Unit 4.1 Interpreting Meaning of Derivative in Context

Topic Question 1

min mL

The function $t = f(A)$ models the time, in minutes, for a chemical reaction to occur as a function of the amount A of catalyst used, measured in milliliters. What are the units for $f''(A)$?

(A) minutes per milliliter

(B) milliliters per minute

(C) minutes per milliliter per milliliter

(D) milliliters per minute per minute

$$t' = f' = \frac{\text{time}}{\text{cat}} \; \frac{\text{min}}{\text{mL}}$$

$$t'' = f'' = \frac{\text{min}}{\text{mL}^2}$$

Topic Question 2 Calculator

$$Q(t) = 3e^{-0.7t}\sin\left(\tfrac{t}{3}\right) + 0.01\sin(4t) - 0.02\cos(4t)$$

The function Q defined above models the electric charge, measured in coulombs, inside a lightbulb t seconds after it is turned on. Which of the following presents the method for finding the instantaneous rate of change of the lightbulb's electric charge, in coulombs per second, at time $t = 4$?

(A) $Q''(4) = -0.213$

(B) $Q'(4) = -0.171$

(C) $\frac{Q(4) - Q(0)}{4 - 0} = 0.053$

(D) $Q(4) = 0.194$

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$$\frac{d}{dX}\left(3e^{-0.7X}\sin(X/3) + .01\sin(4X) - 0.02\cos(4X)\right)_{X=4}$$

-0.17115

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Topic Question 5 Calculator

$$D(t) = 10 + 4.9\cos\left(\frac{\pi}{6}t\right)$$

The function D defined above models the depth, in feet, of the water t hours after 12 A.M. in a certain harbor. Which of the following presents the method for finding the instantaneous rate of change of the depth of the water, in feet per hour, at 6 A.M. ?

$t=6$

(A) $\frac{D(6)-D(0)}{6-0} = -1.633$

(B) $D'(6) = 0$

(C) $D''(6) = 1.343$

(D) $D(6) = 5.100$

66%

$$\frac{d}{dX}(10 + 4.9\cos((\pi/6)X))_{X=6}$$

0

Topic Question 6

The function $t = f(S)$ models the time, in hours, for a sample of water to evaporate as a function of the size S of the sample, measured in milliliters. What are the units for $f''(S)$?

(A) hours per milliliter

(B) milliliters per hour

(C) hours per milliliter per milliliter

(D) milliliters per hour per hour

$t' = f'(S) = \frac{\text{hours}}{\text{mL}}$

$t'' = f''(S) = \frac{\text{hrs}}{\text{mL}} / \text{mL}$

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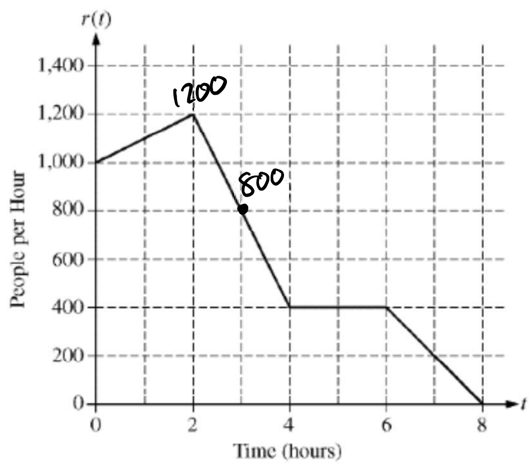
APClassroom FRQ 2 Calculator

rate



There are 700 people in line for a popular amusement-park ride when the ride begins operation in the morning. Once it begins operation, the ride accepts passengers until the park closes 8 hours later. While there is a line, people move onto the ride at a rate of 800 people per hour. The graph above shows the rate, $r(t)$, at which people arrive at the ride throughout the day. Time t is measured in hours from the time the ride begins operation.

Is the number of people waiting in line to get on the ride increasing or decreasing between t=2 and t=3? Justify your answer.

People are moving onto the ride at a rate of 800 people/hour.

