Kuta Software - Infinite Calculus

Name_____

Differentiation - Natural Logs and Exponentials

Date_____ Period____

Differentiate each function with respect to x.

1) $y = \ln x^3$

$\frac{1}{x^3} \cdot 3x^2 = \frac{3x^2}{x^3} = \boxed{\frac{3}{x}}$

2) $y = e^{2x^3}$

$e^{2x^3} \cdot 6x^2 = \boxed{6x^2 e^{2x^3}}$

3) $y = \ln(\ln 2x^4)$

$\frac{1}{\ln 2x^4} \cdot \frac{1}{2x^4} \cdot 8x^3 = \frac{1}{\ln 2x^4} \cdot \frac{4}{x}$

$= \boxed{\frac{4}{x \ln 2x^4}}$

4) $y = \ln(\ln 3x^3)$

$\frac{1}{\ln 3x^3} \cdot \frac{1}{3x^3} \cdot 9x^2 = \frac{1}{\ln 3x^3} \cdot \frac{3}{x}$

$= \boxed{\frac{3}{x \ln 3x^3}}$

5) $y = \cos(\ln 4x^3)$

$-\sin(\ln 4x^3) \cdot \frac{1}{4x^3} \cdot 12x^2$ $\quad x$

$\boxed{\frac{-3\sin(\ln 4x^3)}{x}}$

6) $y = e^{e^{3x^2}}$

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

$\boxed{6x e^{e^{3x^2} + 3x^2}}$

7) $y = e^{(4x^3+5)^2}$

$e^{(4x^3+5)^2} \cdot 2(4x^3+5) \cdot 12x^2$

$\boxed{24x^2 e^{(4x^3+5)^2}(4x^3+5)}$

8) $y = \ln 4x^2 \cdot (-x^3 - 4)$ $\quad fg' + gf'$

$\ln(4x^2) \cdot -3x^2 + (-x^3-4) \cdot \frac{1}{4x^2} \cdot 8x$

$-3x^2 \ln(4x^2) + (-x^3-4) \cdot \frac{2}{x}$

$\frac{-3x^3 \ln(4x^2)}{x} - \frac{2x^3 - 8}{x}$ $= \boxed{\frac{-3x^3 \ln 4x^2 - 2x^3 - 8}{x}}$

9) $y = \ln\left(-\frac{4x^4}{x^3-3}\right)^5 = 5\ln\left(-\frac{4x^4}{x^3-3}\right)$

$5\left(\frac{1}{-\frac{4x^4}{x^3-3}}\right)$

10) $y = \frac{e^{5x^4}}{e^{4x^2+3}}$

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$$= \frac{3}{x}$$

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5) $y = \cos \ln 4x^3$

$$\frac{dy}{dx} = -\sin \ln 4x^3 \cdot \frac{1}{4x^3} \cdot 12x^2$$
$$= -\frac{3 \sin \ln 4x^3}{x}$$

6) $y = e^{e^{3x^2}}$

$$\frac{dy}{dx} = e^{e^{3x^2}} e^{3x^2} \cdot 6x$$
$$= 6xe^{e^{3x^2} + 3x^2}$$

7) $y = e^{(4x^3 + 5)^2}$

$$\frac{dy}{dx} = e^{(4x^3 + 5)^2} \cdot 2(4x^3 + 5) \cdot 12x^2$$
$$= 24x^2 e^{(4x^3 + 5)^2} (4x^3 + 5)$$

8) $y = \ln 4x^2 \cdot (-x^3 - 4)$

$$\frac{dy}{dx} = \ln 4x^2 \cdot -3x^2 + (-x^3 - 4) \cdot \frac{1}{4x^2} \cdot 8x$$
$$= \frac{-3x^3 \ln 4x^2 - 2x^3 - 8}{x}$$

9) $y = \ln \left(-\frac{4x^4}{x^3 - 3} \right)^5$

$$\frac{dy}{dx} = 5\left(\frac{1}{-4x^4} \cdot -16x^3 - \frac{1}{x^3 - 3} \cdot 3x^2 \right)$$
$$= \frac{5(x^3 - 12)}{x(x^3 - 3)}$$ (Rules of logarithms used)

10) $y = \frac{e^{5x^4}}{e^{4x^2 + 3}}$

$$\frac{dy}{dx} = e^{5x^4 - (4x^2 + 3)} (20x^3 - 8x)$$
$$= 4xe^{5x^4 - 4x^2 - 3} (5x^2 - 2)$$ (Rules of exponents used)

#9) $5\left(-\frac{1}{\frac{4x^4}{x^3-3}}\right)\cdot($

$\frac{gf'-fg'}{g^2}$

$= 5\left(\frac{x^3-3}{-4x^4}\right)\cdot\left[\frac{(x^3-3)(-16x^3)-(-4x^4)\cdot(3x^2)}{(x^3-3)^2}\right]$

$= 5\frac{1}{-4x^4}\cdot\left[\frac{-16x^6+48x^3+12x^6}{(x^3-3)}\right]$

$= 5\frac{1}{-4x^4}\left[\frac{-4x^6+48x^3}{x^3-3}\right]$

$5\frac{1}{-4x^4}\left(\frac{-4x^3(x^3-12)}{x^3-3}\right)$

x

$\boxed{\frac{5(x^3-12)}{x(x^3-3)}}$

#10) $\dfrac{e^{5x^4}}{e^{4x^2+3}}$ $\qquad \dfrac{gf' - fg'}{g^2}$

$$\frac{e^{4x^2+3} \cdot e^{5x^4} \cdot 20x^3 - e^{5x^4} \cdot e^{4x^2+3} \cdot 8x}{\left(e^{4x^2+3}\right)^2}$$

$$\frac{20x^3 e^{4x^2+3+5x^4} - 8x e^{4x^2+3+5x^4}}{\left(e^{4x^2+3}\right)^2}$$

$$\frac{e^{4x^2+3}\left(20x^3 e^{5x^4} - 8x e^{5x^4}\right)}{\left(e^{4x^2+3}\right)^2}$$

$$\frac{e^{5x^4}\left(20x^3 - 8x\right)}{e^{4x^2+3}}$$

$$e^{5x^4} e^{-(4x^2+3)} = \frac{e^{5x^4-4x^2-3}\left(20x^3-8x\right)}{4x e^{5x^4-4x^2-3}\left(5x^2-2\right)}$$