Calculus AB Formulas

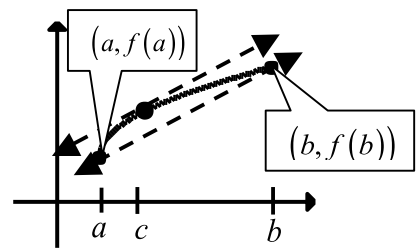
1) Definition of the __________________________: $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

$$f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

2) Definition of Continuous Functions at Point x=a

1. f(a) ____________________
2. $\lim_{x \to a} f(x)$ _______________________. ($\lim_{x \to a-} f(x) = \lim_{x \to a+} f(x)$) (__________ matches __________)
3. $f(a) = \lim_{x \to a} f(x)$

3) Odd functions: $f(-x) = -f(x)$, Symmetric to ______________
Even functions: $f(-x) = f(x)$, Symmetric to _________________.



4) Mean Value Theorem Equation: $f'(c) = \frac{f(b) - f(a)}{b - a}$

for $a < c < b$ (for $f(x)$ continuous on [a, b] and differentiable on (a, b))

______________________ = _______________________

6) First Fundamental Theorem of Calculus:

$\int_a^b f'(x)\,dx =$ ____________________

7) Second Fundamental Theorem of Calculus:

$$\frac{d}{dx} \int_a^x f(t)\,dt = \_\_\_\_\_\_\_\_\_$$

When Chain Rule applies: $\frac{d}{dx} \int_a^u f(t)\,dt = f(u) \frac{du}{dx}$

8) Approximation of the Area Under a Curve

a) Riemann Sum: Draw a figure and add up the rectangle areas
  a. **Midpoint, Right-Hand, Left-Hand**
(with equal width) width= ____________

b) Trapezoids: (with unequal widths) add up areas of all trapezoids $A =$ ___________________

(with n equal widths) $A \approx \frac{1}{2} \frac{b-a}{n} \left(f(x_1) + 2f(x_2) + 2f(x_3) + \ldots + 2f(x_n) + f(x_{n+1}) \right)$

12) Growth and Decay Equation ________________

13) Trig Limits

$\lim_{x \to 0} \frac{sinx}{x} =$ ____ $\lim_{x \to 0} \frac{x}{sinx} =$ _____ $\lim_{h \to 0} \frac{cosh - 1}{h} =$ ______

**** Remember that we can now use L'Hopital's rule for these limits too**

14) Derivative of an Inverse

$g'(y) = \frac{1}{f'(g(y))} = \frac{1}{f'(x)}$ (Easier to just memorize that "Image points have ____________ slopes.")

15) Finding Asymptotes

Horizontal Asymptotes: **B**_______ **o**__ **B**________ **0**, **B**__________ **o**__ **T**_____ **N**______, **E**____________ **a**____ **t**____ **s**________ **D**___________ **C**_________________

(Can also use this for limits towards _______.)

Vertical Asymptotes: Factor _______________________ and set equal to ________________.

16) Finding Zeros

Set ______________________ equal to zero

17) Position – Velocity – Acceleration

$s(t)$ or $x(t)$ – $v(t)$ – $a(t)$

$\frac{d}{dt}s(t) = v(t)$ $\qquad \int a(t)dt = v(t) + C$

$\frac{d}{dt}v(t) = a(t)$ $\qquad \int v(t)dt = s(t) + C$

$v(t) = 0$ implies particle at _________________.

$v(t) > 0$ implies particle moving to ________________ $v(t) < 0$ implies particle moving to ______________

$|v(t)|$ = __________________

Particle __________________ if velocity and acceleration have the same sign. Particle ___________________ if velocity and acceleration have opposite signs.

18) Intermediate Value Theorem

If f is continuous on a closed interval [a,b] and c is any number between f(a) and f(b) then there is at least one number x in the interval [a,b] such that f(x)=c

19) Trig Identities

$\sin^2 x + \cos^2 x = 1$ $\qquad \tan^2 x + 1 = \sec^2 x$ $\qquad 1 + \cot^2 x = \csc^2 x$

20) Average Rate of Change vs. Instantaneous Rate of Change

Average rate of change of a Function on [a, b]: $m = \frac{f(b) - f(a)}{b - a}$ (this is just slope between two points)

Instantaneous Rate of Change: use the derivative (finds slope at <u>one</u> point)

21) Tangent – Normal Lines

Tangent: $y - y_1 = m(x - x_1)$ use the derivative to find m

Normal: $y - y_1 = \frac{-1}{m}(x - x_1)$

22) Curve Sketching for $y = f(x)$:

f(x)	f '(x)	f ''(x)
Increasing		
Decreasing		
Concave Up		
Concave Down		

Max. or Min. Points: Relative: $f'(x) = 0$ or $f'(x)$ undefined. **Make an** f' **number line.**

Absolute:

Extreme Value Theorem: If a function is continuous on a closed interval [a,b], then *f* has both a max value and a min value on [a,b].

The candidates for absolute extrema are relative extrema **or endpoints** of a closed interval.

