Lesson 1.1 - Can Change Occur at an Instant?

AP Calc. AB/BC

Warm up:

1. Are you signed into our Google Classroom?

2. Have you explored any of the links in the resources topic under our Classwork?

3. Are you signed into our AP Classroom?

4. Have you explored AP Classroom to find our Unit 1 homework? (Progress Checks)

Calculus

1.1 Can change occur at an instant?

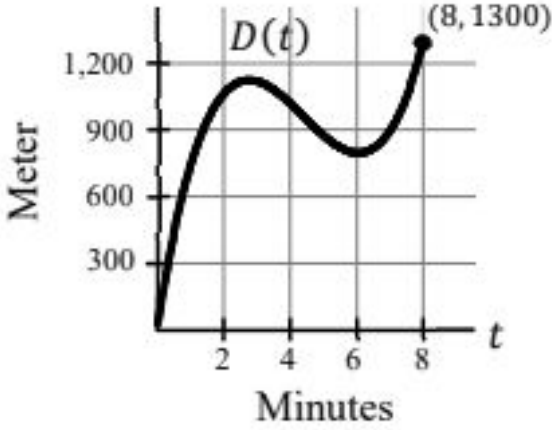
Notes

Write your questions and thoughts here!

The Father(s) of Calculus

Can Change occur at an instant?

1. Mr. Brust's distance from his house is modeled by the function $D(t)$. While riding his bike to the store, he realizes he dropped his wallet and turns around to find it. After finding his wallet, he finishes his ride to the store.



   a. What is his average speed (rate of change) for his trip to the store if he arrives after 8 minutes?

   b. What was his average rate of change between 2 and 6 minutes?

   c. What was his average rate of change between 2 and 3 minutes?

Is it possible to know how fast he was going at an instant?

d. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 2$.

e. Give a rough estimate of the instantaneous rate of change at $t = 2$.

2. $b(t)$ represents the buffalo population in the United States where t is measured in years since 1800.

   a. What does $b(90)$ represent?

   b. What does $\frac{b(50)-b(0)}{50-0}$ represent?

   c. What does $\frac{b(32)-b(31.999)}{32-31.999}$ represent?

Notes Filled In:

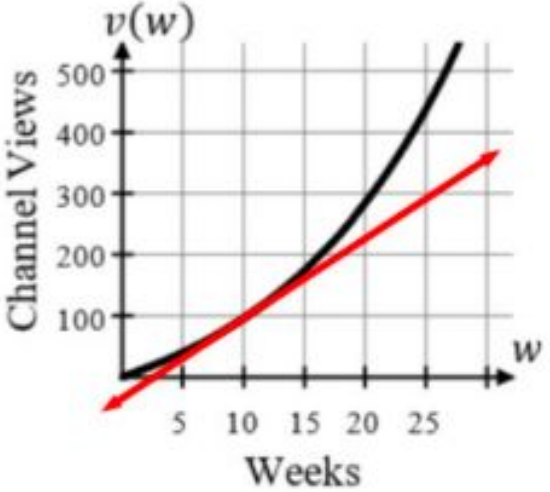
AP Calc. AB/BC - Lesson 1.1 - Filled In

Practice - Test Prep.

Take the next 5-10 minutes to work together on the practice - test prep section of our notes.

We will go through it together on the board after the time is up!

1. Mr. Kelly has decided to quit his job as a teacher and be a social influencer. The number of views on his new channel is modeled by the function v, where $v(w)$ gives the number of views and w gives the number of weeks since he started the channel for $0 \leq w \leq 26$. The graph of the function v is shown to the right.



   a. Draw a tangent line at $w = 10$.

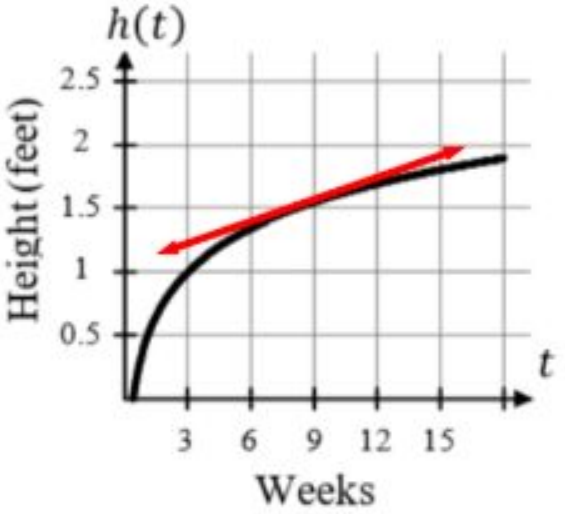
   b. Give a rough estimate of the instantaneous rate of change at $w = 10$.