People are entering line at rate of 1200 to 800 people/hour between $t=2$ and $t=3$ hours

∴ People entering line > people entering ride

∴ line is increasing.

APClassroom FRQ 5 Calculator

When a certain grocery store opens, it has 50 pounds of bananas on a display table. Customers remove bananas from the display table at a rate modeled by

$$f(t) = 10 + (0.8t)\sin\left(\frac{t^2}{100}\right) \text{ for } 0 < t \leq 12,$$ lbs/hour removal

where $f(t)$ is measured in pounds per hour and t is the number of hours after the store opened. After the store has been open for three hours, store employees add bananas to the display table at a rate modeled by

$$g(t) = 3 + 2.4\ln(t^2 + 2t) \text{ for } 3 < t \leq 12,$$ lbs/hour Add

where $g(t)$ is measured in pounds per hour and t is the number of hours after the store opened.

Find $f'(7)$. Using correct units, explain the meaning of $f(7)$ in the context of the problem.

$$\frac{d}{dX}(10 + (0.8X)\sin(X^3/100))_{X=7}$$

-8.11954

Reference Only

$f'(7) = -8.120$

Seven hours after the store has opened, the rate at which customers are removing bananas is decreasing by 8.120 lbs per hour each hour.

Unit 4.1 Interpreting Meaning of Derivative in Context

APClassroom MC 13 Calculator

A file is downloaded to a computer at a rate modeled by the differentiable function $f(t)$, where t is the time in seconds since the start of the download and $f(t)$ is measured in megabits per second. Which of the following is the best interpretation of $f'(5) = 2.8$? mb/sec/sec

(A) At time $t = 5$ seconds, the rate at which the file is downloaded to the computer is 2.8 megabits per second. (B) (C)(D)

(B) At time $t = 5$ seconds, the rate at which the file is downloaded to the computer is increasing at a rate of 2.8 megabits per second per second.

← $f(t)$ →
← $f'(t)$ →

(C) Over the time interval $0 \leq t \leq 5$ seconds, 2.8 megabits of the file are downloaded to the computer.

(D) Over the time interval $0 \leq t \leq 5$ seconds, the average rate at which the file is downloaded to the computer is 2.8 megabits per second.

APClassroom MC 14 Calculator

For $t \geq 0$ hours, H is a differentiable function of t that gives the temperature, in degrees Celsius, at an Arctic weather station. Which of the following is the best interpretation of $H'(24)$? °C/hr

(A) The change in temperature during the first day X

(B) The change in temperature during the 24th hour An hour is a long time

(C) The average rate at which the temperature changed during the 24th hour X

(D) The rate at which the temperature is changing during the first day X

(E) The rate at which the temperature is changing at the end of the 24th hour End of hour is an instant

APClassroom MC 15 Calculator

The function $P(t)$ models the population of the world, in billions of people, where t is the number of years since January 1, 2010. Which of the following is the best interpretation of the statement $P'(1) = 0.076$? billion people/year

(A) On February 1, 2010, the population of the world was increasing at a rate of 0.076 billion people per year.

(B) On January 1, 2011, the population of the world was increasing at a rate of 0.076 billion people per year.

(C) On January 1, 2011, the population of the world was 0.076 billion people.

(D) From January 1, 2010 to January 1, 2011, the population of the world was increasing at an average rate of 0.076 billion people per year.

(E) When the population of the world was 1 billion people, the population of the world was increasing at a rate of 0.076 billion people per year.

APCLASSROOM MC 16 CALCULATOR

On a certain day, the total number of pieces of candy produced by a factory since it opened is modeled by C, a differentiable function of the number of hours since the factory opened. Which of the following is the best interpretation of $C'(3) = 500$? pieces/hr

(A) The factory produces 500 pieces of candy during its 3rd hour of operation. X

(B) The factory produces 500 pieces of candy in the first 3 hours after it opens. X

(C) The factory is producing candy at a rate of 500 pieces per hour, 3 hours after it opens. ✓

(D) The rate at which the factory is producing candy is increasing at a rate of 500 pieces per hour per hour, 3 hours after it opens. X

APCLASSROOM MC 18 CALCULATOR

The number of insects in a certain population at time t days is modeled by the function P with first derivative $P'(t) = 0.3t^2 + 12t + 210$. At time $t = 0$, the number of insects in the population is 40. Which of the following statements are true?

