

Derivative Rule Quest

Use derivative rules to analyze changing quantities.

HIGH SCHOOL • MA.912.C.2.3

MA.912.C.2.3 "Prove the rules for finding derivatives of constants, sums, products, quotients and the Chain Rule."

NAME _____

DATE _____

DERIVATIVE RULES

Constants differentiate to 0, and you can differentiate each term in a sum or difference separately. For a product use $u'v + uv'$, for a quotient use $(u'v - uv')/v^2$, and for a composite function multiply by the derivative of the inside.

WORKED EXAMPLE

Find d/dx of $y = (13x + 17)(x + 5)$.

1. Let $u = 13x + 17$ and $v = x + 5$.
2. Apply the product rule: $y' = 13(x + 5) + (13x + 17)$.
3. Combine like terms: $y' = 26x + 82$.

Answer: $26x + 82$

PRACTICE 6 problems

1 Find d/dx of $y = 8$.

ANSWER _____

2 Find d/dx of $y = 6x^7 - 9x^4 + 11x$.

ANSWER _____

3 Find d/dx of $y = (6x^3 - 8)(x^4 + 12)$.

ANSWER _____

4 Find d/dx of $y = (x^7 + 6)/x^3$.

ANSWER _____

5 Find d/dx of $y = (4x^3 - 6)^8$.

ANSWER _____

6 Find d/dx of $y = 9x^4 + (3x^2 + 8)^7$.

ANSWER _____

APPLY IT Show your work

- 1** The esports club models the number of live viewers, in hundreds, x hours after a tournament stream begins by $V(x)=(x+6)(x^2+8)$. Find the instantaneous rate that viewers are joining at $x=3$. Give your answer in viewers per hour.

WORK SPACE

ANSWER _____

- 2** A fitness app models a challenge score by $S(x)=(x^2+7)^3$, where x is the number of workout sessions. Treat x as continuous. Find the instantaneous change in score at $x=3$.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Assume f and g are differentiable. Use the limit definition of a derivative and limit laws to prove that $\frac{d}{dx}[f(x)+g(x)]=f'(x)+g'(x)$.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Find d/dx of $y=8$.	0
2	Find d/dx of $y=6x^7-9x^4+11x$.	$42x^6-36x^3+11$
3	Find d/dx of $y=(6x^3-8)(x^4+12)$.	$18x^2(x^4+12)+(6x^3-8)(4x^3)$
4	Find d/dx of $y=(x^7+6)/x^3$.	$[7x^6(x^3)-(x^7+6)(3x^2)]/x^6$
5	Find d/dx of $y=(4x^3-6)^8$.	$96x^2(4x^3-6)^7$
6	Find d/dx of $y=9x^4+(3x^2+8)^7$.	$36x^3+42x(3x^2+8)^6$

PART 2 • APPLY IT

- 7,100 viewers per hour** Use the product rule: $V'(x)=(x^2+8)+2x(x+6)$. At $x=3$, $V'(3)=71$ hundred viewers per hour, which is 7,100 viewers per hour.
- 4,608 points per session** Use the Chain Rule: $S'(x)=6x(x^2+7)^2$. At $x=3$, $S'(3)=18(16)^2=4,608$ points per session.

CHALLENGE

$$\lim_{h \rightarrow 0} \{[f(x+h)+g(x+h)]-[f(x)+g(x)]\}/h = \lim_{h \rightarrow 0} \{[f(x+h)-f(x)]/h + [g(x+h)-g(x)]/h\} = \lim_{h \rightarrow 0} [f(x+h)-f(x)]/h + \lim_{h \rightarrow 0} [g(x+h)-g(x)]/h = f'(x)+g'(x).$$

Accept algebraically equivalent derivatives, including correct unsimplified product-rule and quotient-rule forms. For the quotient problem, the derivative is valid for x not equal to 0.