$\boxed{556.}$ $y = e^{2x}$

$$\frac{dy}{dx} = e^{2x} \cdot 2 = \boxed{2e^{2x}}$$

$\boxed{558.}$ $y = \underline{x^2}_{f}\,\underline{e^x}_{g}$ $f' = 2x$

$g' = e^x$

$$\frac{dy}{dx} = 2xe^x + x^2 \cdot e^x$$

$$\boxed{xe^x(2+x)}$$

560. $y = 8^{2x}$

$y' = 8^{2x} \cdot \ln(8) \cdot 2$

$(2^3)^{2x} \cdot 2^1 \cdot \ln(8)$

$2^{6x} \cdot 2^1 \cdot \ln(8)$

$y' = 2^{6x+1} \cdot \ln(8)$

568. $y = \ln(\sin(x))$

$y' = \frac{1}{\sin(x)} \cdot \cos(x)$

$y' = \frac{\cos(x)}{\sin(x)}$

$y' = \cot(x)$

570. $y = \log_3(1+x)$

$y' = \frac{1}{(1+x)\ln 3} \cdot 1$

$y' = \frac{1}{(1+x)\ln 3}$

589. $g(x) = \underset{f}{3^{2x}} \cdot \underset{g}{2^{3x^2}}$ product rule

$f = 3^{2x}$

$f' = 3^{2x} \cdot \ln 3 \cdot 2$

$2\ln 3 \cdot 3^{2x}$

$\ln 3^2 \cdot 3^{2x}$

$\ln 9 \cdot 3^{2x}$

$g = 2^{3x^2}$

$g' = 2^{3x^2} \cdot \ln 2 \cdot 6x$

$6x \cdot \ln 2 \cdot 2^{3x^2}$

$f'g + fg'$

$\ln 9 \cdot 3^{2x} \cdot 2^{3x^2} + 3^{2x} \cdot 6x \cdot \ln 2 \cdot 2^{3x^2}$

factor out

$3^{2x} \cdot 2^{3x^2} \cdot (\ln 9 + 6x \ln 2)$

$\boxed{562.}$ $y = 2^{\sin(x)}$

$y' = 2^{\sin(x)} \cdot \ln 2 \cdot \cos(x)$

$y' \ \ln 2 \cdot \cos(x) \cdot 2^{\sin(x)}$

$\boxed{564.}$ $y = \dfrac{e^{5x}}{x^2} \begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $\quad f' = 5e^{5x}$, $\quad g' = 2x$

$\dfrac{5e^{5x} \cdot x^2 - e^{5x} \cdot 2x}{x^4} = \dfrac{\cancel{x}e^{5x}(5x - 2)}{\cancel{x^4}3}$

$\dfrac{e^{5x}(5x-2)}{x^3}$

$\boxed{566.}$ $y = \ln(2 - x^2)$

$\dfrac{dy}{dx} = \dfrac{1}{2-x^2} \cdot -2x = \dfrac{-2x}{2-x^2}$

$\boxed{572.}$ $y = \underset{f}{x}\underset{g}{\ln(x)} - x$ $\quad f' = 1$, $\quad g' = \frac{1}{x}$

$y' = 1 \cdot \ln(x) + \cancel{x} \cdot \frac{1}{\cancel{x}} - 1$

$\ln(x) + \cancel{1} \cancel{-1} \Rightarrow \ln(x)$

$\boxed{576.}$ $g(x) = \ln(e^x + 1)$

$g'(x) = \dfrac{1}{e^x+1} \cdot e^x$

$= \dfrac{e^x}{e^x+1} \overset{\text{or...}}{\Rightarrow} \dfrac{1}{(1 + \frac{1}{e^x})}$

$\boxed{580.}$ $D(x) = \ln(\ln(x))$

$D'(x) = \dfrac{1}{\ln(x)} \cdot \dfrac{1}{x} \Rightarrow \dfrac{1}{x\ln(x)}$

$\boxed{582.}$ $g(x) = \ln((3x-2)^{1/5})$

$g'(x) = \dfrac{1}{\sqrt[5]{3x-2}} \cdot \dfrac{1}{5}(3x-2)^{-4/5} \cdot 3$

$\dfrac{1 \cdot 1 \cdot 3}{5 \cdot (3x-2)^{1/5}(3x-2)^{4/5}} \Rightarrow \dfrac{3}{5 \cdot (3x-2)^{5/5}}$

