AP Calculus Need To Know Quiz **Name: ____________________**

Relationships of f, f ', and f ''

1) f(x) is increasing when f '(x) is >0 or positive
2) f(x) is decreasing when f '(x) is <0 or negative
3) f(x) has a local minimum when f '(x) is changing from negative to positive
4) f(x) has a local maximum when f '(x) is changing from positive to negative
5) f(x) has a point of inflection when f '(x) is changing from inc. to dec. or vice versa
6) f(x) is concave up when f '(x) is increasing
7) f(x) is concave down when f '(x) is decreasing
8) f(x) is concave up when f ''(x) is >0 or positive
9) f(x) is concave down when f ''(x) is <0 or negative
10) f(x) has a point of inflection when f ''(x) is changing from pos. to neg. or vice versa

Derivatives: a and n are constants, u, v, and w are functions of x

1) $\frac{d}{dx}(a) = 0$	2) $\frac{d}{dx}(f(u)) = f'(u)\frac{du}{dx}$
3) $\frac{d}{dx}(x) = 1$	4) $\frac{d}{dx}(\ln(u)) = \frac{1}{u}\frac{du}{dx}$
5) $\frac{d}{dx}(au) = a\frac{du}{dx}$	6) $\frac{d}{dx}(e^u) = e^u\frac{du}{dx}$
7) $\frac{d}{dx}(u+v-w) = \frac{du}{dx}+\frac{dv}{dx}-\frac{dw}{dx}$	8) $\frac{d}{dx}(a^u) = a^u \ln a\frac{du}{dx}$
9) $\frac{d}{dx}(uv) = u\frac{dv}{dx}+v\frac{du}{dx}$	10) $\frac{d}{dx}(\sin u) = \cos(u)\frac{du}{dx}$
11) $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$	12) $\frac{d}{dx}(\cos u) = -\sin(u)\frac{du}{dx}$
13) $\frac{d}{dx}(u^n) = nu^{n-1}\frac{du}{dx}$	14) $\frac{d}{dx}(\tan u) = \sec^2 u\frac{du}{dx}$
15) $\frac{d}{dx}(\sqrt{u}) = \frac{1}{2\sqrt{u}}\frac{du}{dx}$	16) $\frac{d}{dx}(\sec u) = \sec u \tan u\frac{du}{dx}$
17) $\frac{d}{dx}\left(\frac{1}{u}\right) = -\frac{1}{u^2}\frac{du}{dx}$	18) $\frac{d}{dx}(\csc u) = -\csc u \cot u\frac{du}{dx}$
19) $\frac{d}{dx}\left(\frac{1}{u^n}\right) = -\frac{n}{u^{n+1}}\frac{du}{dx}$	20) $\frac{d}{dx}(\cot u) = -\csc^2 u\frac{du}{dx}$

PVA – Particle Motion:
When is a particle moving forward/right/up? **v(t) > 0**

When is a particle moving backward/left/down? **v(t) < 0**

When is a particle stopped? **v(t) = 0**

When is a particle speeding up? **v(t) and a(t) have the same signs**

When is a particle slowing down? **v(t) and a(t) have opposite signs**

What is speed? **|v(t)|**

What is the relationship between position and velocity? **Velocity is the derivative of position**
X'(t) = v(t) or s'(t) = v(t)

What is the relationship between position and acceleration?
Acceleration is the 2^{nd} derivative of position.

What is the relationship between velocity and acceleration?
Acceleration is the derivative of velocity.

