

Differentiation ... The Chain Rule

... Set 3

Practice- Chain Rule

Differentiate each function with respect to x .

1) $f(x) = (4x^3 - 5)^4$

2) $f(x) = (-x^5 + 5)^4$

3) $y = (x^4 + 3)^2$

4) $y = (2x^2 + 5)^4$

5) $f(x) = (2x^4 + 3)^{\frac{1}{2}}$

6) $f(x) = (-5x^3 + 2)^{-5}$

7) $y = (-x^3 - 2)^{\frac{1}{2}}$

8) $f(x) = (4x^4 + 3)^{-5}$

9) $f(x) = \sqrt{5x + 4}$

10) $y = (5x^3 + 3)^5$

11) $y = (5x^3 - 3)^3$

12) $y = (-5x^4 + 3)^4$

13) $f(x) = \cos 2x^2$

14) $f(x) = \cos 4x^3$

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Answers

Answers to Practice- Chain Rule

- 1) $f'(x) = 4(4x^3 - 5)^3 \cdot 12x^2$ 2) $f'(x) = 4(-x^5 + 5)^3 \cdot -5x^4$ 3) $\frac{dy}{dx} = 2(x^4 + 3) \cdot 4x^3$
- 4) $\frac{dy}{dx} = 4(2x^2 + 5)^3 \cdot 4x$ 5) $f'(x) = \frac{1}{2}(2x^4 + 3)^{-\frac{1}{2}} \cdot 8x^3$
- 6) $f'(x) = -5(-5x^3 + 2)^{-6} \cdot -15x^2$ 7) $\frac{dy}{dx} = \frac{1}{2}(-x^3 - 2)^{-\frac{1}{2}} \cdot -3x^2$
- 8) $f'(x) = -5(4x^4 + 3)^{-6} \cdot 16x^3$ 9) $f'(x) = \frac{1}{2}(5x + 4)^{-\frac{1}{2}} \cdot 5$ 10) $\frac{dy}{dx} = 5(5x^3 + 3)^4 \cdot 15x^2$
- 11) $\frac{dy}{dx} = 3(5x^3 - 3)^2 \cdot 15x^2$ 12) $\frac{dy}{dx} = 4(-5x^4 + 3)^3 \cdot -20x^3$ 13) $f'(x) = -\sin 2x^2 \cdot 4x$
 $= -4x \sin 2x^2$
- 14) $f'(x) = -\sin 4x^3 \cdot 12x^2$
 $= -12x^2 \sin 4x^3$

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Practice- Chain Rule

Differentiate each function with respect to x .

15) $y = \sin 4x^4$

16) $y = \cos 4x^5$

17) $f(x) = \tan 3x^3$

18) $f(x) = \tan 4x^4$

19) $y = \sec x^2$

20) $y = \csc 5x^2$

21) $f(x) = \sin(\sin x^3)$

22) $y = \sin(\cos 5x^5)$

23) $y = e^{x^3}$

24) $y = \ln 2x^5$

25) $y = \ln x^4$

26) $y = e^{x^5}$

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$$\begin{array}{ll} 15) \frac{dy}{dx} = \cos 4x^4 \cdot 16x^3 & 16) \frac{dy}{dx} = -\sin 4x^5 \cdot 20x^4 \\ & = -20x^4 \sin 4x^5 \\ 17) f'(x) = \sec^2 3x^3 \cdot 9x^2 & 18) f'(x) = \sec^2 4x^4 \cdot 16x^3 \\ & = 16x^3 \sec^2 4x^4 \\ & = 9x^2 \sec^2 3x^3 \\ 19) \frac{dy}{dx} = \sec x^2 \tan x^2 \cdot 2x \\ & = 2x \sec x^2 \tan x^2 \\ 20) \frac{dy}{dx} = -\csc 5x^2 \cot 5x^2 \cdot 10x & 21) f'(x) = \cos(\sin x^3) \cdot \cos x^3 \cdot 3x^2 \\ & = -10x \csc 5x^2 \cot 5x^2 \\ & = 3x^2 \cos(\sin x^3) \cos x^3 \\ 22) \frac{dy}{dx} = \cos(\cos 5x^5) \cdot -\sin 5x^5 \cdot 25x^4 & 23) \frac{dy}{dx} = e^{x^3} \cdot 3x^2 \\ & = -25x^4 \cos(\cos 5x^5) \sin 5x^5 \\ 24) \frac{dy}{dx} = \frac{1}{2x^5} \cdot 10x^4 \\ & = \frac{5}{x} \\ 25) \frac{dy}{dx} = \frac{1}{x^4} \cdot 4x^3 & 26) \frac{dy}{dx} = e^{x^5} \cdot 5x^4 \\ & = \frac{4}{x} \end{array}$$

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For each problem, you are given a table containing some values of differentiable functions $f(x)$, $g(x)$ and their derivatives. Use the table data and the rules of differentiation to solve each problem.

27)

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	2	2	1	1
2	4	$\frac{1}{2}$	2	1
3	3	-1	3	1
4	2	-1	4	1

Part 1) Given $h_1(x) = (f(x))^2$, find $h_1'(3)$

Part 2) Given $h_2(x) = f(g(x))$, find $h_2'(1)$

28)

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	1	1	4	-2
2	2	$\frac{3}{2}$	2	$-\frac{3}{2}$
3	4	$\frac{1}{2}$	1	$\frac{1}{2}$
4	3	-1	3	2

Part 1) Given $h_1(x) = (f(x))^2$, find $h_1'(1)$

Part 2) Given $h_2(x) = f(g(x))$, find $h_2'(1)$

29)

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	2	1	1	2
2	3	1	3	$\frac{3}{2}$
3	4	0	4	$-\frac{1}{2}$
4	3	-1	2	-2

Part 1) Given $h_1(x) = (f(x))^2$, find $h_1'(2)$

Part 2) Given $h_2(x) = f(g(x))$, find $h_2'(4)$

30)

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	2	2	1	2
2	4	0	3	$\frac{3}{2}$
3	2	$-\frac{3}{2}$	4	$-\frac{1}{2}$
4	1	-1	2	-2

Part 1) Given $h_1(x) = (f(x))^2$, find $h_1'(2)$

Part 2) Given $h_2(x) = f(g(x))$, find $h_2'(2)$

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Answers

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$$27) \begin{aligned} h_1'(3) &= -6 \\ h_2'(1) &= 2 \end{aligned}$$

$$28) \begin{aligned} h_1'(1) &= 2 \\ h_2'(1) &= 2 \end{aligned}$$

$$29) \begin{aligned} &= \frac{4}{x} \\ h_1'(2) &= 6 \\ h_2'(4) &= -2 \end{aligned}$$

$$30) \begin{aligned} h_1'(2) &= 0 \\ h_2'(2) &= -\frac{9}{4} \end{aligned}$$