AP Calculus Extra Practice - "The Chain Rule"

Find the equation for the derivative of the following functions. Then verify your answer by graphing both the numerical derivative (nDeriv) and your equation for the derivative.

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

2. $y=\left(\sqrt{x^3+3}\right)^3$

3. $y=\sin(x^3+4x^2)$

4. $y=\cos(3x^2+4)^5$

5. $y=\cos^3\sqrt{(x^2+4x)}$

6. $y = \sin(x^3)$

7. $y = \cos^2(x^4)$

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

9. $f(x) = \tan(x^2 + 3)\cos(x^2 + 3)$

10. $f(x) = (x^2 + \sin(x^3 + 4x))^{50}$

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Chain Rule Practice
Answers

1. $5(x^2+3x)^4 \cdot (2x+3) = y'$ ✓

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

$y' = \frac{9x^2\sqrt{x^3+3}}{2}$ ✓

3. $y' = \cos(x^3+4x^2)(3x^2+8x)$ $y' = (3x^2+8x)\cos(x^3+4x^2)$ ✓

4. $y' = [\sin(3x^2+4)^5] \cdot 5(3x^2+4)^4 \cdot 6x$

Wide variation with $\sin$ ✓

$y' = -30x \cdot \sin(3x^2+4)^5 (3x^2+4)^4$ $= -30x(3x^2+4)^4 \sin(3x^2+4)^5$

5. $y = (\cos\sqrt{x^2+4x})^3$ $y' = 3(\cos\sqrt{x^2+4x})^2 \cdot -\sin(\sqrt{x^2+4x}) \cdot \frac{1}{2}(x^2+4x)^{-\frac{1}{2}}(2x+4)$

$y' = \frac{-3 \cdot \cos^2\sqrt{x^2+4x} \cdot \sin\sqrt{x^2+4x} \cdot (2x+4)}{2\sqrt{x^2+4x}}$ ✓

6. $y' = 3x^2\cos(x^3)$ ✓

7. $y = (\cos x^4)^2$ ✓ $y' = 2\cos(x^4) \cdot (-\sin x^4) \cdot 4x^3$

$y' = -8x^3\cos(x^4) \cdot \sin(x^4)$ ✓

8. $-4(x^2+3x+2)^{-5} \cdot (2x+3) = y'$

$\frac{-8x-12}{(x^2+3x+2)^5} = f'(x)$ ✓

9. $y = \sin(x^2+3)$

$f'(x) = 2x\cos(x^2+3)$ ✓

10. $f'(x) = 50(x^2+\sin(x^3+4x))^{49} \cdot (2x+\cos(x^3+4x)(3x^2+4))$

$= 50(x^2+\sin(x^3+4x))^{49}(2x+\cos(x^3+4x)(3x^2+4))$

$f'(x) = 50(x^2+\sin(x^3+4x))^{49}(2x+(3x^2+4)\cos(x^3+4x))$ ✓