LESSON MAKER PRO

Change Over Time

Find and interpret average rates of change

HIGH SCHOOL · ATM.F.31

ATM.F.31 "Write a function that describes a relationship between two quantities; and be able to calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval..."

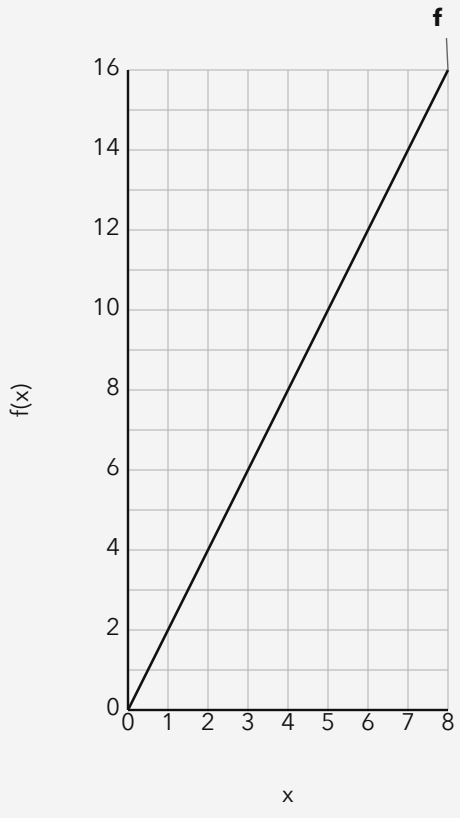
NAME _____ DATE _____

THE BIG IDEA

To find an average rate of change, divide the change in output by the change in input. On a graph, read or estimate the outputs at the ends of the interval. A negative rate means the output decreased as the input increased.

WORKED EXAMPLE

Use the graph to find the average rate of change of f from x = 2 to x = 6.



1. Read the outputs: f(2) = 4 and f(6) = 12.
2. Find the change in output: 12 - 4 = 8.
3. Find the change in input: 6 - 2 = 4.
4. Divide: 8/4 = 2.

Answer: 2 output units per input unit

PRACTICE 6 problems

1 Find the average rate of change of $f(x) = 3x + 4$ from $x = 0$ to $x = 4$.

ANSWER _____

2 Find the average rate of change of $g(x) = x^2 - 2x$ from $x = -1$ to $x = 3$.

ANSWER _____

3 Use the table to find the average rate of change from $x = 0$ to $x = 6$.

VALUES OF F

x	f(x)
0	14
2	11
4	7
6	2

ANSWER _____

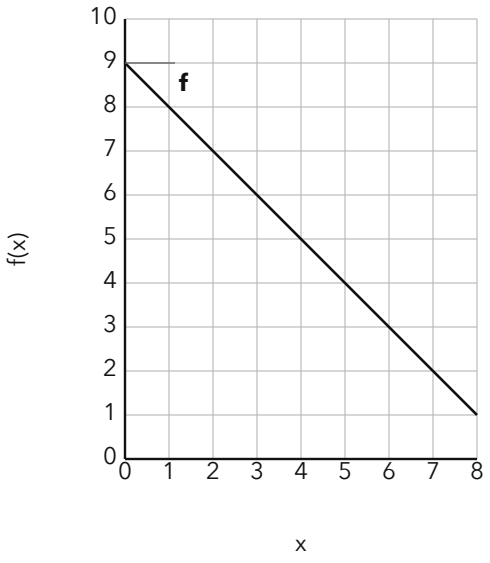
4 Use the table to find the average rate of change from $x = -2$ to $x = 2$.

VALUES OF H

x	h(x)
-2	9
0	5
2	3
4	9

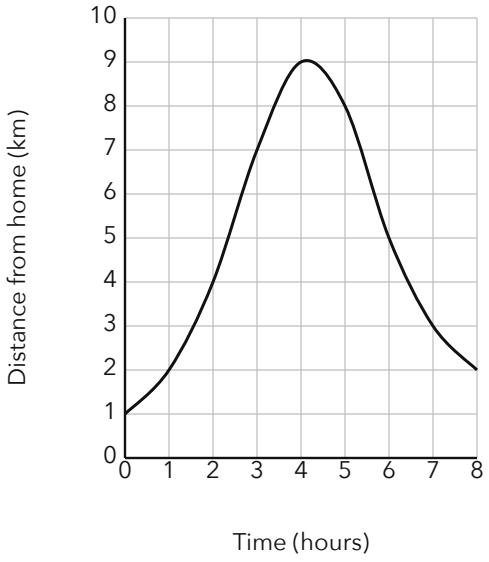
ANSWER _____

5 Use the graph to find the average rate of change of f from $x = 2$ to $x = 7$.



ANSWER _____

6 Use the graph to estimate the average rate of change in distance from home from hour 1 to hour 6.



ANSWER _____

APPLY IT Show your work

1 A student tracks the number of followers on a video channel. Use the table to find the average rate of change from week 2 to week 6. What does your answer mean?

CHANNEL FOLLOWERS

Week	Followers
0	120
2	170
4	260
6	330

ANSWER _____

2 A phone's battery level is modeled by B(t) = 90 - 12t, where t is hours of use and B(t) is the battery percentage. Find the average rate of change from t = 1 to t = 5. What does the sign tell you?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A function's average rate of change is 4 from x = 0 to x = 3 and -2 from x = 3 to x = 9. Find its average rate of change from x = 0 to x = 9. Explain why averaging 4 and -2 does not give the answer.

WORK SPACE AND ANSWER

ANSWER KEY

Change Over Time

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Find the average rate of change of $f(x) = 3x + 4$ from $x = 0$ to $x = 4$.	**3**
2	Find the average rate of change of $g(x) = x^2 - 2x$ from $x = -1$ to $x = 3$.	**0**
3	Use the table to find the average rate of change from $x = 0$ to $x = 6$.	**-2**
4	Use the table to find the average rate of change from $x = -2$ to $x = 2$.	**-3/2**
5	Use the graph to find the average rate of change of f from $x = 2$ to $x = 7$.	**-1**
6	Use the graph to estimate the average rate of change in distance from home from hour 1 to hour 6.	**About 3/5 km per hour**

PART 2 · APPLY IT

1. **40 followers per week. The channel gained an average of 40 followers per week from week 2 to week 6.** Subtract the follower counts, then divide by the elapsed time: (330 - 170)/(6 - 2) = 40.
2. **-12 percentage points per hour. The negative sign means the battery level decreased.** B(1) = 78 and B(5) = 30, so the average rate is (30 - 78)/(5 - 1) = -12 percentage points per hour.

CHALLENGE

0. The output changes by 4(3) = 12 over the first interval and -2(6) = -12 over the second, for a total change of 0. Averaging the two rates gives the wrong answer because the intervals have different lengths.

Accept equivalent fractions or decimals. For the curved graph, accept a reasonable estimate near 0.6 km per hour.