

- Consider the function  $f(x) = 6x + \sin x$ .
  - 5 pts. Show that  $f$  is one-to-one and hence has an inverse.
  - 10 pts. Find  $(f^{-1})'(0)$  using the Inverse Function Theorem
- 10 pts. each Find the derivative of each function.
  - $y = \frac{x}{\ln x - 2}$
  - $f(x) = \tan(\cos(e^x))$
  - $g(x) = (\cot x)^{x-1}$
  - $h(t) = t^{(t^{1/2})}$
  - $\ell(x) = 4 \log_3(1 - x^3)$
  - $\varphi(u) = \tan^{-1}(4u - 4)$
  - $y = x^2 \cosh^3 5x$
- 10 pts. Find an equation of the line tangent to  $y = 2e^x + 8$  at the point where  $x = \ln 6$ .
- 10 pts. each Determine each indefinite integral.
  - $\int x^5 e^{x^6} dx$
  - $\int \frac{1}{(x \ln x) \ln(\ln x)} dx$
  - $\int \frac{e^{\cos x}}{\csc x} dx$
- 10 pts. each Evaluate each definite integral.
  - $\int_{-2}^2 \frac{e^{t/2}}{e^{t/2} + 1} dt$
  - $\int_0^{3/2} \frac{1}{\sqrt{36 - 4x^2}} dx$
  - $\int_0^1 \cosh^3 4x \sinh 4x dx$
- 10 pts. Evaluate the limit using L'Hôpital's Rule:  $\lim_{x \rightarrow \infty} (2x^3 + 1)^{1/\ln x}$ .

## FORMULAS & DEFINITIONS

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