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

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

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

Chain Rule (… set 2)

Answers

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) $f'(x) = -\sin 4x^3 \cdot 12x^2$
$= -12x^2\sin 4x^3$

15) $\frac{dy}{dx} = \cos 4x^4 \cdot 16x^3$
$= 16x^3\cos 4x^4$

16) $\frac{dy}{dx} = -\sin 4x^5 \cdot 20x^4$
$= -20x^4\sin 4x^5$

Chain Rule (… set 2)

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

Chain Rule (… set 2)

Answers

17) $f'(x) = \sec^2 3x^3 \cdot 9x^2$
$= 9x^2 \sec^2 3x^3$

18) $f'(x) = \sec^2 4x^4 \cdot 16x^3$
$= 16x^3 \sec^2 4x^4$

19) $\frac{dy}{dx} = \sec x^2 \tan x^2 \cdot 2x$
$= 2x \sec x^2 \tan x^2$

20) $\frac{dy}{dx} = -\csc 5x^2 \cot 5x^2 \cdot 10x$
$= -10x \csc 5x^2 \cot 5x^2$

21) $f'(x) = \cos(\sin x^3) \cdot \cos x^3 \cdot 3x^2$
$= 3x^2 \cos(\sin x^3) \cos x^3$

22) $\frac{dy}{dx} = \cos(\cos 5x^5) \cdot -\sin 5x^5 \cdot 25x^4$
$= -25x^4 \cos(\cos 5x^5) \sin 5x^5$

23) $\frac{dy}{dx} = e^{x^3} \cdot 3x^2$

24) $\frac{dy}{dx} = \frac{1}{2x^5} \cdot 10x^4$
$= \frac{5}{x}$

25) $\frac{dy}{dx} = \frac{1}{x^4} \cdot 4x^3$
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26) $\frac{dy}{dx} = e^{x^5} \cdot 5x^4$

Chain Rule (… set 2)

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 $h_2'(2)$

Answers

27) $h_1'(3) = -6$
$h_2'(1) = 2$

28) $h_1'(1) = 2$
$h_2'(1) = 2$

29) $h_1'(2) = 6$
$h_2'(4) = -2$

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