Excitement w/ Derivatives 5/15 NN

556. $y = e^{2x}$ $y' = 2e^{2x}$

557. $y = e^{-\frac{3}{2}x}$ $y' = -\frac{3}{2}e^{-\frac{3}{2}x}$

558. $y = \underset{f}{x^2}\,\underset{g}{e^x}$ $f: x^2$ $f': 2x$ $g: e^x$ $g': e^x$

$y' = 2xe^x + x^2e^x \rightarrow \boxed{xe^x(2+x)}$

559. $y = 5e^{2-x} \rightarrow y' = 5e^{2-x} \cdot -1$

$y' = -5e^{2-x}$

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

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

~~2ln8~~

$2\ln 8 \cdot 8^{2x}$

$\ln 64 \; 8^{2x}$

561. $y = 3^{x^2}$

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

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

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

563. $y = 9^{-x} \rightarrow y' = 9^{-x} \cdot \ln 9 \cdot -1$?

$-\ln 9 \cdot 9^{-x}$

$\ln \frac{1}{9} \cdot 9^{-x}$

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

$y' = \dfrac{f'g - fg'}{g^2}$ $\dfrac{5e^{5x} \cdot x^2 - e^{5x} \cdot 2x}{x^4} \rightarrow \dfrac{\cancel{x} \cdot e^{5x}(5x-2)}{x^{\cancel{4}}3}$

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

565. $y = \ln x^2 = \frac{1}{x^2} \cdot 2x = \frac{2x}{x^2} = \frac{2}{x}$

566 $y = \ln(2-x^2) \Rightarrow y' = \frac{1}{2-x^2} \cdot -2x \rightarrow \frac{-2x}{2-x^2}$

567. $y = \ln(5x+1) \rightarrow y' = \frac{1}{5x+1} \cdot 5 \Rightarrow \frac{5}{5x+1}$

568. $y = \ln(\sin x) \Rightarrow y' = \frac{1}{\sin(x)} \cdot \cos(x) \rightarrow \frac{\cos(x)}{\sin(x)} = \cot(x)$

569. $y = (\ln x)^2 \Rightarrow y' = 2(\ln x)' \cdot \frac{1}{x}$ $\frac{2}{x} \ln x$

571. $y = \log_9 x^{1/2}$

$y = \frac{1}{2} \log_9 x \rightarrow \boxed{y' = \frac{1}{2x \ln 9}}$

570 $y = \log_3(x+1) = \boxed{y' = \frac{1}{(x+1)\ln 3}}$

572. $y = x \cdot \ln x - x$

$f' = 1$

$g' = \frac{1}{x}$

$\uparrow \quad \uparrow$

$f \quad g$

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

$y' = \ln x + 1 - 1 \longrightarrow \ln x$

573. $y = \frac{\ln x}{x^2}$ $\leftarrow f$, $\leftarrow g$

$f' = \frac{1}{x}$

$g' = 2x$

$y' = \frac{\frac{1}{x} \cdot x^2 - \ln x \cdot 2x}{x^4}$

$\frac{1 - 2\ln x}{x^3} \leftarrow \frac{x(1 - 2\ln x)}{x^4} = \frac{x - 2x\ln x}{x^4}$

574. $g(x) = x^3 e^{2x}$ $\quad f': 3x^2$

$f \quad g \quad\quad g': 2e^{2x}$

$3x^2 e^{2x} + x^3 \cdot 2e^{2x}$

$x^2 e^{2x}(3 + 2x)$

575. $Z(x) = 4e^{4x^2+5}$

$Z'(x) = 4e^{4x^2+5} \cdot 8x \rightarrow \boxed{32x \cdot e^{4x^2+5}}$

576. $j(x) = \ln(e^x+1)$

$j'(x) = \frac{1}{e^x+1} \cdot e^x = \frac{e^x}{e^x+1}$

577. $f(x) = \frac{e^x-1}{e^x+1} \begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $\quad f': e^x$ $\quad g': e^x$

