AP Calculus AB

Higher Order Derivatives

1) $y = \frac{x^4}{4} + \frac{5}{6}x^3 - x^2 + 9x - 1$

$y' = x^3 + \frac{5}{2}x^2 - 2x + 9$

$y'' = 3x^2 + 5x - 2$

$y''' = 6x + 5$

$y^{(iv)} = 6$

2) $y = -7x^5 - 9$

$y' = -35x^4$

$y'' = -140x^3$

3) $f(x) = 9x^{-3} - \frac{7}{x}$

$f'(x) = -27x^{-4} + 7x^{-2}$

$f''(x) = 108x^{-5} - 14x^{-3}$

4) $y = (3 + 5x^{-1})^3$

$\frac{dy}{dx} = 3(3 + 5x^{-1})^2 \cdot (-5x^{-2})$

$\frac{d^2y}{dx^2} = 3(3+5x^{-1})^2(10x^{-3}) + (-5x^{-2})\left[6(3+5x^{-1})(-5x^{-2})\right]$

$= 30x^{-3}(3+5x^{-1})^2 + 150x^{-4}(3 + 5x^{-1})$

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

$y' = x\left[4(3x+2)^3(3)\right] + (3x+2)^4$

simplify before finding y''

$y' = 12x(3x+2)^3 + (3x+2)^4$

$= (3x+2)^3\left[12x + 3x + 2\right]$

$= (3x+2)^3(15x+2)$

$y'' = (3x+2)^3(15) + (15x+2)\left[3(3x+2)^2(3)\right]$

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

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

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

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

$f''(x) = \frac{(x+1)^2(2x+2) - (x^2+2x-2)\left[2(x+1)\right]}{(x+1)^4}$

7) $f(x) = x^3 - 9x + 3 \quad (3,3)$

point	slope
$(3,3)$	$f'(x) = 3x^2 - 9$
	$f'(3) = 18$

$y - 3 = 18(x - 3)$

8) $f(x) = 4x^3 + 6x^2 - 72x + 18$

$f'(x) = 12x^2 + 12x - 72 = 0$

$x^2 + x - 6 = 0$

$(x+3)(x-2) = 0$

$x = -3 \quad x = 2$

$(-3, 180) \quad (2, -70)$

9) $\frac{d}{dx}\left(f(g(3x^9))\right)$

$f'(g(3x^9)) \cdot g'(3x^9) \cdot (27x^8)$