MAT 231- Calculus 1 Review- Prof. Santilli
BACKGROUND INFORMATION FOR CALCULUS 2

INVERSE HYPERBOLIC TRIG FUNCTIONS:

1.) $\sinh^{-1} x = \ln\left(x + \sqrt{x^2 + 1}\right)$

2.) $\cosh^{-1} x = \ln\left(x + \sqrt{x^2 - 1}\right)$

3.) $\tanh^{-1} x = \frac{1}{2}\ln\left(\frac{1+x}{1-x}\right)$

LIMITS:

1.) $\lim_{x \to a} f(x) = \infty - \infty = \text{indeterminate}$.

2.) $\lim_{x \to a} f(x) = \frac{1}{0} = \pm\infty, DNE$.

3.) $\lim_{x \to a} f(x) = \frac{0}{0} = \text{indeterminate}$.

4.) $\lim_{x \to a} f(x) = \infty^{\infty} = \infty$.

5.) $\lim_{x \to a} f(x) = 1^{\infty} = \text{indeterminate}$.

6.) $\lim_{x \to a} f(x) = 0^{0} = \text{indeterminate}$.

7.) $\lim_{x \to a} f(x) = \frac{1}{\infty} = 0$

8.) $\lim_{x \to a} f(x) = \frac{\infty}{\infty} = \text{indeterminate}$

9.) $\lim_{x\to 0}(1+x)^{\frac{1}{x}} = e$

10.) $\lim_{x\to 0}\frac{\sin x}{x} = 1$

11.) $\lim_{x\to 0}\frac{1-\cos x}{x} = 0$

12.) $\lim_{x\to 0}\left(\frac{e^x - 1}{x}\right) = 1$

13.) $\lim_{x\to\infty}\frac{Ax^{m+1}+\ldots}{Bx^m+\ldots} = \infty$

14.) $\lim_{x\to\infty}\frac{Ax^m+\ldots}{Bx^{m+1}+\ldots} = 0$

15.) $\lim_{x\to\infty}\frac{Ax^m+\ldots}{Bx^m+\ldots} = \frac{A}{B}$

16.) $\lim_{x\to a} f(x) = 0^{\infty} = 0$

17.) $\lim_{x\to a} f(x) = (0)(\infty) =$ indeterminate

18.) $\lim_{x\to a} f(x) = (-\infty - \infty) = -\infty$

19.) $\lim_{x\to a} f(x) = \infty^{-\infty} = \frac{1}{\infty^{\infty}} = \frac{1}{\infty} = 0$

20.) $\lim_{x\to a} f(x) = \infty^{0} =$ indeterminate

21.) $\lim_{x\to a} f(x) = \infty + \infty = \infty$

DERIVATIVES:

1.) The product rule is the first times the derivative to the second plus the second times the derivative of the first, i.e.,

$$\frac{d\left(\mathrm{f(x)g(x)}\right)}{dx} = f(x)\frac{dg(x)}{dx} + g(x)\frac{df(x)}{dx}$$

2.) The chain rule is the derivative of the outer function times the derivative of the inner function, i.e., $\frac{d\left(\mathrm{f(g(x))}\right)}{dx} = \frac{df}{dg}\frac{dg}{dx}$

3.) The quotient rule is the bottom times the derivative of the top minus the top times the derivative of the bottom all over the bottom squared, i.e.,

$$\frac{d\left(\frac{\mathrm{f(x)}}{\mathrm{g(x)}}\right)}{dx} = \frac{g(x)\frac{df(x)}{dx} - f(x)\frac{dg(x)}{dx}}{[g(x)]^2}$$

4.) $\frac{d\left(\mathrm{u}^{\mathrm{a}}\right)}{dx} = a\mathrm{u}^{\mathrm{a-1}}\frac{du}{dx}$

5.) $\frac{d\left(\mathrm{a}^{\mathrm{u}}\right)}{dx} = \mathrm{a}^{\mathrm{u}}\ln a\frac{du}{dx}$

6.) $\frac{d\left(\mathrm{e}^{\mathrm{u}}\right)}{dx} = \mathrm{e}^{\mathrm{u}}\frac{du}{dx}$

