LESSON MAKER PRO

Tangent Line Snapshots

Use derivatives to find instant-by-instant change.

HIGH SCHOOL · MA.912.C.2.2

MA.912.C.2.2 "Interpret the derivative as an instantaneous rate of change or as the slope of the tangent line."

NAME _____ DATE _____

INSTANTANEOUS CHANGE

At x = a, the derivative f'(a) gives the instantaneous rate of change of f. It is also the slope of the tangent line to the graph at x = a. Find the derivative first, then substitute the given input.

WORKED EXAMPLE

For f(x) = 11x - 13, find the slope of the tangent line at x = 17.

1. f'(x) = 11.
2. Evaluate at the given input: f'(17) = 11.
3. The derivative value is the tangent-line slope.

Answer: 11

PRACTICE 6 problems

1 For $p(x) = x^2 - 8x + 9$, find p'(3).

ANSWER _____

2 For $g(x) = 9x^3 - 2x^2 + 8x$, find the slope of the tangent line at x = 5.

ANSWER _____

3 For $h(x) = x^5 - 8x$, find h'(2).

ANSWER _____

4 Find the equation of the tangent line to $k(x) = x^2 + 8x - 5$ at x = 2.

ANSWER _____

5 A cyclist's distance d(t), in meters, from a checkpoint has d'(8) = -5, where t is time in seconds. Interpret this derivative value.

ANSWER _____

6 For $r(x) = x^2 - 12x$, find the x-value where the tangent line is horizontal.

ANSWER _____

APPLY IT Show your work

1 A student in a drone club models a drone's height, in meters, by $h(t) = 5t^2 + 8t$, where t is time in seconds. Find the drone's instantaneous vertical velocity at $t = 6$.

WORK SPACE

ANSWER

2 A laptop's battery percentage is modeled by $B(t) = 100 - 2t^2$, where t is hours after it is unplugged and $0 \le t \le 7$. Find and interpret the instantaneous rate of change at $t = 6$.

WORK SPACE

ANSWER

CHALLENGE One step up

Use the limit definition of the derivative to find the slope of the tangent line to $f(x) = x^2 + 2x$ at $x = 3$. Simplify $[f(3 + h) - f(3)]/h$, then explain why its value as h approaches 0 is the instantaneous slope.

WORK SPACE AND ANSWER

ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	For $p(x) = x^2 - 8x + 9$, find $p'(3)$.	**-2**
2	For $g(x) = 9x^3 - 2x^2 + 8x$, find the slope of the tangent line at $x = 5$.	**663**
3	For $h(x) = x^5 - 8x$, find $h'(2)$.	**72**
4	Find the equation of the tangent line to $k(x) = x^2 + 8x - 5$ at $x = 2$.	**y = 12x - 9**
5	A cyclist's distance d(t), in meters, from a checkpoint has d'(8) = -5, where t is time in seconds. Interpret this derivative value.	**At t = 8 seconds, the cyclist's distance from the checkpoint is decreasing at 5 meters per second.**
6	For $r(x) = x^2 - 12x$, find the x-value where the tangent line is horizontal.	**x = 6**

PART 2 · APPLY IT

1. **68 meters per second upward** Differentiate to get h'(t) = 10t + 8. Then h'(6) = 68, so the height is increasing at 68 meters per second.
2. **-24 percentage points per hour; at t = 6 hours, the battery percentage is decreasing at 24 percentage points per hour.** B'(t) = -4t. Evaluating gives B'(6) = -24, and the negative sign indicates a decrease.

CHALLENGE

[f(3 + h) - f(3)]/h = h + 8. As h approaches 0, h + 8 approaches 8, so the slope of the tangent line at x = 3 is 8.

Accept equivalent tangent-line forms such as y - 15 = 12(x - 2). Accept equivalent verbal interpretations that include both the rate and whether the quantity is increasing or decreasing.