

$$1. f(x) = 3x^2 - \ln(x) + e^x + 5x - 2 \implies f'(x) = 6x - \frac{1}{x} + e^x + 5$$

$$2. f(x) = \sqrt{x} + \frac{2}{x} - 3x^5 \implies f(x) = x^{1/2} + 2x^{-1} - 3x^5 \implies \\ f'(x) = \frac{1}{2}x^{-1/2} - 2x^{-2} - 15x^4$$

$$3. y = x^3 e^x \implies y' = 3x^2 e^x + x^3 e^x$$

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

$$5. y = (\ln(x) + 2x - 7)^4 \implies y' = 4(\ln(x) + 2x - 7)^3 \left(\frac{1}{x} + 2 \right)$$

$$6. f(x) = \ln\left(\frac{x^2 - 2}{e^{3x}}\right) \implies f(x) = \ln(x^2 - 2) - \ln(e^{3x}) \implies \\ f(x) = \ln(x^2 - 2) - 3x \implies f'(x) = \frac{2x}{x^2 - 2} - 3$$

$$7. y = \ln(4x^3(x^2 + 1)) \implies y = \ln(4) + \ln(x^3) + \ln(x^2 + 1) \implies \\ y = \ln(4) + 3\ln(x) + \ln(x^2 + 1) \implies y' = \frac{3}{x} + \frac{2x}{x^2 + 1}$$

$$8. f(x) = \frac{\sqrt{x}}{x^3} + e^{-2x + \ln(3x)} \implies f(x) = x^{1/2} x^{-3} + e^{-2x} e^{\ln(3x)} \implies \\ f(x) = x^{-5/2} + e^{-2x} 3x \implies f'(x) = -\frac{5}{2}x^{-7/2} + e^{-2x}(-2)3x + e^{-2x}3 \implies \\ f'(x) = -\frac{5}{2}x^{-7/2} - 6xe^{-2x} + 3e^{-2x}$$

$$9. f(x) = \ln(\sqrt{x^3 - x} + e^{5x}) \implies f(x) = \ln((x^3 - x)^{1/2} + e^{5x}) \implies \\ f'(x) = \frac{1}{(x^3 - x)^{1/2} + e^{5x}} \left(\frac{1}{2}(x^3 - x)^{-1/2}(3x^2 - 1) + e^{5x}5 \right)$$

$$10. y = e^{e^x} \implies y' = e^{e^x} e^x e^x$$

$$11. y = x^3 \ln(x + 3)e^{-x} \implies y' = 3x^2 \ln(x + 3)e^{-x} + x^3 \frac{1}{x + 3} e^{-x} + x^3 \ln(x + 3)e^{-x}(-1)$$

$$12. f(x) = \frac{\ln(3x + 2)}{e^x + x} \implies f'(x) = \frac{\frac{3}{3x+2}(e^x + x) - \ln(3x + 2)(e^x + 1)}{(e^x + x)^2}$$

$$13. y = \ln(\sqrt{x}e^{x^2-2x}) \implies y = \ln(x^{1/2}) + \ln(e^{x^2-2x}) \implies y = \frac{1}{2}\ln(x) + x^2 - 2x \implies \\ y' = \frac{1}{2x} + 2x - 2$$

$$14. f(x) = (\ln(e^x + 1))^4 \implies f'(x) = 4(\ln(e^x + 1))^3 \frac{1}{e^x + 1} e^x$$

Find an equation for the line tangent to $y = f(x)$ at the given point.

- $y = x^2$ at $x = 2$.

Notice that $y' = 2x$. The slope of the tangent of $y = x^2$ at $x = 2$ is

$$y'|_{x=2} = 2x|_{x=2} = 2(2) = 4. \text{ If } x = 2, \text{ then } y = 2^2 = 4.$$

Using point slope: $y - 4 = 4(x - 2)$.

The equation of the tangent is $y = 4x - 4$.

- $y = \ln(x)$ at $x = 1$.

Notice that $y' = 1/x$. The slope of the tangent of $y = \ln(x)$ at $x = 1$ is

$$y'|_{x=1} = \frac{1}{x}|_{x=1} = \frac{1}{1} = 1. \text{ If } x = 1, \text{ then } y = \ln(1) = 0.$$

Using point slope: $y - 0 = 1(x - 1)$.

The equation of the tangent is $y = x - 1$.

- $y = e^x$ at $x = 0$.

Notice that $y' = e^x$. The slope of the tangent of $y = e^x$ at $x = 0$ is

$$y'|_{x=0} = e^x|_{x=0} = e^0 = 1. \text{ If } x = 0, \text{ then } y = e^0 = 1. \text{ Using point slope: } y - 1 = 1(x - 0).$$

The equation of the tangent is $y = x + 1$.

- $y = \sqrt{x} = x^{1/2}$ at $x = 9$.

Notice that $y' = (1/2)x^{-1/2}$. The slope of the tangent of $y = x^{1/2}$ at $x = 9$ is

$$y'|_{x=9} = (1/2)x^{-1/2}|_{x=9} = \frac{1}{2\sqrt{9}} = \frac{1}{6}. \text{ If } x = 9, \text{ then } y = \sqrt{9} = 3.$$

Using point slope: $y - 3 = (1/6)(x - 3)$.

The equation of the tangent is $y = \frac{1}{6}x + \frac{3}{2}$.