

1. 10 pts. Given  $f(x) = x^3 + 3 \sin x + 2 \cos x$ , find  $(f^{-1})'(2)$  using the Inverse Function Theorem.

2. 10 pts. each Find the derivative.

(a)  $\frac{d}{dx} \left[ \ln \left( \frac{e^x}{2 + e^x} \right) \right]$

(b)  $\frac{d}{dt} (1 - 3t)^{2t}$

(c)  $\frac{d}{dr} [r \log_6(1/r)]$

(d)  $\frac{d}{dy} (\tan^{-1} y^2 - \cos^{-1} \sqrt{y})$

(e)  $\frac{d}{dx} \tanh^3(e^{2x})$

3. 10 pts. Find an equation of the tangent line to  $y = 2e^x - 1$  at  $x = \ln 3$ .

4. 10 pts. each Evaluate each integral.

(a)  $\int_0^3 \frac{2p - 1}{p + 1} dp$

(b)  $\int \frac{dt}{2t\sqrt{25t^2 - 100}}$

(c)  $\int 5^{-3x} dx$

(d)  $\int_0^{\ln 4} \frac{e^x}{3 + 2e^x} dx$

5. 10 pts. Find the critical points of  $f(x) = xe^{-x^2}$ , and use the First Derivative Test to locate the local maximum and minimum values.

6. 10 pts. each Evaluate the limit using L'Hôpital's Rule.

(a)  $\lim_{x \rightarrow 0^+} (3x)^{x/2}$

(b)  $\lim_{x \rightarrow \infty} \left( \frac{2x - 3}{2x + 5} \right)^{2x+1}$

## FORMULAS

- $(\sin^{-1} x)' = \frac{1}{\sqrt{1-x^2}}$
- $(\tan^{-1} x)' = \frac{1}{1+x^2}$
- $(\sec^{-1} x)' = \frac{1}{|x|\sqrt{x^2-1}}$
- $\int \frac{1}{\sqrt{a^2-x^2}} dx = \sin^{-1}\left(\frac{x}{a}\right) + c$
- $\int \frac{1}{a^2+x^2} dx = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c$
- $\int \frac{1}{x\sqrt{x^2-a^2}} dx = \frac{1}{a} \sec^{-1}\left|\frac{x}{a}\right| + c$
- $\int \tan x dx = \ln|\sec x| + c$
- $\int \cot x dx = \ln|\sin x| + c$
- $\int \sec x dx = \ln|\sec x + \tan x| + c$
- $\int \csc x dx = -\ln|\csc x + \cot x| + c$
- $\int \sin^n x dx = -\frac{\sin^{n-1} x \cos x}{n} + \frac{n-1}{n} \int \sin^{n-2} x dx$
- $\int \cos^n x dx = \frac{\cos^{n-1} x \sin x}{n} + \frac{n-1}{n} \int \cos^{n-2} x dx$
- $\int \tan^n x dx = \frac{\tan^{n-1} x}{n-1} - \int \tan^{n-2} x dx$
- $\int \sec^n x dx = \frac{\sec^{n-2} x \tan x}{n-1} + \frac{n-2}{n-1} \int \sec^{n-2} x dx$