WELCOME TO MATH 152: CALCULUS I

Dr. Janssen

Lecture 1

ABOUT DR. JANSSEN

- At Dordt since 2014
- Alma maters: South Dakota ('07), Nebraska ('09, '13)
- Enjoys: running (marathon$\times$4), board games

Things to call me: Professor Janssen, Dr. Janssen

Things *not* to call me: Mike, Mr. Janssen, Janssen

Lila (age 8)

Sam (age 5)

AGENDA

Syllabus exploration

Expectations and Q&A

Average Velocity

Course Intro and Syllabus Exploration

ACTIVITY: SCAVENGER HUNT

- Go to `student.desmos.com`
- Type in the class code:

  `XF EP TQ`

- Create an account to sign in (this will be required for the preview activities!)
- Find and complete the Syllabus Scavenger Hunt

Highlights

REQUIRED MATERIALS

- Access to Canvas/Active Calculus/Edfinity
- Calculus Bundle from Campus Store

STUDENT HOURS

- "*Student* Hours" are **your** time!
- Drop in if my door is open!

Canvas Tour

Expectations

PREPARING FOR CLASS

- Buy the calculus bundle and do the preview activities in Desmos
- Take care of yourself so you can actively engage in the class

AFTER CLASS

- Make appointments with me! Or just drop by. (Again: I'm in SB 1612.)
- Complete the homework on time.
- Take the exams/quizzes seriously!

ACTIVE LEARNING AND COLLABORATION

- Collaboration is encouraged!
- Make sure you understand a solution before your group/the class moves on.
- All work that you turn in must be your own.

What questions do you have?

QOTD: What is velocity?

EXAMPLE (DESMOS)

My son, Sam, loves throwing things. Suppose he tosses his basketball in the air.

Let $y = s(t) = 64t - 16t^2$ give the height of the basketball in feet at time t in seconds. In groups of 3–4:

1. What is the ball doing on the interval $[0, 2]$?
2. What is the ball doing on the interval $[2, 4]$?
3. What is the ball doing at $t = 2$?
4. Consider the expression
$$AV_{[1,2]} = \frac{s(2) - s(1)}{2 - 1}.$$
What does this measure on the graph of $y = s(t)$? What does it tell us about the motion of the ball? What are the units?

Definition

For an object moving in a straight line with position function $s(t)$, the average velocity of the object from $t = a$ to $t = b$ is given by the formula

$$AV_{[a,b]} = \frac{s(b) - s(a)}{b - a}.$$

ACTIVITY 1.1.2 (DESMOS)

The following questions concern the position function given by $s(t) = 64 - 16(t-1)^2$

(a) Compute the average velocity of the ball on each of the following time intervals: $[0.4, 0.8]$, $[0.7, 0.8]$, $[0.79, 0.8]$, $[0.799, 0.8]$, $[0.8, 1.2]$, $[0.8, 0.9]$, $[0.8, 0.81]$, $[0.8, 0.801]$. Include units for each value.

(b) On the provided graph in Figure 1, sketch the line that passes through the points $A = (0.4, s(0.4))$ and $B = (0.8, s(0.8))$. What is the meaning of the slope of this line? In light of this meaning, what is a geometric way to interpret each of the values computed in the preceding question?

(c) Use a graphing utility to plot the graph of $s(t) = 64 - 16(t-1)^2$ on an interval containing the value $t = 0.8$. Then, zoom in repeatedly on the point $(0.8, s(0.8))$. What do you observe about how the graph appears as you view it more and more closely?

(d) What do you conjecture is the velocity of the ball at the instant $t = 0.8$? Why?

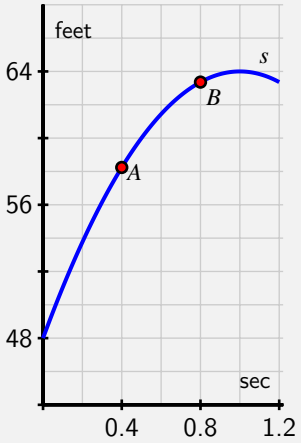

Figure 1: A partial plot of $s(t) = 64 - 16(t-1)^2$.

ACTIVITY 1.1.3 (DESMOS)

(a) Compute the average velocity of the ball on the time interval $[1.5, 2]$. What is different between this value and the average velocity on the interval $[0, 0.5]$?

(b) Use appropriate computing technology to estimate the instantaneous velocity of the ball at $t = 1.5$. Likewise, estimate the instantaneous velocity of the ball at $t = 2$. Which value is greater?

(c) How is the sign of the instantaneous velocity of the ball related to its behavior at a given point in time? That is, what does positive instantaneous velocity tell you the ball is doing? Negative instantaneous velocity?

(d) Without doing any computations, what do you expect to be the instantaneous velocity of the ball at $t = 1$? Why?

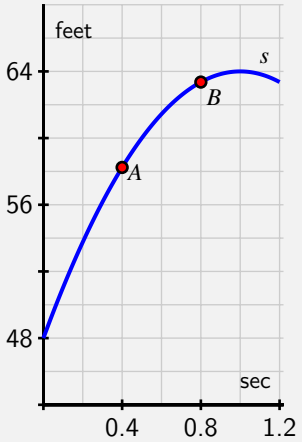

Figure 2: A partial plot of $s(t) = 64 - 16(t-1)^2$.

ACTIVITY 1.1.4

For the function given by $s(t) = 64 - 16(t-1)^2$, find the most simplified expression you can for the average velocity of the ball on the interval $[2, 2+h]$. Use your result to compute the average velocity on $[1.5, 2]$ and to estimate the instantaneous velocity at $t = 2$. Finally, compare your earlier work in Activity 1.1.2.