Name: Richard

QUIZ 14

MATH 200
October 10, 2023

Directions Use logarithmic differentiation to find the derivatives of the given functions.

1. $y = x^{\sin(x)}$

$\ln(y) = \ln(x^{\sin(x)})$

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

$D_x[\ln(y)] = D_x[\sin(x)\ln(x)]$

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

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

$y' = \boxed{x^{\sin(x)}\left(\cos(x)\ln(x) + \frac{\sin(x)}{x}\right)}$

2. $y = \frac{e^x x^2 \sin(x)}{x+1}$

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

$\ln(y) = \ln(e^x x^2 \sin(x)) - \ln(x+1)$

$\ln(y) = \ln(e^x) + \ln(x^2) + \ln(\sin(x)) - \ln(x+1)$

Now take D_x of both sides:

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

$y' = y\left(1 + \frac{2}{x} + \cot(x) - \frac{1}{x+1}\right)$

$\boxed{y' = \frac{e^x x^2 \sin(x)}{x+1}\left(1 + \frac{2}{x} + \cot(x) - \frac{1}{x+1}\right)}$

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Directions Use logarithmic differentiation to find the derivatives of the given functions

1. $y = (x+1)^x$

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

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

$$D_x[\ln(y)] = D_x[x\ln(x+1)]$$

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

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

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

2. $y = \dfrac{x\sqrt{\sin(x)}}{5+e^x}$

$$\ln(y) = \ln\left(\frac{x\sqrt{\sin(x)}}{5+e^x}\right)$$

$$\ln(y) = \ln(x(\sin(x))^{1/2}) - \ln(5+e^x)$$

$$\ln(y) = \ln(x) + \ln((\sin(x))^{1/2}) - \ln(5+e^x)$$

$$\ln(y) = \ln(x) + \frac{1}{2}\ln(\sin(x)) - \ln(5+e^x)$$

Now take D_x of both sides:

$$\frac{y'}{y} = \frac{1}{x} + \frac{1}{2}\frac{\cos(x)}{\sin(x)} - \frac{e^x}{5+e^x}$$

$$y' = y\left(\frac{1}{x} + \frac{1}{2}\cot(x) - \frac{e^x}{5+e^x}\right)$$

$$\boxed{y' = \frac{x\sqrt{\sin(x)}}{5+e^x}\left(\frac{1}{x} + \frac{1}{2}\cot(x) - \frac{e^x}{5+e^x}\right)}$$