

Rate Change Lab

Build and evaluate difference quotients.

HIGH SCHOOL • MA.912.F.1.4

MA.912.F.1.4 "Write an algebraic expression that represents the difference quotient of a function. Calculate the numerical value of the difference quotient at a given pair of points."

NAME _____

DATE _____

THE BIG IDEA

A difference quotient compares the change in output to the change in input: $[f(b)-f(a)]/(b-a)$. To write a general difference quotient, use $[f(x+h)-f(x)]/h$, substitute carefully, and simplify.

WORKED EXAMPLE

For $g(x) = 8x - 17$, write and simplify the difference quotient.

1. Start with $[g(x+h)-g(x)]/h$.
2. Substitute: $[(8(x+h)-17)-(8x-17)]/h$.
3. Simplify the numerator: $(8x+8h-17-8x+17)/h = 8h/h$.
4. Simplify: $8h/h = 8$.

Answer: 8

PRACTICE 6 problems

- 1** For $f(x) = 3x + 4$, write the difference quotient $[f(x+h)-f(x)]/h$. Do not simplify.

ANSWER _____

- 2** For $p(x) = x^2 - 6x$, write and simplify $[p(x+h)-p(x)]/h$.

ANSWER _____

- 3** For $q(x) = x^2 + 9$, calculate the difference quotient from $x = 1$ to $x = 4$.

ANSWER _____

- 4** For $r(x) = x^2 - 3x + 1$, calculate the difference quotient from $x = -1$ to $x = 2$.

ANSWER _____

- 5** For $s(x) = x^3 + 2x$, write and simplify $[s(x+h)-s(x)]/h$.

ANSWER _____

- 6** A function has points $(-4, 7)$ and $(2, -5)$. Calculate the difference quotient between these points.

ANSWER _____

APPLY IT Show your work

- 1** A student tracks followers on a video channel. The follower function $F(d)$ has $F(3) = 270$ and $F(9) = 414$, where d is days after posting. Write and calculate the difference quotient from day 3 to day 9.

WORK SPACE

ANSWER _____

- 2** A gaming app models a player's points after t rounds with $P(t) = t^2 + 6t$. Calculate the difference quotient from $t = 1$ to $t = 5$.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

For $k(x) = x^2 - 4x + 7$, find $[k(x+3)-k(x)]/3$. Then explain why your result depends on x .

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	For $f(x) = 3x + 4$, write the difference quotient $[f(x+h)-f(x)]/h$. Do not simplify.	$[(3(x+h)+4)-(3x+4)]/h$
2	For $p(x) = x^2 - 6x$, write and simplify $[p(x+h)-p(x)]/h$.	$2x + h - 6$
3	For $q(x) = x^2 + 9$, calculate the difference quotient from $x = 1$ to $x = 4$.	5
4	For $r(x) = x^2 - 3x + 1$, calculate the difference quotient from $x = -1$ to $x = 2$.	-2
5	For $s(x) = x^3 + 2x$, write and simplify $[s(x+h)-s(x)]/h$.	$3x^2 + 3xh + h^2 + 2$
6	A function has points $(-4, 7)$ and $(2, -5)$. Calculate the difference quotient between these points.	-2

PART 2 · APPLY IT

- 24 followers per day** Use $[F(9)-F(3)]/(9-3) = (414-270)/6 = 24$. The channel gained an average of 24 followers per day.
- 12 points per round** Find $P(5) = 55$ and $P(1) = 7$. Then $[P(5)-P(1)]/(5-1) = (55-7)/4 = 12$.

CHALLENGE

$2x - 1$. It depends on x because the function is quadratic, so its rate of change changes at different x -values.

Accept equivalent forms of the algebraic difference quotients, including reordered terms. For numerical problems, accept equivalent fraction forms before simplification.