

Name: _____

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QUICK REFERENCE

Power Rule

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

Product Rule

$$(fg)' = f'g + fg'$$

Quotient Rule

$$\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$$

Chain Rule

Outer derivative $\times$ inner derivative

LEVEL 1 · DERIVATIVE MEANING AND BASIC RULES

1 DERIVATIVE MEANING

If $f'(3) = 7$, what does the number 7 represent?Choices: The value $f(3)$ The slope of the tangent line at $x = 3$ The x -intercept

2 CONSTANT RULE

Differentiate:

$$f(x) = 12$$

3 POWER RULE

Differentiate:

$$f(x) = x^6$$

LEVEL 2 · POLYNOMIALS AND POWERS

4 POLYNOMIAL

Differentiate:

$$f(x) = 4x^5 - 3x^3 + 7x - 9$$

5 NEGATIVE EXPONENT

Differentiate:

$$f(x) = x^{-3}$$

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LEVEL 2 · POLYNOMIALS AND POWERS

6 RADICAL

Differentiate:

$$f(x) = \sqrt{x}$$

LEVEL 3 · PRODUCT AND QUOTIENT RULES

7 PRODUCT RULE

Differentiate:

$$y = x^2(x^3 + 1)$$

8 PRODUCT RULE

Differentiate:

$$y = x^3 \sin x$$

9 QUOTIENT RULE

Differentiate:

$$y = \frac{x^2 + 1}{x}$$

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LEVEL 4 · CHAIN RULE AND TRIG DERIVATIVES

10 CHAIN RULE

Differentiate:

$$y = (3x^2 + 1)^5$$

11 TRIG DERIVATIVE

Differentiate:

$$y = 4 \sin x - 3 \cos x$$

12 TRIG + CHAIN RULE

Differentiate:

$$y = \sin(4x^2)$$

13 CHAIN RULE

Differentiate:

$$y = \cos(5x)$$

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LEVEL 5 · TANGENT LINES AND MIXED REVIEW

14 TANGENT SLOPE

For

$$f(x) = x^2$$

find the slope of the tangent line at $x = 3$.

15 TANGENT LINE

Find the equation of the tangent line to

$$f(x) = x^2$$

at $x = 2$.

16 DIFFERENTIABILITY

Consider

$$f(x) = |x|.$$

Does $f'(0)$ exist?Choices: Yes, $f'(0) = 0$ Yes, $f'(0) = 1$ No, $f'(0)$ does not exist

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Use the solutions to check your method and reasoning.

1 DERIVATIVE MEANING

A derivative at a point is an instantaneous rate of change; geometrically it is a tangent-line slope.

Answer: The tangent-line slope at $x = 3$ is 7.**2 CONSTANT RULE**A constant does not change as x changes.

$$\frac{d}{dx}(12) = 0.$$

Answer: $f'(x) = 0$ **3 POWER RULE**

Apply the power rule.

$$\frac{d}{dx}(x^6) = 6x^5.$$

Answer: $f'(x) = 6x^5$ **4 POLYNOMIAL**

Differentiate each term:

$$20x^4 - 9x^2 + 7 - 0.$$

Answer: $f'(x) = 20x^4 - 9x^2 + 7$ **5 NEGATIVE EXPONENT**

Apply the power rule, then rewrite with positive exponents.

$$f'(x) = -3x^{-4} = -\frac{3}{x^4}.$$

Answer: $f'(x) = -\frac{3}{x^4}$ **6 RADICAL**Rewrite $\sqrt{x} = x^{1/2}$.

$$f'(x) = \frac{1}{2}x^{-1/2} = \frac{1}{2\sqrt{x}}.$$

Answer: $f'(x) = \frac{1}{2\sqrt{x}}$ **7 PRODUCT RULE**Use $(fg)' = f'g + fg'$.

$$y' = (2x)(x^3 + 1) + x^2(3x^2) = 5x^4 + 2x.$$

Answer: $y' = 5x^4 + 2x$ **8 PRODUCT RULE**

Differentiate one factor at a time.

$$y' = 3x^2 \sin x + x^3 \cos x.$$

Answer: $y' = 3x^2 \sin x + x^3 \cos x$

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Use the solutions to check your method and reasoning.

9 QUOTIENT RULE

Use the quotient rule.

$$y' = \frac{(2x)(x) - (x^2 + 1)}{x^2} = \frac{x^2 - 1}{x^2}.$$

Answer: $y' = \frac{x^2 - 1}{x^2}$

10 CHAIN RULE

Differentiate the outside, then multiply by the derivative of the inside.

$$y' = 5(3x^2 + 1)^4(6x) = 30x(3x^2 + 1)^4.$$

Answer: $y' = 30x(3x^2 + 1)^4$

11 TRIG DERIVATIVEUse $(\sin x)' = \cos x$ and $(\cos x)' = -\sin x$.

$$y' = 4 \cos x + 3 \sin x.$$

Answer: $y' = 4 \cos x + 3 \sin x$

12 TRIG + CHAIN RULEDifferentiate sine, then multiply by the derivative of $4x^2$.

$$y' = 8x \cos(4x^2).$$

Answer: $y' = 8x \cos(4x^2)$

13 CHAIN RULEDifferentiate cosine, then multiply by the derivative of $5x$.

$$y' = -5 \sin(5x).$$

Answer: $y' = -5 \sin(5x)$

14 TANGENT SLOPEFirst $f'(x) = 2x$. Then evaluate at $x = 3$.

$$f'(3) = 6.$$

Answer: $m = 6$

15 TANGENT LINEHere $f'(2) = 4$ and $f(2) = 4$. Use point-slope form.

$$y - 4 = 4(x - 2) \Rightarrow y = 4x - 4.$$

Answer: $y = 4x - 4$

16 DIFFERENTIABILITYFor $f(x) = |x|$, the left-hand slope at 0 is -1 and the right-hand slope is 1 .

Since the one-sided slopes disagree, the derivative does not exist.

Answer: No. $f'(0)$ does not exist.