Justifications for Relative Max: *f'* changes from positive to negative
Justifications for Relative Min: *f'* changes from negative to positive

Points of Inflection: $f''(x) = 0$ or $f''(x)$ undefined **Make an** f'' **number line.**

Justifications for Points of Inflection: *f'* changes from decreasing to increasing, *f'* changes from increasing to decreasing, *f''* changes from positive to negative or negative to positive.

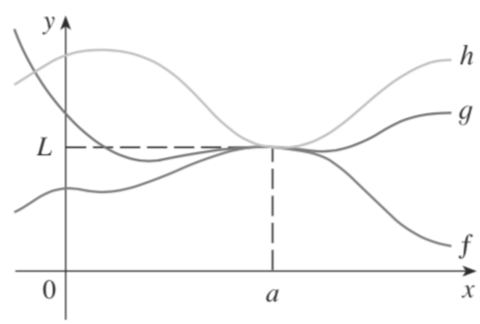
23) Squeeze Theorem

The Squeeze Theorem

If $f(x) \le g(x) \le h(x)$ when x is near a (except possibly at a) and

$$\lim_{x\to a} f(x) = L = \lim_{x\to a} h(x)$$

then $\lim_{x\to a} g(x) = L$



24) Derivatives to Memorize

___________ **Rule:** $\frac{d}{dx}x^n = nx^{n-1}$ ____________ **Rule:** $\frac{d}{dx}\left(f(x)g(x)\right) = f'(x)g(x) + g'(x)f(x)$

______________ **Rule** $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{g(x)^2}$ ______________ **Rule** $\frac{d}{dx}f\left(g(x)\right) = f'\left(g(x)\right)g'(x)$

Log Rules: $\frac{d}{dx}\ln x =$ _______ $\frac{d}{dx}\log_b x =$ _________

Exponential Rules: $\frac{d}{dx}e^x =$ _____ $\frac{d}{dx}b^x =$ _________

Trig Rules: $\frac{d}{dx}\sin x =$ _______ $\frac{d}{dx}\cos x =$ ________

$\frac{d}{dx}\tan x =$ _________ $\frac{d}{dx}\cot x =$ _________

$\frac{d}{dx}\sec x =$ _____________ $\frac{d}{dx}\csc x =$ _____________

Inverse Trig Rules: $\frac{d}{dx}[\_\_\_\_\ ^{-1}x] = \frac{1}{\sqrt{1-x^2}}$ $\quad \frac{d}{dx}[\_\_\_\_\_\ ^{-1}x] = \frac{-1}{\sqrt{1-x^2}}$

$\frac{d}{dx}[\_\_\_\_\ ^{-1}x] = \frac{1}{1+x^2}$ $\quad \frac{d}{dx}[\_\_\_\_\_\ ^{-1}x] = \frac{-1}{1+x^2}$

$\frac{d}{dx}[\_\_\_\_\ ^{-1}x] = \frac{1}{x\sqrt{x^2-1}}$ $\quad \frac{d}{dx}[\_\_\_\_\_\ ^{-1}x] = \frac{-1}{x\sqrt{x^2-1}}$

** IMPLICIT DIFFERENTIATION can be used when it is inconvenient to solve for y.

25) Integrals to Memorize:
**** Use u-substitution if x is not a singular variable.**

Power Rule $\int x^n\,dx = \frac{x^{n+1}}{n+1} + C,\ n \neq -1$

Log Rules $\int \frac{1}{x}\,dx =$ ________________

Exponential Rules $\int e^x\,dx =$ __________

$\int b^x\,dx =$ ___________

Trig Rules

$\int \cos x\,dx =$ _______________

$\int \sin x\,dx =$ _______________

$\int \sec^2 x\,dx =$ _____________

$\int \sec x \tan x\,dx =$ ______________

$\int \csc^2 x\,dx =$ _____________

$\int \csc x \cot x\,dx =$ ______________

Inverse Trig Rules

$$\int \frac{1}{\sqrt{1-x^2}}dx = sin^{-1}x + c \qquad \int \frac{1}{\sqrt{a^2-x^2}}dx = sin^{-1}\frac{x}{a} + c$$

$$\int \frac{1}{1+x^2}dx = tan^{-1}x\ + c \qquad \int \frac{1}{a^2+x^2}dx = \frac{1}{a}tan^{-1}\frac{x}{a}\ + c$$

$$\int \frac{1}{x\sqrt{x^2-1}}dx = sec^{-1}x\ + c \qquad \int \frac{1}{x\sqrt{x^2-a^2}}dx = \frac{1}{a}sec^{-1}\frac{x}{a}\ + c$$

26) Geometry Formulas:

Triangles
-Know how to set up proportions for similar triangles
-Area: _______________
-Area of Equilateral Triangle: _______

Rectangles
-Area: $A = l \cdot w$
-Perimeter: $P = 2l + 2w$

Circles
-Area: $A =$ ____________
-Relationship between radius and diameter: 2r=d
-Circumference: $C =$ ______

Rectangular Prism/Box
-Volume: $V =$ _________________
-Surface Area: $SA = 2(lw + lh + hw)$

Cylinder
-Volume: $V =$ ___________

Sphere
-Volume: $V =$ __________
-Surface Area: $SA =$ __________

Cone
-Volume: $V =$ __________