10 views per week

   c. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $w = 5$.

$$\frac{f(5) - f(4.999)}{5 - 4.999}$$

2. The height of a raspberry bush can be modeled by the function h, where $h(t)$ gives the height measured in feet and t gives the number of weeks it was planted for $0 \leq t \leq 12$. The graph of the function h is shown to the right.



a. Draw a tangent line at $t = 9$.

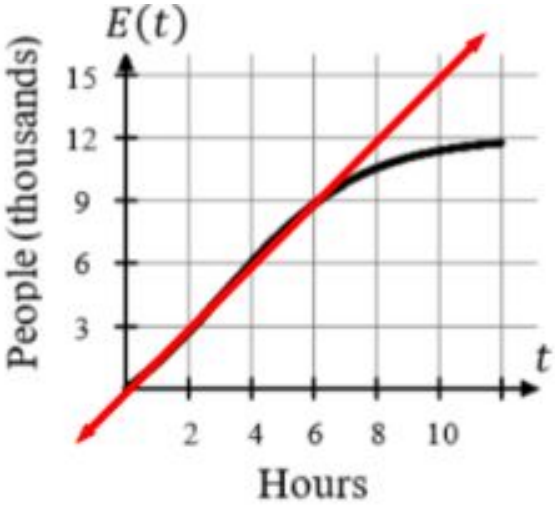
b. Give a rough estimate of the instantaneous rate of change at $t = 9$.

0.1 feet per week (This is a very rough estimate!)

c. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 12$.

$$\frac{h(12) - h(11.999)}{12 - 11.999}$$

3. The number of people who have entered an amusement park is modeled by the function E, where $E(t)$ gives the number of people in thousands who have entered the park and t gives the number of hours since 10:00 a.m. for $0 \leq t \leq 11$. The graph of the function E is shown to the right.



a. Draw a tangent line at $t = 3$.

b. Give a rough estimate of the instantaneous rate of change at $t = 3$.

1500 people per hour

c. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 6$.

$$\frac{E(6) - E(5.999)}{6 - 5.999}$$

4. A basketball player's free throw attempts can be modeled by f, where $f(g)$ is the total number of made free throws during the season and g is the number of games for $0 \leq g \leq 82$.

a. What does $f(50)$ represent?

The number of free throws made through 50 games.

b. What does $\frac{f(50)-f(0)}{50-0}$ represent?

The average rate of change of free throws made per game for the first 50 games.

c. What does $\frac{f(50)-f(49.999)}{50-49.999}$ represent?

The approximate rate of change of free throws made per game on the 50th game.

5. A monthly electric bill charges for each kilowatt-hour (kWh) used. This can be modeled by k where $k(m)$ is the kWh used for the month and m is the month for $0 \leq m \leq 12$.

a. What does $k(8)$ represent?

The kWh used in the 8th month.

b. What does $\frac{k(8)-k(5)}{8-5}$ represent?

The average rate of change in the number of kWh per month between the 5th and 8th month.

c. What does $\frac{k(2)-k(1.999)}{2-1.999}$ represent?

An estimate of the rate of change of kWh per month in the 2nd month.

6. In a country, the number of deaths in a year can be modeled by d, where $d(t)$ is the number of deaths and t is the number of years since 1950 for $0 \leq t \leq 50$.

a. What does $d(40)$ represent?

The number of deaths in 1990.

b. What does $\frac{d(20)-d(10)}{20-10}$ represent?

The average rate of change in number of deaths per year from 1960 to 1970.

c. What does $\frac{d(49)-d(48.999)}{49-48.999}$ represent?

The approximate rate of change of deaths per year in 1999.

7. A dam has a "dam release" that releases water. The amount of water released can be modeled by V, where $V(t)$ is the volume of cubic liters of water and t is the seconds since opening the dam release for $0 \leq t \leq 3600$.

a. What does $V(100)$ represent?

The amount of water released after 100 seconds.

b. What does $\frac{V(100)-V(0)}{100-0}$ represent?

The average rate of change water released per second for the first 100 seconds.

c. What does $\frac{V(100)-V(99.999)}{100-99.999}$ represent?

The approximate rate of change of water being released at the 100th second.