$\dfrac{3}{5(3x-2)^1}$

$\boxed{586.}$ $J(x) = \dfrac{e^x}{x^3} \begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $\quad f' = e^x \quad g' = 3x^2$

$$J'(x) = \frac{e^x \cdot x^3 - e^x \cdot 3x^2}{(x^3)^2} \Rightarrow \frac{x^3 e^x - 3x^2 \cdot e^x}{x^6} \Rightarrow \frac{\cancel{x^2} e^x (x-3)}{\cancel{x^6}\, x^4}$$

$$\frac{e^x (x-3)}{x^4}$$

$\boxed{604}$ $y = \log_3(\sin 2x)$

$$y' = \frac{1}{(\sin 2x)(\ln 3)} \cdot \cos(2x) \cdot 2$$

$$y' = \frac{2\cos(2x)}{\sin(2x)\ln 3}$$

$$y' = \frac{2}{\ln 3} \cdot \cot(2x)$$

$\boxed{606}$

$$y = \underset{f}{e^{3x}} \cdot \underset{g}{\tan(x)} \qquad f' = 3e^{3x} \quad g' = \sec^2(x)$$

$$y' = 3e^{3x} \cdot \tan(x) + e^{3x} \cdot \sec^2(x)$$

$$y' = e^{3x}\left(3\tan(x) + \sec^2(x)\right)$$

$\boxed{609}$ $\sec(x)$

$\boxed{610}$ $e^{\tan(x)}\left(1 + x\sec^2(x)\right)$

$\boxed{605}$ $y = x \cdot \boxed{e^{\ln 3x}}$ b/c $e$ & $\ln$ are inverses of each other

$\Downarrow$

$3x$

$y = 3x^2$

$y' = 6x$

605. $y = \underset{f}{x} \cdot \underset{g}{e^{\ln 3x}}$ product rule

$f = x$ $\quad g = e^{\ln 3x}$

$f' = 1$ $\quad g' = e^{\ln 3x} \cdot \frac{1}{\cancel{3}x} \cdot \cancel{3}$

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

$\boxed{f'g + fg'}$

$1 \cdot e^{\ln 3x} + \cancel{x} \cdot \frac{1}{\cancel{x}} \cdot e^{\ln 3x}$

$e^{\ln 3x} + e^{\ln 3x}$

$2e^{\ln 3x}$ or...

Back at start:

$y = x \cdot e^{\ln 3x}$

$e$ & $\ln$ are opposite/inverse operations. They cancel.

therefore:

$e^{\ln 3x} \Rightarrow 3x$

$y = x \cdot e^{\ln 3x}$

$\Downarrow$

$y = x \cdot 3x$

$y = 3x^2 \rightarrow y' = 6x$

609.

$$y = \ln(\sec(x) + \tan(x))$$

$$y' = \frac{1}{\sec(x) + \tan(x)} \cdot (\sec(x)\tan(x) + \sec^2(x))$$

$$y' = \frac{\sec(x)\tan(x) + \sec^2(x)}{\sec(x) + \tan(x)}$$

factor numerator

$$y' = \frac{\sec(x)\cancel{(\tan(x) + \sec(x))}}{\cancel{\sec(x) + \tan(x)}}$$

$$y' = \sec(x)$$

610.

$$y = x \cdot e^{\tan(x)}$$

product rule $f = x$, $f' = 1$, $g = e^{\tan(x)}$, $g' = e^{\tan(x)} \cdot \sec^2(x)$

$$y' = 1 \cdot e^{\tan(x)} + x \cdot e^{\tan(x)} \cdot \sec^2(x)$$

factor

$$\boxed{e^{\tan(x)}\left(1 + x \cdot \sec^2(x)\right)}$$