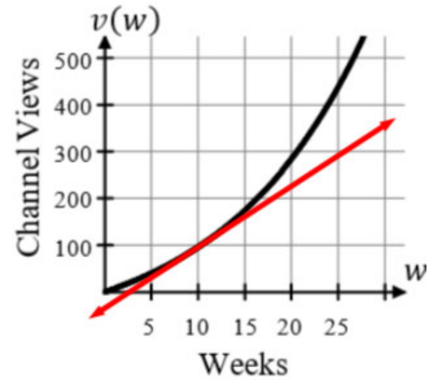
1.1 Can change occur at an instant?

Calculus

Solutions

Practice

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 $w = 5$.

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

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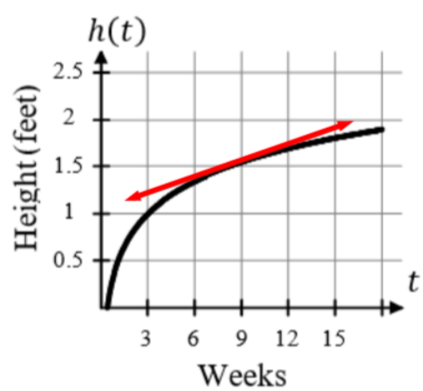
2. The height of a raspberry bush can be modeled by the function h, where $h(t)$ gives the height measured in feet and t gives the number of weeks it was planted for $0 \leq t \leq 12$. The graph of the function h is shown to the right.



   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 $t = 12$.

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

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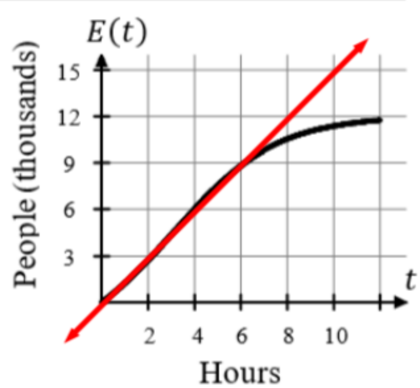
3. The number of people who have entered an amusement park is modeled by the function E, where $E(t)$ gives the number of people in thousands who have entered the park and t gives the number of hours since 10:00 a.m. for $0 \leq t \leq 11$. The graph of the function E is shown to the right.



   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 $0 \le g \le 82$.

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.

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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 $0 \le m \le 12$.

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.

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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 $0 \le t \le 50$.

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.

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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 $0 \le t \le 3600$.

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.