$. The result should be an expression whose only variable is h, and there should be no fractions in the result.

$AV_{[2,2+h]} = \frac{s(2+h) - s(2)}{h} = \frac{-16h^2 - 32h}{h}$
$= \frac{h(-16h - 32)}{h} = -16h - 32.$

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h = 0.5 h = −0.1

5. Use the result of (d) to find the average velocity of an object with position $s(t)$ on the interval $[2, 2.5]$ and then on the interval $[1.9, 2]$. (Hint: What is the value of h each time?)

$AV_{[2,2.5]} = -16(0.5) - 32$

$= -8 - 32$

$= -40$

$AV_{[1.9,2]} = -16(-0.1) - 32$

$= 1.6 - 32$

$= -30.4$

6. In your own words, what is happening as h approaches 0?

As h approaches 0, the time interval [a, a+h] is getting shorter and shorter. So the average velocity is getting closer and closer to instantaneous velocity.

7. Use the result of (4) to find the *instantaneous* velocity of an object with position $s(t)$ at $t = 2$. What does the sign (positive/negative) of the answer indicate? And what are the units of the answer?

Take the average velocity and let h go to 0:

$-16h - 32 \longrightarrow -16(0) - 32$

$= -32$ ft/s.

8. How would you adjust the above processes if you were using the same position function for s but wanted to find the instantaneous velocity at $t = 1$? And by just looking at the graph, what do you think is the value of the instantaneous velocity at $t = 1$?

Calculate $\frac{s(1+h) - s(1)}{h}$, simplify, then let h go to 0.

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What was the muddiest point from today's class?