$P(t) = 0.1t^3 + 6t^2 + 210t$ we will learn this later

I At time $t = 10$, the number of insects in the population is 2840.

II. At time $t = 10$, the number of insects in the population is increasing at a rate of 360 insects per day.

III. At time $t = 10$, the rate of change of the number of insects in the population is increasing at a rate of 18 insects per day per day.

(A) I only

(B) II only

(C) III only

(D) I, II, and III

$Y_1 = 0.3X^2 + 12X + 210$

$Y_2 = 0.1X^3 + 6X^2 + 210X$

$\frac{d}{dX}(Y_1)_{X=10}$

18.00023

$Y_1(10)$

360

$Y_2(10)$

2800

APCLASSROOM MC 19 CALCULATOR

The rate at which water leaks from a tank, in gallons per hour, is modeled by R, a differentiable function of the number of hours after the leak is discovered. Which of the following is the best interpretation of $R'(3)$? gallons/hour / hour

(A) The amount of water, in gallons, that has leaked out of the tank during the first three hours after the leak is discovered

(B) The amount of change, in gallons per hour, in the rate at which water is leaking during the three hours after the leak is discovered

(C) The rate at which water leaks from the tank, in gallons per hour, three hours after the leak is discovered

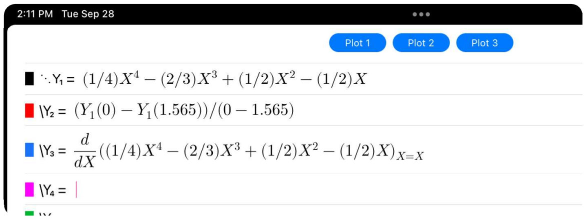
(D) The rate of change of the rate at which water leaks from the tank, in gallons per hour per hour, three hours after the leak is discovered

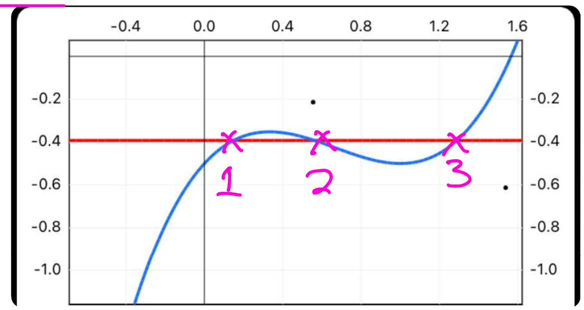
Unit 4.1 Interpreting Meaning of Derivative in Context

APClassroom MC 50 Calculator

Let f be the function defined by $f(x) = \frac{1}{4}x^4 - \frac{2}{3}x^3 + \frac{1}{2}x^2 - \frac{1}{2}x$. For how many values of x in the open interval $(0, 1.565)$ is the instantaneous rate of change of f equal to the average rate of change of f on the closed interval $[0, 1.565]$?

=





Ⓐ Zero

Ⓑ One

Ⓒ Three

Ⓓ Four

APClassroom FRQ 74 Calculator

The wind chill is the temperature, in degrees Fahrenheit (°F), a human feels based on the air temperature, in degrees Fahrenheit, and the wind velocity v, in miles per hour (mph). If the air temperature is 32 °F, then the wind chill is given by $W(v)=55.6-22.1v^{0.16}$ and is valid for $5 \le v \le 60$.

Find $W'(20)$. Using correct units, explain the meaning of $W'(20)$ in terms of the wind chill.

$w'(20) = -0.286$ °F/mph

when the wind velocity is 20 mph, the wind chill is decreasing at a rate of .286°F per mph.