

$$\textcircled{1} \quad y = \ln\left(\frac{x}{x+1}\right) \quad \left\{ \begin{array}{l} 5.1, 5.4 \\ \#1-9 \end{array} \right.$$

$$y = \ln x - \ln(x+1)$$

$$y' = \frac{1}{x} - \frac{1}{x+1}$$

$$\frac{x+1-x}{x^2+x}$$

$$\textcircled{2} \quad y = \ln \sqrt{\frac{x-1}{x+1}}$$

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

$$y' = \frac{1}{2} \cdot \frac{1}{x-1} - \frac{1}{2} \cdot \frac{1}{x+1}$$

$$y' = \frac{1}{2} \left(\frac{1}{x-1} - \frac{1}{x+1} \right)$$

$$\text{or } y' = \frac{1}{x^2-1}$$

$$\textcircled{3} \quad y = \ln(\ln x)$$

$$y' = \frac{1}{\ln x} \cdot \frac{1}{x} = \frac{1}{x \ln x}$$

$$\textcircled{4} \quad \ln(xy) + 5x = 30$$

$$\ln x + \ln y + 5x = 30$$

$$\frac{1}{x} + \frac{1}{y} \cdot \frac{dy}{dx} + 5 = 0$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = -5 - \frac{1}{x}$$

$$\frac{dy}{dx} = y \left(-5 - \frac{1}{x} \right)$$

$$\textcircled{5} \quad y = e^{4x^2-6}$$

$$y' = e^{4x^2-6} \cdot 8x$$

$$\textcircled{6} \quad y = e^{-3x^{-1}}$$

$$y' = e^{-3/x} \cdot 3x^{-2} = \frac{3e^{-3/x}}{x^2}$$

$$\textcircled{7} \quad y = x \ln x$$

$$y' = x \cdot \frac{1}{x} + \ln x \cdot 1$$

$$y' = 1 + \ln x = 0$$

$$\ln x = -1$$

$$x = e^{-1} = \frac{1}{e}$$

$$y = \frac{1}{e} \cdot \ln \frac{1}{e}$$

$$y = \frac{1}{e} \cdot -1 = -\frac{1}{e}$$

Rel Extrema: $\left(\frac{1}{e}, -\frac{1}{e}\right)$

$$y'' = \frac{1}{x} = 0$$

$$x = \emptyset$$

No POI

$$\textcircled{8} \quad y = e^{3x} \cdot \ln x \quad (1, 0)$$

$$y' = e^{3x} \cdot \frac{1}{x} + \ln x \cdot 3e^{3x}$$

$$y'(1) = e^3 \cdot 1 + \ln 1 \cdot 3e^3$$

$$y'(1) = e^3 + 0$$

$$y'(1) = e^3$$

tan line:

$$y - 0 = e^3(x - 1)$$

$$y = e^3(x - 1)$$

$$\textcircled{9} \quad y = \frac{(x+1)(x+2)}{(x-1)(x-2)}$$

$$\ln y = \ln \left(\frac{(x+1)(x+2)}{(x-1)(x-2)} \right)$$

$$\ln y = \ln(x+1) + \ln(x+2) - \ln(x-1) - \ln(x-2)$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{x+1} + \frac{1}{x+2} - \frac{1}{x-1} - \frac{1}{x-2}$$

$$\frac{dy}{dx} = y \left(\frac{1}{x+1} + \frac{1}{x+2} - \frac{1}{x-1} - \frac{1}{x-2} \right)$$

$$\frac{dy}{dx} = \frac{(x+1)(x+2)}{(x-1)(x-2)} \cdot \left(\frac{1}{x+1} + \frac{1}{x+2} - \frac{1}{x-1} - \frac{1}{x-2} \right)$$