Author 1 _____

Author 2 _____

Author 3 _____

01 – Introduction to Velocity

1. My friend and I are slightly bored and decide to figure out how fast I can throw a ball up in the air. We find a baseball and a tall apartment building. The building will help us measure since each level of a typical residential building is 10 feet tall. I throw the ball straight up while my friend takes a video. Reviewing the video, we build the following table, which lists the height $h(t)$ of the ball at a given time t measured in seconds since I threw the ball.

t (in seconds)	0	0.5	1	1.5	2	2.5	3
$h(t)$ (in feet)	6	52	90	120	142	156	162

(a) How tall am I?

(b) What is the average velocity of the ball from second 0 to second 1? Call this A_1. How about from second 1 to second 2? Call this A_2.

$A_1 =$

$A_2 =$

To see how fast I throw, let's try to find the velocity of the ball at time $t = 1$.

Let's write $v(t)$ for velocity at time t. We want to find $v(1)$.

(c) Which of the following is most reasonable: $A_1 = v(1)$, $A_1 < v(1)$, or $A_1 > v(1)$? **Why**?

(d) Repeat for A_2. Which is most reasonable: $v(1)$, $A_2 < v(1)$, or $A_2 > v(1)$? **Why**?

Here's the data again:

t (in seconds)	0	0.5	1	1.5	2	2.5	3
$h(t)$ (in feet)	6	52	90	120	142	156	162

(e) What is the average velocity of the ball over the interval $[0.5, 1]$? How about $[1, 1.5]$?

Taking a closer look at the video, we get the following 1/10-second and 1/100-second data.

t (in seconds)	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5
$h(t)$ (in feet)	50	60.24	68.16	75.76	83.04	90	96.64	102.96	108.96	114.64	120

t (in seconds)	0.97	0.98	0.99	1	1.01	1.02	1.03
$h(t)$ (in feet)	87.9456	88.6336	89.3184	90	90.6784	91.3536	92.0256

(f) Use the data to fill in the following tables.

Time Interval	Avg. Velocity
[0,1]	
[0.5,1]	
[0.9,1]	
[0.99,1]	

Time Interval	Avg. Velocity
[1,2]	
[1,1.5]	
[1,1.1]	
[1,1.01]	

(g) Give your best estimate of $v(1)$. *What would you need to improve or verify your estimate?*
My estimate for $v(1)$ is _____ because...

To improve or verify my estimate I would need...

(h) After we discuss this together, make a final guess for $v(1)$. **Why did you choose that answer?**

$v(1) =$