# Exponential and Logarithmic Functions Review

Thursday, March 9, 2017 10:28 AM

AP Calculus
Chapter 7 Review

## Exponential and Logarithmic Functions Review

| Rule | Exercise |
|---|---|
| $\frac{d}{dx}e^u$ <br> $= e^u \cdot \frac{du}{dx}$ | $\frac{d}{dx}3e^{5x^2}$ <br> $= 3e^{5x^2} \cdot (10x)$ <br> $= 30xe^{5x^2}$ |
| $\frac{d}{dx}b^u$ <br> $= b^u \cdot \ln b \cdot \frac{du}{dx}$ | $\frac{d}{dx}3^{x^2}$ <br> $= 3^{x^2} \cdot \ln 3 \cdot (2x)$ <br> $= 2x\ln 3 \cdot 3^{x^2}$ |
| $\frac{d}{dx}\sin^{-1}u = \frac{u'}{\sqrt{1-u^2}}$ <br> $\frac{d}{dx}\cos^{-1}u = \frac{-u'}{\sqrt{1-u^2}}$ <br> $\frac{d}{dx}\tan^{-1}u = \frac{u'}{1+u^2}$ | $\frac{d}{dx}5\arcsin(4x)$ <br> $= 5 \cdot \frac{4}{\sqrt{1-(4x)^2}}$ <br> $= \frac{20}{\sqrt{1-16x^2}}$ |
| $\frac{d}{dx}\ln u$ <br> $= \frac{1}{u} \cdot \frac{du}{dx}$ | $\frac{d}{dx}\ln\frac{e^x}{3x}$ <br> $\frac{d}{dx}\left[\ln e^x - \ln 3x\right]$ <br> $= \frac{d}{dx}\left[x - \ln 3x\right]$ <br> $= 1 - \frac{1}{3x} \cdot 3$ <br> $= 1 - \frac{1}{x}$ $= \frac{x-1}{x}$ |
| $\frac{d}{dx}\log_b u$ <br> $= \frac{1}{u} \cdot \frac{1}{\ln b} \cdot \frac{du}{dx}$ | $\frac{d}{dx}\log_3\frac{x^2}{x+2}$ <br> $\frac{d}{dx}\left[\log_3 x^2 - \log_3(x+2)\right]$ <br> $= \frac{1}{x^{\cancel{2}}} \cdot \frac{1}{\ln 3} \cdot 2\cancel{x} - \frac{1}{x+2} \cdot \frac{1}{\ln 3} \cdot (1)$ <br> $= \frac{2}{x\ln 3} - \frac{1}{(x+2)\ln 3}$ |

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

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

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| Logarithmic Differentiation:<br>• Take the ln of both sides<br>• Simplify the ln<br>• Take the derivative (Implicit) | $y = x^{\cos x}$<br>$\ln y = \ln x^{\cos x}$<br>$\ln y = \cos x \cdot \ln x$<br>$\frac{1}{y} \cdot \frac{dy}{dx} = \cos x \cdot \frac{1}{x} + (-\sin x) \ln x$<br>$\frac{dy}{dx} = y\left[\frac{\cos x}{x} - \sin x \ln x\right]$<br>$\frac{dy}{dx} = x^{\cos x}\left[\frac{\cos x}{x} - \sin x \ln x\right]$ |
| $\int e^u du$<br>$= e^u + C$ | $\int e^{1-2x}\,dx$<br>$u = 1-2x$<br>$\frac{du}{dx} = -2$<br>$\frac{du}{-2} = dx$<br>$= \int e^u \cdot \frac{du}{-2}$<br>$= -\frac{1}{2}\int e^u du$<br>$= -\frac{1}{2} e^u + C$<br>$= -\frac{1}{2} e^{1-2x} + C$ |
| $\int b^u du$<br>$= \frac{b^u}{\ln b} + C$ | $\int x(6^{x^2})dx$<br>$u = x^2$<br>$\frac{du}{dx} = 2x$<br>$\frac{du}{2} = x\,dx$<br>$\int 6^u \cdot \frac{du}{2}$<br>$\frac{1}{2}\int 6^u du$<br>$= \frac{1}{2} \cdot \frac{6^u}{\ln 6} + C$<br>$= \frac{6^{x^2}}{2\ln 6} + C$<br>$= \frac{6^{x^2}}{\ln 36} + C$ |
| $\int \frac{du}{\sqrt{a^2 - u^2}} = \arcsin\frac{u}{a} + C$<br>$\int \frac{du}{a^2 + u^2} = \frac{1}{a}\arctan\frac{u}{a} + C$ | $\int \frac{3}{\sqrt{4 - 9x^2}}dx$<br>$a = 2$<br>$u = 3x$<br>$\frac{du}{dx} = 3$<br>$du = 3dx$<br>$= \int \frac{1}{\sqrt{a^2 - u^2}} du$<br>$= \arcsin\frac{u}{a} + C$<br>$= \arcsin\frac{3x}{2} + C$ |
| $\int \frac{1}{u} du = \ln\lvert u \rvert + C$ | $\int \frac{1}{3x - 5}dx$<br>$u = 3x - 5$<br>$\frac{du}{dx} = 3$<br>$\frac{du}{3} = dx$<br>$= \int \frac{1}{u} \cdot \frac{du}{3}$<br>$= \frac{1}{3}\int \frac{1}{u} du$<br>$= \frac{1}{3} \cdot \ln\lvert u \rvert + C$<br>$= \frac{1}{3}\ln\lvert 3x - 5 \rvert + C$ |
| $\int u\,du = \frac{u^2}{2} + C$ | $\int 5x^2(2x^3 + 1)^4dx$<br>$u = 2x^3 + 1$<br>$\frac{du}{dx} = 6x^2$<br>$\frac{du}{6} = x^2dx$<br>$= 5\int u^4 \cdot \frac{du}{6}$<br>$= \frac{5}{6}\int u^4 du$<br>$= \frac{\cancel{5}}{6} \cdot \frac{u^5}{\cancel{5}} + C$<br>$= \frac{(2x^3+1)^5}{6} + C$ |