10-23

Do Now

Find the derivative of the function

$f(x) = \left(\frac{3}{3-x}\right)^2$

$f'(x) = 2\left(\frac{3}{3-x}\right)^1 \cdot \frac{\cancel{(3-x)(0)} - 3(-1)}{(3-x)^2}$

$= 2\left(\frac{3}{3-x}\right) \cdot \frac{3}{(3-x)^2}$

$= \frac{18}{(3-x)^3}$

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HW Solutions

Find the derivative of the function.

1. $y = (3x-2)^4$

$y' = 4(3x-2)^3(3)$

$y' = 12(3x-2)^3$

2. $f(x) = 5(2-x^2)^3$

$f'(x) = 15(2-x^2)^2(-2x)$

$f'(x) = -30x(2-x^2)^2$

3. $y = (6+3x)^{2/3}$

$y' = \frac{2}{3}(6+3x)^{-1/3}(3)$

$y' = \frac{2}{\sqrt[3]{6+3x}}$

4. $f(x) = \sqrt{x+3}$

$f'(x) = \frac{1}{2}(x+3)^{-1/2}(1)$

$f'(x) = \frac{1}{2\sqrt{x+3}}$

5. $g(x) = \sqrt[3]{x^2-9}$

$g'(x) = \frac{1}{3}(x^2-9)^{-2/3}(2x)$

$g'(x) = \frac{2x}{3\sqrt[3]{(x^2-9)^2}}$

6. $y = \frac{-2}{(x^2-3x-4)^2}$

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

$y' = \frac{4(2x-3)}{(x^2-3x-4)^3}$

$y = -2(x^2-3x-4)^{-2}$

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

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The Derivative of the Natural Exponential Function:

Let u be a differentiable function of x.

1. $\frac{d}{dx}[e^x] = e^x$

2. $\frac{d}{dx}[e^u] = e^u \frac{du}{dx} = e^u \cdot u'$

EX #1: Find the derivative.

A.) $f(x) = e^{-x^2}$

$f'(x) = e^{-x^2} \cdot (-2x)$

$= -2xe^{-x^2}$

B.) $f(x) = e^{-\frac{3}{x}}$

$f'(x) = e^{-\frac{3}{x}} \cdot 3x^{-2}$

$f'(x) = \frac{3}{x^2}e^{-3/x}$

$-\frac{3}{x} \to -3x^{-1}$

C.) $f(x) = e^{2x-1}$

$f'(x) = e^{2x-1} \cdot 2$

$= 2e^{2x-1}$

D.) $f(x) = xe^x$

$f'(x) = xe^x + e^x(1)$

$f'(x) = e^x(x+1)$

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DERIVATIVE OF THE NATURAL LOGARITHMIC FUNCTION:

1. $\frac{d}{dx}[\ln x] = \frac{1}{x}, x > 0$

2. $\frac{d}{dx}[\ln u] = \frac{1}{u}\frac{du}{dx} = \frac{u'}{u}, \quad u > 0$

If u is a differentiable function of x such that $u \neq 0$, then

3. $\frac{d}{dx}[\ln|u|] = \frac{u'}{u}$

$y = \ln 5x$

$y' = \frac{5}{5x} \to \frac{1}{x}$

Find the derivative of the function.

A.) $y = \ln(\overset{u}{x^2+2})$

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

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

$\frac{u'}{u}$

B.) $y = \ln\sqrt{x^2-9}$

$y' = \frac{\frac{1}{2}(x^2-9)^{-\frac{1}{2}} \cdot 2x}{\sqrt{x^2-9}}$

$(x^2-9)^{\frac{1}{2}}$

$\frac{1}{2}(x^2-9)^{-\frac{1}{2}} \cdot 2x$

$y' = \frac{x(x^2-9)^{-\frac{1}{2}}}{\sqrt{x^2-9}}$

$y' = \frac{x}{\sqrt{x^2-9} \cdot \sqrt{x^2-9}}$

$y' = \frac{x}{x^2-9}$

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Practice

① $y = e^{2x^2-5x}$

$y' = e^{2x^2-5x} \cdot 4x-5$

$= (4x-5)e^{2x^2-5x}$

② $y = \ln x^2$

$y' = \frac{2x}{x^2} = \frac{2}{x}$

③ $y = e^{2x}\ln 3x$

$y' = e^{2x} \cdot \frac{3}{3x} + \ln 3x \cdot 2e^{2x}$

$y' = \frac{1}{x}e^{2x} + 2e^{2x}\ln 3x$

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