DO NOW

Find the derivative of:

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

$y = u^5 \qquad u = x^2 + x$

$\frac{dy}{du} = 5u^4 \qquad \frac{du}{dx} = 2x + 1$

$\frac{dy}{du} = 5(x^2+x)^4$

$\frac{dy}{dx} = 5(x^2+x)^4(2x+1)$

$\frac{dy}{dx} = (10x+5)(x^2+x)^4$

3.4 The Chain Rule - Day 2

Recall:

$\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$

derivative of outer function · derivative of inner function

The General Power Rule:

If $y = [u(x)]^n$, where u is a differentiable function of x and n is a rational number, then:

$\frac{dy}{dx} = n[u(x)]^{n-1} \cdot u'(x)$

OR

$y' = n u^{n-1} \cdot u'$

Examples - without 'u' substitution:

1. $y = (2x - 5)^3$

$y' = 3(2x-5)^2 \cdot 2$

$y' = 6(2x-5)^2$

2. $f(x) = \sqrt{3 - 2x}$

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

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

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

3. $y = \frac{2}{3x+1}$

$y = 2(3x+1)^{-1}$

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

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

4. $y = \sqrt[3]{(x^2 - 1)^2}$

$y = (x^2-1)^{2/3}$

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

$y' = \frac{4x}{3\sqrt[3]{x^2-1}}$

$y' = \frac{4x}{3(x^2-1)^{1/3}}$

5. $y = \sqrt[3]{3x^2 - x + 1}$

$y = (3x^2 - x + 1)^{1/3}$

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

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

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

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6. $y = \sqrt{\frac{2x + 1}{x}}$

$y = \left(\frac{2x+1}{x}\right)^{1/2}$

$y' = \frac{1}{2}\left(\frac{2x+1}{x}\right)^{-\frac{1}{2}} \frac{d}{dx}\left[\frac{2x+1}{x}\right]$

$y' = \frac{1}{2}\left(\frac{2x+1}{x}\right)^{-1/2} \cdot \left[\frac{x(2) - (2x+1)(1)}{x^2}\right]$

$y' = \frac{1}{2}\left(\frac{x}{2x+1}\right)^{1/2} \cdot \left[\frac{x(2) - (2x+1)}{x^2}\right]$

$y' = \frac{1}{2}\left(\frac{x}{2x+1}\right)^{1/2} \cdot \left[\frac{2x - 2x - 1}{x^2}\right]$

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

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

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

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7. $y = x(3x - 9)^3$

$y' = x\frac{d}{dx}\left[(3x-9)^3\right] + (3x-9)^3\frac{d}{dx}[x]$

$y' = x \cdot 3(3x-9)^2(3) + (3x-9)^3(1)$

$y' = 9x(3x-9)^2 + (3x-9)^3$

$y' = (3x-9)^2(9x + 3x - 9)$

$y' = (3x-9)^2(12x-9)$

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