Independent Work Time

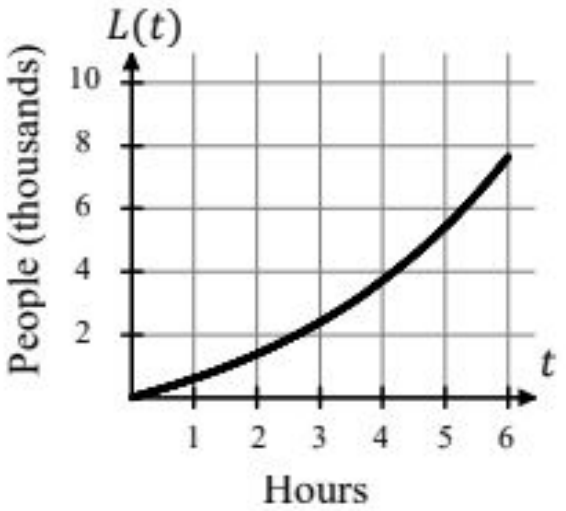
Please work on the CA worksheet during this time.

We will go through any questions from the CA worksheet tomorrow during the Warmup.

If you finish the CA worksheet early then you can go to AP Classroom and work on homework, step-by-step, watch a daily video, or utilize a different resource from GC

Lesson 1.1 - CA1 worksheet

1. The number of people who have left an amusement park is modeled by the function L, where $L(t)$ gives the number of people in thousands who have left the park and t gives the number of hours since 10:00 a.m. for $0 \leq t \leq 6$. The graph of the function L is shown to the right.



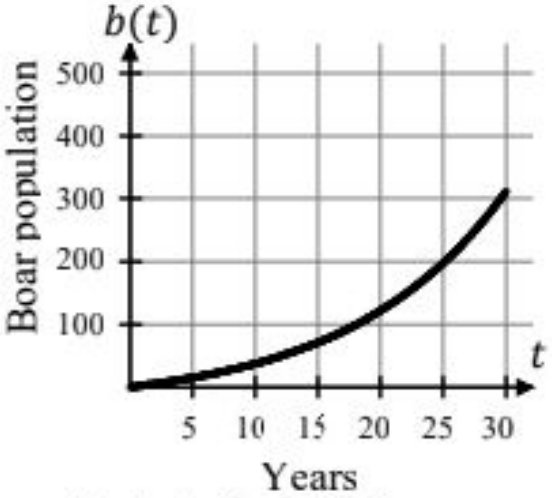
   a. Draw a tangent line at $t = 1$.

   b. Give a rough estimate of the instantaneous rate of change at $t = 1$.

   c. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 4$.

Lesson 1.1 - CA1 worksheet

2. The population of a community of wild boar is modeled by the function b, where $b(t)$ gives the number of boar and t gives the number of years since 1990. for $0 \leq t \leq 30$. The graph of the function b is shown to the right.



   a. Draw a tangent line at $t = 25$.

   b. Give a rough estimate of the instantaneous rate of change at $t = 25$.

   c. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 5$.

Lesson 1.1 - CA1 worksheet

3. The number of people enlisting in the army each year can be modeled by E, where $E(t)$ is the number of new recruits and t is the year since 1980 for $0 \leq t \leq 20$.

a. What does $E(7)$ represent?

b. What does $\frac{E(7)-E(2)}{7-2}$ represent?

c. What does $\frac{E(7)-E(6.999)}{7-6.999}$ represent?

Lesson 1.1 - CA1 worksheet

4. The number of jobs created in the U.S. for the 2021 economy can be modeled by J, where $J(t)$ is number of new jobs and t is the month for $0 \leq t \leq 12$.

a. What does $J(3)$ represent?

b. What does $\frac{J(6)-J(2)}{6-2}$ represent?

c. What does $\frac{J(10)-J(9.999)}{10-9.999}$ represent?

Answers to 1.1 CA #1

1a. check graph. 1b. ≈ 400 people per hour. 1c. $\frac{L(4)-L(3.999)}{4-3.999}$		2a. check graph. 2b. ≈ 20 boar per year. 2c. $\frac{b(5)-b(4.999)}{5-4.999}$
3a. The number of new recruits in 1987.	3b. The average rate of change in number of new recruits per year from 1982 to 1987.	3c. The rate of change of new recruits per year in 1987.
4a. The number of new jobs created in March.	4b. The average rate of change in number of new jobs created per month from February to June.	4c. The rate of new jobs created per month in October of 2021.