7.) $\frac{d\left(\mathrm{lnu}\right)}{dx} = \frac{1}{u}\frac{du}{dx}$

8.) $\frac{d\left(\mathrm{log_a u}\right)}{dx} = \frac{1}{u\ln a}\frac{du}{dx}$

9.) $$\frac{d|u|}{dx} = \frac{|u|}{u}\frac{du}{dx}$$

10.) $$\frac{d(\sin u)}{dx} = \cos u \frac{du}{dx}$$

11.) $$\frac{d(\sec u)}{dx} = \sec u \tan u \frac{du}{dx}$$

12.) $$\frac{d(\cos u)}{dx} = -\sin u \frac{du}{dx}$$

13.) $$\frac{d(\cot u)}{dx} = -\csc^2 u \frac{du}{dx}$$

14.) $$\frac{d(\csc u)}{dx} = -\csc u \cot u \frac{du}{dx}$$

15.) $$\frac{d(\tan u)}{dx} = \sec^2 u \frac{du}{dx}$$

16.) $$\frac{d(\sin^{-1} u)}{dx} = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$$

17.) $$\frac{d(\sec^{-1} u)}{dx} = \frac{1}{|u|\sqrt{u^2-1}}\frac{du}{dx}$$

18.) $$\frac{d(\csc^{-1} u)}{dx} = \frac{-1}{|u|\sqrt{u^2-1}}\frac{du}{dx}$$

19.) $$\frac{d\left(\tan^{-1}u\right)}{dx}=\frac{1}{1+u^2}\frac{du}{dx}$$

20.) $$\frac{d\left(\cos^{-1}u\right)}{dx}=\frac{-1}{\sqrt{1-u^2}}\frac{du}{dx}$$

21.) $$\frac{d\left(\cot^{-1}u\right)}{dx}=\frac{-1}{1+u^2}\frac{du}{dx}$$

22.) $$\frac{d\left(\text{constant}^{\text{variable}}\right)}{dx}=\left(\text{constant}^{\text{variable}}\right)\ln(\text{constant})\left(\frac{\mathrm{d}(\text{variable})}{\mathrm{dx}}\right)$$

23.) $$\frac{d\left(\text{variable}^{\text{constant}}\right)}{dx}=(\text{constant})\left(\text{variable}^{\text{constant}-1}\right)\left(\frac{\mathrm{d}(\text{variable})}{\mathrm{dx}}\right)$$

24.) $$\frac{d\left(\text{variable}^{\text{variable}}\right)}{dx}\rightarrow \text{use logarithmic differentiation}$$

25.) $$\frac{d\left(\text{constant}^{\text{constant}}\right)}{dx}=0$$

26.) $$\frac{d(\sinh u)}{dx}=\cosh u\frac{du}{dx}$$

27.) $$\frac{d(\cosh u)}{dx}=\sinh u\frac{du}{dx}$$

28.) $$\frac{d(\tanh u)}{dx}=\operatorname{sech}^2 u\frac{du}{dx}$$

29.) $$\frac{d(\coth u)}{dx} = -\operatorname{csch}^2 u \frac{du}{dx}$$

30.) $$\frac{d(\operatorname{sech} u)}{dx} = -\operatorname{sech} u \tanh u \frac{du}{dx}$$

31.) $$\frac{d(\operatorname{csch} u)}{dx} = -\operatorname{csch} u \coth u \frac{du}{dx}$$

32.) $$\frac{d(\sinh^{-1} u)}{dx} = \frac{1}{\sqrt{u^2+1}} \frac{du}{dx}$$

33.) $$\frac{d(\tanh^{-1} u)}{dx} = \frac{1}{1-u^2} \frac{du}{dx}$$

34.) $$\frac{d(\cosh^{-1} u)}{dx} = \frac{1}{\sqrt{u^2-1}} \frac{du}{dx}$$

35.) $$\frac{d(\coth^{-1} u)}{dx} = \frac{1}{1-u^2} \frac{du}{dx}$$

36.) $$\frac{d(\operatorname{sech}^{-1} u)}{dx} = \frac{-1}{u\sqrt{1-u^2}} \frac{du}{dx}$$

37.) $$\frac{d(\operatorname{csch}^{-1} u)}{dx} = \frac{-1}{|u|\sqrt{1+u^2}} \frac{du}{dx}$$