

Rules of Differentiation. (Week 2)

$$\frac{d}{dx}(c f(x)) = c f'(x)$$

Constant
Multiple

$$\frac{d}{dx}(c) = 0$$

derivative of a
constant is zero

$$\frac{d}{dx}(f(x) + g(x)) = f'(x) + g'(x)$$

Sum Rule

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

Power Rule,
for all real numbers n

$$\frac{d}{dx}(f(x)g(x)) = f'(x)g(x) + f(x)g'(x)$$

Product Rule

$$\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$$

Quotient
Rule

$$\frac{d}{dx}(f(x) - g(x)) = f'(x) - g'(x)$$

Sum Rule
(subtraction)

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(e^{cx}) = ce^{cx}$$

for any constant c .

$$\frac{d}{dx}(\sin(x)) = \cos(x), \quad \frac{d}{dx}(\cos(x)) = -\sin(x)$$

Derivatives

Find the derivative of $f(x)$:

① $f(x) = x^2$

② $f(x) = 5x^2 + 1$

③ $f(x) = 1 - x^2$

④ $f(x) = x + 2$

⑤ $f(x) = 3x^8 - 5x - 2$

⑥ $f(x) = 5 - x$

⑦ $f(x) = e^x$

⑧ $f(x) = x^2 + e^2$

⑨ $f(x) = 1 - e^x - 2x^7 + \pi$

⑩ $f(x) = (x+1)(2x^2 - 3)$

⑪ $f(x) = \sqrt{x}$

⑫ $f(x) = \frac{3x^2 + 1}{\sqrt{x}}$

⑬ $f(x) = \frac{\sqrt{x}}{3x^2 + 1}$

⑭ $f(x) = \frac{1+x}{x^{2/3}}$

⑮ $f(x) = ax^2 + bx + c$
 a, b, c are constants

⑯ $f(x) = 7x^2(x+1)e^x$

⑰ $f(x) = \pi^2 e^x + 1$

⑱ $f(x) = \pi^2 e^{\pi x}$

⑲ $f(x) = x^2 e^{-3x}$

⑳ $f(x) = \sqrt[3]{x} e^{5x}$

㉑ $f(x) = \cos(x)$

㉒ $f(x) = e^x \sin(x)$

㉓ $f(x) = \frac{1+x}{\sin(x)}$

㉔ $f(x) = x^8 e^{2x} \cos(x)$

㉕ $f(x) = \frac{x-2}{x^2+3}$

More Derivative Problems

- ① Find the equation of the tangent line to the graph of $f(x) = \frac{1}{\sqrt{x}}$ when $x=3$.
- ② Calculate $g'(0)$ for $g(x) = 5e^{2x}$.
- ③ Calculate $h''(1)$ for $h(x) = 2xe^{-x}$.
- ④ Find the equation of the tangent line to the graph of $C(x) = x \sin(x)$ at $x=\pi$.
- ⑤ How many tangent lines exist for $f(x) = x^2 + 1$ that pass through the point $(-1, -2)$?
- ⑥ Find the third derivative of the function $f(x) = 3x^2 - \pi x + e^{2x} - \cos(x)$.
- ⑦ Calculate $f'(x)$ for $f(x) = \sqrt{x-5}$ using the limit definition of the derivative.