Limits:
As x approaches a constant
= # Done

=#/0 Test LHL and RHL answer will either be infinity, negative infinite or DNE

=0/0 Factoring, Multiply by the Conjugate, or L'Hopitals

As x approaches infinity:
Top heavy: Plug in x to see if answer is infinity or negative infinity

Bottom heavy: 0

Equal power: Ratio of coefficients of dominant terms

Definition of Continuity:

1. Limit as x approaches c exists

2. f(c) exists

3. Limit as x approaches c equals f(c)

What is IVT? What conditions must be true? What does it guarantee?
Guarantees an output/y-value. Condition is that the function is continuous.
What is Rolle's Theorem? What conditions must be true? What does is guarantee?
Guarantees a slope of zero. Conditions function is continuous and differentiable on the interval.
What is MVT? What conditions must be true? What does it guarantee?
Guarantees the slope of (f(b) – f(a))/ (b – a) = f ' (c) Conditions are the same as Rolles

Derivative power rule: **Bring down the exponent, decrease the exponent by 1.**

Integral power rule: **Increase the exponent by 1, divide by the new exponent.**

Important Integrals:

$\int e^x dx = e^x + C$
$\int \frac{1}{x} dx = \ln\lvert x\rvert + C$
$\int \tan x \, dx = -\ln\lvert \cos x \rvert + C$

First fundamental theorem of calculus:

$$\int_a^b f(x)dx = F(b) - F(a)$$

Derivatives		Integrals	
	||	sin(x)	^
	||	cos(x)	||
	||	-sin(x)	||
	V	-cos(x)	||

Theta	0	Pi/6	Pi/4	Pi/3	Pi/2	Pi	3Pi/2	2Pi
Sin(Theta)	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	0	-1	0
Cos(Theta)	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	-1	0	1
Tan(Theta)	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	Undefined	0	Undefined	0

Riemann Sums:
LRAM **overapproximates a decreasing function and underapproximates an increasing function**

RRAM **overapproximates an increasing function and underapproximates a decreasing function**

Trapezoidal = (LRAM + RRAM)/2

$\int_a^b f(x)dx = -\int_b^a f(x)dx$ $\int_a^c f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx$

Revolution of solids:

Area when in the form y = $\int_a^b f(x) - g(x)dx$ Top curve - bottom

Area when in the form x = $\int_c^d f(y) - g(y)dy$ Right curve - left

Disc Formula: $V = \pi \int_a^b (R(x))^2 dx$

Washer Formula: $V = \pi \int_a^b (R(x))^2 - (r(x))^2 dx$

Derivative for the following functions:

$\frac{d}{dx}\sin^{-1} x = \frac{1}{\sqrt{1-x^2}}$	$\frac{d}{dx}\sin^{-1} u = \frac{1}{\sqrt{1-u^2}} \cdot \frac{du}{dx}$
$\frac{d}{dx}\cos^{-1} x = \frac{-1}{\sqrt{1-x^2}}$	$\frac{d}{dx}\cos^{-1} u = \frac{-1}{\sqrt{1-u^2}} \cdot \frac{du}{dx}$
$\frac{d}{dx}\tan^{-1} x = \frac{1}{1+x^2}$	$\frac{d}{dx}\tan^{-1} u = \frac{1}{1+u^2} \cdot \frac{du}{dx}$
$\int \frac{1}{\sqrt{a^2-u^2}} du = \sin^{-1}\frac{u}{a} + C$	$\int \frac{1}{a^2+u^2} du = \tan^{-1}\frac{u}{a} + C$

Average value function formula:

$$f_{ave} = \frac{1}{b-a}\int_a^b f(x)dx$$

Total distance traveled formula:

$$Total\ distance\ traveled = \int_a^b |v(t)|dt$$

Displacement formula:

$$Displacement = \int_a^b v(t)dt$$

Current position at t = c, given the s(0) = 5:

$$s(c) = 5 + \int_0^c v(t)dt$$

Second fundamental theorem of calculus:

$$\frac{d}{dx}\int_c^x f(t)dt = f(x) \qquad \frac{d}{dx}\int_c^u f(t)dt = f(u) \cdot \frac{du}{dx}$$

Find the particular solution to the differential equation with the initial condition f(a) = b.

1) Separate
2) Integrate
3) Don't forget +C
4) Plug in initial condition
5) Solve for C
6) Rewrite equation
7) Solve for y

Tangent Line or Line Tangent to the Curve

$$y - y_1 = m(x - x_1)$$