$\frac{e^x(e^x+1) - (e^x-1)e^x}{(e^x+1)^2} \rightarrow \frac{e^x(\cancel{e^x}+1 - \cancel{e^x}+1)}{(e^x+1)^2}$

$\frac{2e^x}{(e^x+1)^2}$

578. $K(x) = \log_3(x^2+e^x)$

$K'(x) = \frac{1}{(x^2+e^x)\ln 3} \cdot (2x+e^x)$

$K'(x) = \frac{2x+e^x}{(x^2+e^x)\ln 3}$

579. $R(x) = \frac{2^x-1}{5^x} \begin{matrix} \leftarrow f: \\ \leftarrow g: \end{matrix}$ $\quad f': 2^x \ln 2$ $\quad g': 5^x \ln 5$

$\frac{2^x \ln 2(5^x) - (2^x-1)5^x \ln 5}{(5^x)^2}$

580. $D(x) = \ln(\ln(x))$ $\quad \frac{1}{\ln x} \cdot \frac{1}{x} = \frac{1}{x \ln x}$

581. $A(x) = \ln(x^2+x+1)^2 = 2\ln(x^2+x+1)$

$A'(x) = 2 \cdot \frac{1}{x^2+x+1} \cdot (2x+1) \longrightarrow \boxed{\frac{4x+2}{x^2+x+1}}$

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

$g(x) = \frac{1}{5} \ln(3x-2)$

$g'(x) = \frac{1}{5} \cdot \frac{1}{3x-2} \cdot 3 \longrightarrow \frac{3}{5(3x-2)}$

583. $A(x) = \frac{\ln x}{x-2}$ $\begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $\quad \begin{matrix} f': \frac{1}{x} \\ g': 1 \end{matrix}$

$\cancel{\frac{1}{x \cdot \ln x}}$ $\quad \frac{\frac{1}{x} \cdot (x-2) - \ln(x) \cdot 1}{(x-2)^2} \Rightarrow \frac{(x-2) - x\ln x}{x(x-2)^2}$

584. $B(x) = \frac{x-2}{\ln x}$ $\begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $\quad \begin{matrix} f': 1 \\ g': \frac{1}{x} \end{matrix}$ $\quad \frac{1 \cdot \ln x - (x-2)(\frac{1}{x})}{(\ln x)^2} \begin{matrix} \cdot x \\ \cdot x \end{matrix}$

$\frac{x \ln x - (x-2)}{x(\ln x)^2}$

585. $M(x) = e^{-2x^3}$

$M'(x) = \boxed{-6x^2 e^{-2x^3}}$

586. $J(x) = \frac{e^x}{x^3}$ $\begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $\quad \begin{matrix} f': e^x \\ g': 3x^2 \end{matrix}$ $\quad \frac{e^x \cdot x^3 - e^x \cdot 3x^2}{(x^3)^2}$

$\frac{e^x(x-3)}{x^4} \leftarrow \frac{\cancel{x^2} e^x (x-3)}{\cancel{x^6}}$

587. $F(x) = x^2 e^{-4\ln x}$) prop. of exponents

$F(x) = x^2 \cdot (e^{\ln x})^{-4}$

opposites/inverses

$F(x) = x^2 (x)^{-4}$) prop. of exp.

$F(x) = x^{-2}$

$F'(x) = -2x^{-3} = -\frac{2}{x^3}$

588. $f(x) = 10^{3x^2 - 6x}$ $\boxed{f'(x) = 10^{3x^2-6x} \ln 10 \cdot (6x - 6)}$

589. $g(x) = 3^{2x} 2^{3x^2} \longrightarrow g(x) = (3^2)^x (2^3)^{x^2} \longrightarrow g(x) = 9^x \cdot 8^{x^2}$

f g

$f' : 9^x \ln 9$

$g' : 8^{x^2} \ln 8 \cdot 2x$

$g'(x) = f'g + fg'$

$g'(x) = 9^x \ln 9 \cdot \underline{8^{x^2}} + \underline{9^x} \cdot \underline{8^{x^2}} \cdot \ln 8 \cdot 2x$

