Derivatives of Logarithmic Fons
ex Differentiate

$$
\text { a) } \begin{aligned}
\ln 3 x & \\
\frac{d}{d x} \ln 3 x & =\frac{1}{3 x} \\
& =\frac{1}{x}
\end{aligned}
$$

b) $\ln x^{4}$

$$
\begin{aligned}
\frac{d}{d x} \ln x^{4} & =\frac{1}{x^{4}}\left(4 x^{3}\right) \\
& =\frac{4}{x}
\end{aligned}
$$

c) $\ln (2 x+3)$

$$
\begin{aligned}
\frac{\partial}{d x} \ln (2 x+3) & =\frac{1}{2 x+3}(2) \\
& =\frac{2}{2 x+3}
\end{aligned}
$$

d)

$$
\begin{aligned}
& \ln \left(2 x^{2}+3 x-5\right) \\
& \frac{d}{d x} \ln \left(2 x^{2}+3 x-5\right)=\frac{1}{2 x^{2}+3 x-5}(4 x+3) \\
&=\frac{4 x+3}{2 x^{2}+3 x-5}
\end{aligned}
$$

ex.2. Differentiate

$$
\begin{aligned}
& \text { erentiate } \\
& \begin{aligned}
f(x) & =\log _{10}(2+\sin x) \\
f^{\prime}(x) & =\frac{1}{(2+\sin x) \ln 10} \cdot \cos x \\
& =\frac{\cos x}{(2+\sin x) \ln 10}
\end{aligned}
\end{aligned}
$$

ex.3 Find $\frac{d y}{d x}$ if $y=\log _{a} a \sin x$

$$
\begin{aligned}
\frac{d y}{d x} & =\frac{1}{a^{\sin x} \ln a} \cdot a^{\sin x} \cdot \ln a \cdot \cos x \\
& =\cos x
\end{aligned}
$$

* Easier to simplity first.

$$
\begin{aligned}
y=\sin x \log _{a} a \quad y & \log _{a} a^{\sin x} \Rightarrow a^{y}=a^{\sin x} \\
y=\sin x & : s \\
& y=\sin x \\
& \frac{d y}{d x}=\cos x
\end{aligned}
$$

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$$
\begin{aligned}
& y=\ln x \\
& e^{y}=x \\
& \frac{d}{d x} e^{y}=\frac{d}{d x} x \\
& e^{y} \cdot \frac{d y}{d x}=1 \\
& \frac{d y}{d x}=\frac{1}{e^{y}} \\
& \frac{d y}{d x}=\frac{1}{x}
\end{aligned}
$$

Prof
$\frac{d}{d x} \log _{a} x=\frac{1}{x \ln a}$

$$
\log _{2} 8=3
$$

change of base

$$
\log _{a} x=\frac{\ln x}{\ln a}
$$

$$
\frac{d}{d x} \log _{a} x=\frac{d}{d x}\left(\frac{\ln x}{\ln a}\right)
$$

$$
\frac{\log 8}{\log 2}
$$

$$
=\frac{1}{\ln a} \frac{d}{d x} \ln x
$$

$$
=\frac{1}{\ln a} \cdot \frac{1}{x}
$$

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

It Follows

$$
\frac{d}{d x} \log a=\frac{1}{4 \sin n} \cdot \frac{d x}{d x}
$$

pg. $17^{8}$

* $15-29.2 d$ $37,39,41$

