

- will soon start using Matlab; check out the course website for relevant info.
- HW #2 due this Friday (9/4), along w/ quiz
- reminder: Exam I on 9/16

Review (cont.)

Exponential Functions

$$f(x) = a^x$$

base exponent

NOTE: diff. from power function
 $g(x) = x^a$

→ one common base that is a very important # is the quantity e
~~that~~

$$e = 2.718281 \dots$$

$$= \lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$$

$$\ln(a^x) = x \ln a$$

$$e^{\ln(a^x)} = a^x = e^{x \ln a}$$

So any exponential written w/ a base other than e can be written as $e^{\text{something}}$

Properties of Exp. Functions

$$\square a^r \cdot a^s = a^{r+s}$$

$$\square \frac{a^r}{a^s} = a^{r-s}$$

$$\square a^{-r} = \frac{1}{a^r}$$

$$\square (ab)^r = a^r \cdot b^r$$

$$\square (a^r)^s = a^{r \cdot s}$$

Logarithms

8/31/09

Pg. 2

→ a logarithm essentially represents an exponent

$$y = a^x \iff x = \log_a y$$

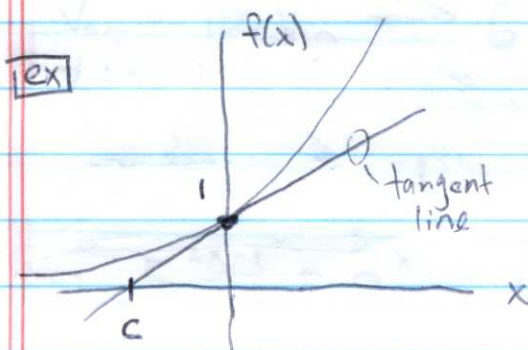
Properties of Logarithms

$$\square \log(AB) = \log(A) + \log(B)$$

$$\square \log\left(\frac{A}{B}\right) = \log(A) - \log(B)$$

$$\square \log(A^p) = p \log(A)$$

$$\square \ln \equiv \log_e \quad (\text{notation})$$



$$f(x) = 2^x \rightarrow \text{find } c$$

(stemming from line tangent to $f(x)$ @ $x=0$)

$$\square \frac{df}{dx} = \ln 2 \cdot 2^x$$

→ slope of tangent line

$$\square \text{eqn. of tangent line: } y(x) = mx + b$$

→ to find m , we need to determine $\left. \frac{df}{dx} \right|_{x=0} = \ln 2 = m$

→ b is the y-intercept (i.e. 1)

$$\Rightarrow y(x) = \ln 2 \cdot x + 1$$

3 to find c , determine x-intercept (i.e. where $y=0$)

$$\rightarrow 0 = \ln 2 \cdot c + 1 \Rightarrow \boxed{c = -\frac{1}{\ln 2}}$$

ex solve for x

$$\bullet \log_3 x = -2 \rightarrow 3^{\log_3 x} = 3^{-2}, x = \frac{1}{9}$$

$$\bullet \log_{1/2} 8 = x \rightarrow \frac{1}{2}^{\log_{1/2} 8} = \frac{1}{2}^x = 8 = 2^{-x}$$

$x = -3$

8/31/09

pg. 3

useful identities: $\log_a a^x = x, a^{\log_a x} = x$

ex decibels

eg. gain in an electric circuit
= 6

$$\text{gain} \equiv \frac{V_{\text{out}}}{V_{\text{in}}} \quad (\text{ratio})$$

$$\text{gain [dB]} = 20 \cdot \log_{10} \left(\frac{V_{\text{out}}}{V_{\text{in}}} \right)$$

$$V_{\text{out}} = V_{\text{in}} \rightarrow G = 0 \text{ dB}$$

$$V_{\text{out}} = 10 V_{\text{in}} \rightarrow G = 20 \text{ dB}$$

$$V_{\text{out}} = 100 V_{\text{in}} \rightarrow G = 40 \text{ dB}$$

$$V_{\text{out}} = 1000 V_{\text{in}} \rightarrow G = 60 \text{ dB} \quad \dots \text{ and so on}$$

20 dB $\rightarrow$ represents an order of magnitude change

ex $5^{2x-1} = 2^x$ (solve for x)

$$\ln(5^{2x-1}) = \ln(2^x) \rightarrow (2x-1)\ln 5 = x\ln 2$$

$$\rightarrow x = \frac{\ln 5}{2\ln 5 - \ln 2} \quad \leftarrow \begin{matrix} =? \\ \frac{1}{2 - \log_5 2} \end{matrix}$$

Mechanisms of Diff. Calculus

i) product rule: $\frac{d}{dx}(f(x)g(x)) = f'g + g'f$
 $f' \equiv \frac{df(x)}{dx}$

ii) quotient rule: $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g f' - f g'}{g^2}$

[finish on 9/1]