$g'(x) = 9^x \cdot 8^{x^2} (\ln 9 + 2x \cdot \ln 8)$

$f'g + fg'$

596. $y = \underset{f}{3x} \cdot \underset{g}{\csc 2x}$ $y' = 3\csc 2x + 3x \cdot -2\csc 2x \cot 2x$

$f' = 3$ $g' = -\csc 2x \cdot \cot 2x \cdot 2$

$y' = 3\csc 2x - 6x\csc 2x \cot 2x$

$\boxed{3\csc 2x(1 - 2x\cot 2x)}$

597. $y = \dfrac{\cot 5x}{3x^2}$ $\begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $f' = -\csc^2 5x \cdot 5$ $g' = 6x$

$\dfrac{-5\csc^2(5x)\cdot 3x^2 - \cot(5x)(6x)}{(3x^2)^2} = \boxed{\dfrac{-15x^2\csc^2(5x) - 6x\cdot\cot(5x)}{9x^4}}$

598. $y = (\cot 5x)^{1/2} \rightarrow y' = \frac{1}{2}(\cot(5x))^{-1/2} \cdot (-\csc^2(5x)) \cdot 5$

$-\dfrac{5\csc^2(5x)}{2\sqrt{\cot(5x)}}$

599. $y = \underset{f}{3\sin(8x)}\underset{g}{\cos(8x)}$ $y' = 24\cos(8x)\cos(8x) + 3\sin(8x) \cdot -8\sin(8x)$

$f' = 3\cos(8x)\cdot 8$ $g' = -8\sin(8x)$

$24\cos(8x)$

$\boxed{y' = 24\cos^2(8x) - 24\sin^2(8x)}$

600. $y = \dfrac{\ln x}{\sin x}$ $\begin{matrix} \leftarrow f \\ \leftarrow g \end{matrix}$ $f' = \frac{1}{x}$ $g' = \cos x$ $y' = \dfrac{\frac{1}{x}\sin(x) - \ln x \cdot \cos x}{\sin^2(x)}$

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

601. $y = (\cos 3x)^2 - (\sin 3x)^2$

$y' = 2(\cos 3x)' \cdot -\sin 3x \cdot 3 - [2(\sin 3x)' \cos(3x) \cdot 3]$

$-6\cos(3x)\sin(3x) - 6\cos(3x)\sin(3x)$

$\boxed{-12\cos(3x)\sin(3x)}$

602. $y = e^{\sin x} \Rightarrow y' = \boxed{e^{\sin(x)} \cdot \cos(x)}$

603. $y = 3^{\cos x} \rightarrow y' = 3^{\cos x} \cdot \ln 3 \cdot -\sin(x)$

604. $y = \log_3(\sin(2x))$

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

$\frac{2}{\ln 3}\cot(2x)$

605. $y = x e^{\ln(3x)}$

Inverses!

$y = x \cdot \cancel{e}^{\ln(3x)} \rightarrow y = x \cdot 3x \Rightarrow 3x^2 \rightarrow y' = 6x$

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

$\boxed{e^{3x}(3\tan(x) + \sec^2 x)}$

$f' = 3e^{3x}$ $g' = \sec^2(x)$

607. $y = e^{\frac{1}{x^2}} = e^{x^{-2}}$

$y' = \cancel{e^{x^{-2}}}$

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

$$\frac{-2e^{x^{-2}}}{x^3}$$

608. $y = e^{x^2/4}$

$\cancel{y} = e^{\frac{1}{4}x^2} \longrightarrow \boxed{y' = e^{\frac{1}{4}x^2} \cdot \frac{1}{2}x}$

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

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

$$\boxed{\frac{\sec(x)\tan(x) + \sec^2(x)}{\sec(x) + \tan(x)}}$$

610. $y = \underset{f}{x}\,\underset{g}{e^{\tan(x)}}$

$f' : 1 \qquad g' : \cancel{\tan(x)}\; e^{\tan(x)}\, \sec^2(x)$

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

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