MATHEMATICS · GRADES 10-12

Average rate of change

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you measure how fast something changed on average. Your average speed on a drive, or how quickly a plant grew over a month, are both average rates of change. It is an average, so it smooths out the fast and slow bits, and it tells you the overall trend rather than what happened at one moment.



Rule

$$\text{Average rate of change} = \frac{f(b) - f(a)}{b - a}.$$

It is the average speed of the change over the interval, and on a graph it is the slope of the line joining the two points.

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Worked examples

EXAMPLE 1

Q Find the average rate of change of $f(x) = x^2$ from $x = 1$ to $x = 3$

SOLUTION

Find the function values: $f(1) = 1$ and $f(3) = 9$.

Find the change in y and the change in x: $9 - 1 = 8$ and $3 - 1 = 2$.

Divide: $\frac{8}{2} = 4$, so the average rate of change is 4.

EXAMPLE 2

Q Find the average rate of change of $f(x) = 2x + 1$ from $x = 0$ to $x = 2$

SOLUTION

Find the function values: $f(0) = 1$ and $f(2) = 5$.

Find the changes: $5 - 1 = 4$ and $2 - 0 = 2$.

Divide: $\frac{4}{2} = 2$, so the average rate of change is 2.

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Practice questions

1. A rocket's height is $f(x) = x^2$ metres after x seconds. Find the average rate of change from $x = 0$ to $x = 2$

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2. A ball's height is $f(x) = x^2$. Find the average rate of change from $x = 2$ to $x = 4$

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3. A taxi charges $f(x) = 3x$ dollars for x km. Find the average rate of change from $x = 1$ to $x = 5$

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4 A plant's height is $f(x) = x^2$ cm after x weeks. Find the average rate of change from $x = 1$ to $x = 2$

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5 A phone plan costs $f(x) = 5x + 2$ dollars for x GB. Find the average rate of change from $x = 0$ to $x = 3$

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6 A car travels from 0 km at hour 0 to 120 km at hour 2. What is its average speed in km per hour?

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7 A runner's distance function has average rate of change 4 from $x = 1$ to $x = 5$. If $f(1) = 3$, what is $f(5)$?

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8 The average rate of change of $f(x) = 3x$ is the same on every interval. Why?

A. Because it is a curve that gets steeper as x grows

B. Because the slope is 0

C. Because it is a straight line with slope 3

D. Because the slope changes on every interval

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9 Use the table to find the average rate of change from x = 1 to x = 3

Height of a plant, f(x) cm after x weeks

x	f(x)
0	0
1	3
2	8
3	15

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10 Which of these average rates of change is NOT 2:

A $f(x) = x^2$ from x = 0 to x = 2

B f(x) = 2x from x = 1 to x = 3

C $f(x) = x^2$ from x = 2 to x = 3

D f(x) = 2x from x = 0 to x = 5

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ANSWER KEY

1. 2

2. 6

3. 3

4. 3

5. 5

6. 60

7. 19

8. Because it is a straight line with slope 3

9. 6

10. $f(x) = x^2$ from $x = 2$ to $x = 3$

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