



Solutions

The Chain Rule

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Q1) a) $f(x) = (x + 4)^3$
 $f'(x) = 3(x + 4)^2$

b) $f(x) = 3(x + 1)^5$
 $f'(x) = 15(x + 1)^4$

c) $f(x) = (x - 2)^{-3}$
 $f'(x) = -3(x - 2)^{-4}$

Q2) a) $f(x) = (3x + 2)^3$
 $f'(x) = 3(3x + 2)^2 \cdot 3$
 $= 9(3x + 2)^2$

c) $f(x) = (4x - 3)^{-2}$
 $f'(x) = -2(4x - 3)^{-3} \cdot 4$
 $= -8(4x - 3)^{-3}$

e) $y = \left(\frac{1}{2}x + 3\right)^4$
 $\frac{dy}{dx} = 4\left(\frac{1}{2}x + 3\right)^3 \cdot \frac{1}{2}$
 $= 2\left(\frac{1}{2}x + 3\right)^3$

d) $f(x) = 4(x + 2)^{-2}$
 $f'(x) = -8(x + 2)^{-3}$

e) $f(x) = 5 + (x - 2)^4$
 $f'(x) = 4(x - 2)^3$

f) $f(x) = 6x^2 - 2(x - 4)^3$
 $f'(x) = 12x - 6(x - 4)^2$

b) $y = 2(2x - 5)^6$
 $\frac{dy}{dx} = 12(2x - 5)^5 \cdot 2$
 $= 24(2x - 5)^5$

d) $g(x) = 2(1 - 3x)^2$
 $g'(x) = 4(1 - 3x) \cdot -3$
 $= -12(1 - 3x)$

f) $f(x) = 3x - 4(3 - 2x)^{-2}$
 $f'(x) = 3 + 8(3 - 2x)^{-3}$



$$\begin{aligned}\text{Q3) a) } f(x) &= (4x - 4)^{\frac{1}{2}} \\ f'(x) &= \frac{1}{2}(4x - 4)^{-\frac{1}{2}} \cdot 4 \\ &= 2(4x - 4)^{-\frac{1}{2}}\end{aligned}$$

$$\begin{aligned}\text{c) } g(x) &= \sqrt{(2 - 4x)^3} \\ &= (2 - 4x)^{\frac{3}{2}} \\ g'(x) &= \frac{3}{2}(2 - 4x)^{\frac{1}{2}} \cdot -4 \\ &= -6(2 - 4x)^{\frac{1}{2}}\end{aligned}$$

$$\begin{aligned}\text{Q4) a) } f(x) &= \frac{1}{(x + 2)^3} \\ &= (x + 2)^{-3} \\ f'(x) &= -3(x + 2)^{-4}\end{aligned}$$

$$\begin{aligned}\text{c) } y &= \frac{1}{4(x - 3)} \\ &= \frac{1}{4}(x - 3)^{-1} \\ \frac{dy}{dx} &= -\frac{1}{4}(x - 3)^{-2}\end{aligned}$$

$$\begin{aligned}\text{b) } f(x) &= 3(2x + 5)^{-\frac{1}{3}} \\ f'(x) &= -(2x + 5)^{-\frac{4}{3}} \cdot 2 \\ &= -2(2x + 5)^{-\frac{4}{3}}\end{aligned}$$

$$\begin{aligned}\text{d) } h(x) &= \sqrt[4]{\left(\frac{1}{2}x^2 - 5\right)^3} \\ &= \left(\frac{1}{2}x^2 - 5\right)^{\frac{3}{4}} \\ h'(x) &= \frac{3}{4}\left(\frac{1}{2}x^2 - 5\right)^{-\frac{1}{4}} \cdot x \\ &= \frac{3}{4}x\left(\frac{1}{2}x^2 - 5\right)^{-\frac{1}{4}}\end{aligned}$$

$$\begin{aligned}\text{b) } g(x) &= \frac{3}{x - 2} \\ &= 3(x - 2)^{-1} \\ g'(x) &= -3(x - 2)^{-2}\end{aligned}$$

$$\begin{aligned}\text{d) } f(x) &= \sqrt{(2x + 3)} = (2x + 3)^{\frac{1}{2}} \\ f'(x) &= \frac{1}{2}(2x + 3)^{-\frac{1}{2}} \cdot 2 \\ &= (2x + 3)^{-\frac{1}{2}}\end{aligned}$$