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① $f(x) = \tan(\ln(x))$ chain rule

$$\Rightarrow f'(x) = \boxed{\sec^2(\ln(x)) \left(\frac{1}{x}\right)}$$

② $f(x) = x^4 e^{x^{-1/2}}$ product rule

$$\Rightarrow f'(x) = \boxed{(x^4)(e^{x^{-1/2}}(-\frac{1}{2}x^{-3/2})) + (e^{x^{-1/2}})(4x^3)}$$

③ $f(x) = \frac{x + \ln(x)}{e^x - 1}$ quotient rule

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

④ $f(x) = e^{(\sin(x))}$

$$\Rightarrow f'(x) = \boxed{e^{(\sin(x))} (\cos(x))}$$

⑤ $f(x) = \ln(\sqrt[4]{x^3 + 1})$

rewrite

$$= \ln(x^3 + 1)^{1/4}$$

$$= \frac{1}{4} \ln(x^3 + 1)$$

$$\Rightarrow f'(x) = \boxed{\frac{1}{4} \cdot \frac{1}{x^3 + 1} \cdot (3x^2)} \quad \text{or} \quad \boxed{\frac{1}{4} \cdot \frac{3x^2}{x^3 + 1}}$$

⑥ $f(x) = x^3 \ln(x^2 + 2)$ product rule

$$\Rightarrow f'(x) = \boxed{(x^3)\left(\frac{1}{x^2 + 2}(2x)\right) + \ln(x^2 + 2)(3x^2)}$$

⑦ $f(x) = \ln(\ln(x^2))$ chain rule twice

$$\Rightarrow f'(x) = \boxed{\frac{1}{\ln(x^2)} \left(\frac{1}{x^2}(2x)\right)}$$

$$\textcircled{8} \quad f(x) = \ln(x^3) e^{\sqrt{1-3x}}$$

$$= 3 \ln(x) \cdot e^{(1-3x)^{1/2}}$$

$$\Rightarrow f'(x) = \left[(3 \ln(x)) \left(e^{(1-3x)^{1/2}} \left(\frac{1}{2} (1-3x)^{-1/2} (-3) \right) \right) + \left(e^{(1-3x)^{1/2}} \right) \left(3 \left(\frac{1}{x} \right) \right) \right]$$

$$\textcircled{9} \quad f(x) = \frac{e^{(4x)} + x^2}{\sec(x) + \ln(x)}$$

$$\Rightarrow f'(x) = \frac{(\sec(x) + \ln(x)) (e^{4x} (4) + 2x) - (e^{4x} + x^2) (\sec(x) \tan(x) + \frac{1}{x})}{\sec(x) \ln(x)^2}$$

$$\textcircled{10} \quad f(x) = \ln(\sec(x))$$

$$\Rightarrow f'(x) = \frac{1}{\sec(x)} \cdot (\sec(x) \tan(x))$$

$$\textcircled{11} \quad f(x) = 5x \sin^{-1}(x)$$

$$\Rightarrow f'(x) = \left[(5x) \left(\frac{1}{\sqrt{1-x^2}} \right) + (\sin^{-1}(x)) (5) \right]$$

$$\textcircled{12} \quad f(x) = \frac{\tan^{-1}(x^2)}{x^2 + x}$$

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

$$\textcircled{13} \quad f(x) = \sec^{-1}(2x^3)$$

$$\Rightarrow f'(x) = \frac{1}{|2x^3| \sqrt{(2x^3)^2 - 1}} (6x^2)$$

$$\textcircled{14} \quad f(x) = \ln(\tan^{-1}(x))$$

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