Product Rule

To find $P'(x)$ when $P(x) = f(x) \cdot g(x)$

$$P'(x) = f'(x) \cdot g(x) + f(x) \cdot g'(x)$$

ex) $y = (3x-4)(x^2+6x-7)$

$y' = 3(x^2+6x-7) + (3x-4)(2x+6)$ ...

ex) $y = (3x+4)^{10}(2x-1)^8$

$= 10(3x+4)^9(3)(2x-1)^8 + (3x+4)^{10}\,8(2x-1)^7(2)$

$= 30(3x+4)^9(2x-1)^8 + 16(3x+4)^{10}(2x-1)^7$

ex) $y = 3x^2\sqrt{x^2+4x} = 3x^2(x^2+4x)^{1/2}$

$= 6x(x^2+4x)^{1/2} + \frac{1}{2}(x^2+4x)^{-1/2}(2x+4)(3x^2)$

$= 6x\sqrt{x^2+4x} + \frac{3x^2(2x+4)}{2\sqrt{x^2+4x}}$

If $P(x) = f(x) \cdot g(x) \cdot h(x)$

$$P'(x) = f'(x)g(x)h(x) + f(x)g'(x)h(x) + f(x)g(x)h'(x)$$

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

$$\frac{dy}{dx} = 3(x^2-4)(2x-x^2) + (3x+1)(2x)(2x-x^2) + (3x+1)(x^2-4)(2-2x)$$

Quotient Rule

To find $Q'(x)$ when $Q(x) = \frac{N(x)}{D(x)}$

$$Q'(x) = \frac{N'(x)D(x) - N(x)D'(x)}{D(x)^2}$$

ex) $y = \frac{x^2}{5x^2-1}$

$$y' = \frac{2x(5x^2-1) - x^2(10x)}{(5x^2-1)^2} \ldots$$

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

$$y = \frac{3(2x+1)^2(2)(3x^2-6)^4 - (2x+1)^3 4(3x^2-6)^3(6x)}{(3x^2-6)^{8}5}$$

$$y = \frac{6(2x+1)^2(3x^2-6) - 24x(2x+1)^3}{(3x^2-6)^5}$$

ex) $y = \frac{(2x+1)^3(2x)}{\sqrt{x^2+5x}}$

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$$y' = \frac{\left[3(2x+1)^2(2)(2x) + (2x+1)^3(2)\right]\sqrt{x^2+5x} - (2x+1)^3(2x)\frac{1}{2}(x^2+5x)^{-1/2}(2x+5)}{\sqrt{x^2+5x}^2}$$

$$= \frac{\left[12x(2x+1)^2 + 2(2x+1)^3\right]\sqrt{x^2+5x} - (2x+1)^3 x(x^2+5x)^{-1/2}(2x+5)}{x^2+5x}$$