Things I Should Know In Calculus Class

Quadratic Formula $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Pythagorean Identities $\sin^2 x + \cos^2 x = 1$ $\quad 1 + \tan^2 x = \sec^2 x$ $\quad 1 + \cot^2 x = \csc^2 x$

Angle sum and difference formulas

$$\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y$$
$$\cos(x \pm y) = \cos x \cos y \mp \sin x \sin y$$

Double angle formulas

$$\sin 2x = 2 \sin x \cos x$$
$$\cos 2x = \cos^2 x - \sin^2 x$$
$$\cos 2x = 2\cos^2 x - 1$$
$$\cos 2x = 1 - 2\sin^2 x$$

Alternate versions of the half-angle formulas $\cos^2 x = \dfrac{1 + \cos 2x}{2}$ $\quad \sin^2 x = \dfrac{1 - \cos 2x}{2}$

$$\sin(-x) = -\sin x \qquad \tan(-x) = -\tan x \qquad \sec(-x) = \sec x$$
$$\cos(-x) = \cos x \qquad \cot(-x) = -\cot x \qquad \csc(-x) = -\csc x$$

Slope-intercept form $y = mx + b$ **point-slope form** $y - y_1 = m(x - x_1)$

Vertical line $x = a$ **horizontal line** $y = b$

Absolute value of a number x is the number $|x| = \sqrt{x^2} = x$ **if** $x \geq 0$ and $x < 0.$

Graphing trigonometric functions $f(x) = a \sin b(x - c) + d$

$|a| = \text{amplitude} \qquad \dfrac{2\pi}{b} = \text{period}$

$|c| = \text{horizontal shift} \qquad |d| = \text{vertical shift}$

Definition of the derivative $f'(x) = \lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$

position **down—take a derivative**
velocity
acceleration **up—take an integral**

Things I Should Know In Calculus Class

Continuity Test

The function $y = f(x)$ **is continuous at** $x = c$ **if and only if all of the following are true:**

1) $f(c)$ **exists** (c **is in the domain of** f)
2) $\lim_{x \to c} f(x)$ **exists**
3) $\lim_{x \to c} f(x) = f(c)$

Chain Rule $\frac{d}{dx}\left(u^n\right) = n\left(u^{n-1}\right)du$

Product Rule $f(x)g'(x) + g(x)f'(x)$

(First times the derivative of the second) plus (the second times the derivative of the first)

Quotient Rule $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

(Bottom times the derivative of the top) minus (the top times the derivative of the bottom) over the bottom squared

Limit Rules $\lim_{h \to 0} \frac{\sin(h)}{h} = 1$ $\lim_{h \to 0} \frac{1-\cos(h)}{h} = 0$ $\lim_{x \to \infty} \frac{1}{x} = 0$

Derivatives $\begin{cases} \sin u = \cos u\,du \\ \cos u = -\sin u\,du \\ \tan u = \sec^2 u\,du \end{cases}$ $\begin{cases} \sec u\,du = \sec u \tan u\,du \\ \csc u\,du = -\csc u \cot u\,du \\ \cot u\,du = -\csc^2 u\,du \end{cases}$

$f(f^{-1}(x)) = x$ $f^{-1}(f(x)) = x$

Horizontal line test—if passes, the function has an inverse.
An inverse is determined by interchanging x and y in the function and then solving the equation for y.

First Derivative Test

1. **f increases on I if** $f'(x) > 0$ **for all x in I**
2. **f decreases on I if** $f'(x) < 0$ **for all x in I**

Second Derivative Test

1. **Concave up on I when** $f''(x) > 0$
2. **Concave down on I when** $f''(x) < 0$
3. **Inflection point when** $f''(x) = 0$ **or** $f''(x)$ **fails to exist**

Things I Should Know In Calculus Class

Symmetry

1. **y-axis** $f(-x) = f(x)$
2. **x-axis** $f(-x) = -f(x)$
3. **origin** $f(-x,-y) = f(x,y)$ **origin symmetry contains x and y symmetry**

x-intercepts are zeros of the function

The graph of an odd function is symmetric with respect to the origin.
The graph of an even function is symmetric with respect to the y-axis.

Asymptotes

Horizontal $\lim\limits_{x\to\infty} f(x)$ **or**

1. **higher exponent in numerator—no horizontal asymptote**
2. **higher exponent in denominator—** $y = 0$
3. **exponents are equal in numerator and denominator—ratio of the coefficients**

Vertical—zeros of the denominator

Oblique (slant)—higher exponent must be in the numerator—divide the denominator into the numerator—the quotient is the asymptote

Candidates for maximum and/or minimum (one of the following is true)

1. $f'(x) = 0$
2. $f'(x)$ **does not exist**
3. **endpoints (if any) of the domain of** f

L'Hopital's Rule for indeterminate forms $\lim\limits_{x\to a} \dfrac{f(x)}{g(x)} = \dfrac{0}{0}$**, if this occurs then** $\lim\limits_{x\to a} \dfrac{f'(x)}{g'(x)}$.

Exponential Growth and Decay $A = Ce^{kt}$ $\dfrac{dy}{dx} = ky$

Logistics $y = \dfrac{A}{1 + Be^{-Akt}}$

Translations

$f(x-h)$ **shifts** $f(x)$ **h units to the right**
$f(x+h)$ **shifts** $f(x)$ **h units to the left**
$f(x)+k$ **shifts** k **units upward**
$f(x)-k$ **shifts** k **units downward**

A closed interval [,] contains the endpoints, an open interval (,) does not.

Things I Should Know In Calculus Class

Properties of the natural logarithm $y = \ln x$

Domain: all positive reals
Range: All Reals
Continuous
Always concave down
One-to-one (inverse is $y = e^x$ **)**

$\ln 1 = 0$

$\ln e = 1$

$$\frac{d}{dx}\ln u = \frac{1}{u}du$$

Laws of logarithms:

$$\ln(ab) = \ln a + \ln b$$

$$\ln\frac{a}{b} = \ln a - \ln b$$

$$\ln a^n = n\ln a$$

Properties of the exponential function $y = e^x$

Domain: all Reals
Range: $y > 0$
Continuous
Always increasing
One-to-one (inverse is $y = \ln x$**)**

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

$\ln e^n = n\ln e = n$

$y = e^x \Leftrightarrow x = \ln y$

$\ln e^x = x$

$e^{\ln x} = x$

$$\frac{d}{dx}e^u = e^u\,\frac{du}{dx}$$

$(e^x)(e^x) = e^{2x}$ $\qquad$ $e^{-x} = \dfrac{1}{e^x}$

$a^x = e^{x\ln a} \qquad (a \neq 1, a > 0)$

$\dfrac{d}{dx}a^x = a^x\ln a$ $\qquad$ $\dfrac{d}{dx}a^u = a^u\ln a\dfrac{du}{dx}$

Things I Should Know In Calculus Class

Volume Formulas

Cone $\frac{1}{3}\pi r^2 h$ **Cylinder** $\pi r^2 h$ **rectangular box** lwh

Sphere $\frac{4}{3}\pi r^3$

Surface Area Formulas

Sphere $4\pi r^2$ **cylinder with closed top** $2\pi r^2 + 2\pi rh$

Cylinder with open top $\pi r^2 + 2\pi rh$

Box with a top **area of four sides + area of top and bottom**

Table of Trigonometric Values

Radians	Sine	Cosine
0	**0**	**1**
$\frac{\pi}{6}$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
$\frac{\pi}{4}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$
$\frac{\pi}{2}$	**1**	**0**
π	**0**	**-1**
$\frac{3\pi}{2}$	**-1**	**0**