20 $y = \sec\left(\frac{x^2+1}{x^4+2}\right)^3$ $(\sec u)' = u' \sec u \tan u$

$$\left(\frac{(x^2+1)^3}{(x^4+2)^3}\right)' = \frac{(x^2+1)^2}{(x^4+2)^4}\left[6x(x^4+2) - 12x^3(x^2+1)\right]$$

$$y' = \frac{(x^2+1)^2}{(x^4+2)^4}(-6x^5+12x-12x^3)\sec\left(\frac{x^2+1}{x^4+2}\right)^3 \tan\left(\frac{x^2+1}{x^4+2}\right)^3$$

2.8

$$(\ln|x|)' = \frac{1}{x}$$

$$(\ln u)' = \frac{u'}{u}$$

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

$$\ln ab = \ln a + \ln b$$

$$\ln \frac{a}{b} = \ln a - \ln b$$

$$\ln x^p = p \ln x$$

$$\ln \frac{1}{x} = -\ln x$$

$$\boxed{\begin{array}{c} \ln 1 = 0 \\ \ln e = 1 \end{array}}$$

$$\ln \sqrt[n]{\frac{a^x b^y}{c^z}} = \frac{x}{n}\ln a + \frac{y}{n}\ln b - \frac{z}{n}\ln c$$

Ex

$$y = \frac{(x^2+1)(x+3)^{1/2}}{x-1}$$

$$\ln y = \ln \frac{(x^2+1)(x+3)^{1/2}}{x-1}$$

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

$$\frac{y'}{y} = \frac{2x}{x^2+1} + \frac{1}{2}\frac{1}{x+3} - \frac{1}{x-1}$$

$$y' = \underbrace{\boxed{\frac{(x^2+1)(x+3)^{1/2}}{x-1}}}_{=y}\left(\frac{2x}{x^2+1} + \frac{1}{2(x+3)} - \frac{1}{x-1}\right)$$

$$\frac{d}{dx}(5e^x) = 5e^x$$

$$\frac{d}{dx}\left(e^{\sin x}\right) = \cos x \, e^{\sin x}$$

$$(\sqrt{u})' = \frac{u'}{2\sqrt{u}}$$

$$\frac{d}{dx}\left(e^{\sqrt{3x+1}}\right) = \left(\sqrt{3x+1}\right)' e^{\sqrt{3x+1}}$$

$$= \frac{3}{2\sqrt{3x+1}} e^{\sqrt{3x+1}}$$

$$\frac{d}{dx}(\log_a u) = \frac{u'}{u}\frac{1}{\ln a}$$

$$(a^u)' = u' a^u \ln a$$

$$a^x = e^{x\ln a} = e^{\ln a^x}$$

$$x^n = e^{n\ln x}$$

$$f(x) = x^x = y$$

$$\ln y = \ln x^x$$

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

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

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

$$= x^x(\ln x + 1)$$

#1 $y = \ln\sqrt{x+5}$ $\qquad (x+5)^{1/2}$

$= \frac{1}{2}\ln(x+5)$

$y' = \frac{1}{2}\,\frac{1}{x+5}$

#2 $y = (3x+7)\ln(2x-1)$

$y' = 3\ln(2x-1) + (3x+7)\frac{2}{2x-1}$

$= 3\ln(2x-1) + \frac{6x+14}{2x-1}$

#6 $y = \ln\left(\frac{x^2(x+1)^3}{(x+3)^{1/2}}\right)$

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

$y' = \frac{2}{x} + \frac{3}{x+1} - \frac{1}{2}\,\frac{1}{x+3}$

#36 $f(x) = e^{-2x^3}$

$f'(x) = -6x^2 e^{-2x^3}$

#38 $f(x) = 2x^3 e^x$

$f'(x) = 6x^2 e^x + 2x^3 e^x$

$= (6x^2 + 2x^3)e^x$

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

#48 $f(x) = \dfrac{e^x}{x^2+1}$

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

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

#51 $y = \sqrt{e^{2x^2} + e^{-2x^2}}$

$$= (e^{2x^2} + e^{-2x^2})^{1/2}$$

$$y' = \frac{1}{2}\left(4xe^{2x^2} - 4xe^{-2x^2}\right)\left(e^{2x^2} + e^{-2x^2}\right)^{-1/2}$$

$$= \frac{2x\,(e^{2x^2} - e^{-2x^2})}{\sqrt{e^{2x^2} + e^{-2x^2}}}$$

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

$$\frac{y'}{y} = \frac{1}{2}\,\frac{4xe^{2x^2} - 4xe^{-2x^2}}{e^{2x^2} + e^{-2x^2}}$$

$$y' = \frac{1}{2}\,\frac{4x(e^{2x^2} - e^{-2x^2})}{e^{2x^2} + e^{-2x^2}}\sqrt{e^{2x^2} + e^{-2x^2}}$$

$$= \frac{4x\,(e^{2x^2} - e^{-2x^2})}{\sqrt{e^{2x^2} + e^{-2x^2}}}$$