Algebraic

- $a^2 - b^2 = (a-b)(a+b)$
- $a^3 - b^3 = (a-b)(a^2+ab+b^2)$
- Quadratic Formula: $\dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$

Geometric

- Area of Circle: πr^2
- Circumference of Circle: $2\pi r$
- Circle with center (h,k) and radius r:

$$(x-h)^2 + (y-k)^2 = r^2$$

- Distance from (x_1, y_1) to (x_2, y_2):

$$\sqrt{(x_1-x_2)^2 + (y_1-y_2)^2}$$

- Area of Triangle: $\frac{1}{2}bh$
- $\sin\theta = \dfrac{\text{opposite leg}}{\text{hypotenuse}}$
- $\cos\theta = \dfrac{\text{adjacent leg}}{\text{hypotenuse}}$
- $\tan\theta = \dfrac{\text{opposite leg}}{\text{adjacent leg}}$
- If $\triangle ABC$ is similar to $\triangle DEF$ then

$$\frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$$

- Volume of Sphere: $\frac{4}{3}\pi r^3$
- Surface Area of Sphere: $4\pi r^2$
- Volume of Cylinder/Prism: (height)(area of base)
- Volume of Cone/Pyramid: $\frac{1}{3}$(height)(area of base)

Trigonometric

- $\sin^2\theta + \cos^2\theta = 1$
- $\sin(2\theta) = 2\sin\theta\cos\theta$
- $\cos(2\theta) = \cos^2\theta - \sin^2\theta$
$= 1 - 2\sin^2\theta$
$= 2\cos^2\theta - 1$

Graph: $y = \frac{1}{x}$

$y = \pm x^2$

$y = |kx+b|$

- Highest order rule: $\lim\limits_{x\to\infty} \dfrac{f(x)}{g(x)}$

Limits

- $\lim\limits_{x\to a} f(x) = L$ if for every $\varepsilon > 0$ there exists $\delta > 0$ so that $|f(x) - L| < \varepsilon$ when $|x-a| < \delta$.
- $\lim\limits_{x\to a} f(x)$ exists if and only if

$$\lim_{x\to a^-} f(x) = \lim_{x\to a^+} f(x)$$

- $\lim\limits_{\theta\to 0} \dfrac{\sin\theta}{\theta} = 1$
- $\lim\limits_{\theta\to 0} \dfrac{1-\cos\theta}{\theta} = 0$

Derivatives

- $f'(x) = \lim\limits_{h\to 0} \dfrac{f(x+h) - f(x)}{h}$
- $(fg)' = f'g + fg'$
- $\left(\dfrac{f}{g}\right)' = \dfrac{f'g - fg'}{g^2}$
- $(f(g(x)))' = f'(g(x)) \cdot g'(x)$
- $(\sin x)' = \cos x$
- $(\cos x)' = -\sin x$
- $(\tan x)' = \sec^2 x$
- $(\sec x)' = \sec x \cdot \tan x$

$(x^n)' = n \cdot x^{n-1}$

$x^n \xrightarrow{\text{anti-D}} \frac{1}{n+1} x^{n+1}$

Theorems

- (IVT) If f is continuous on $[a,b]$, $f(a) \neq f(b)$, and N is between $f(a)$ and $f(b)$ then there exists $c \in (a,b)$ that satisfies $f(c) = N$.
- (MVT) If f is continuous on $[a,b]$ and differentiable on (a,b) then there exists $c \in (a,b)$ that satisfies $f'(c) = \dfrac{f(b)-f(a)}{b-a}$.
- (FToC P1) If $F(x) = \displaystyle\int_a^x f(t)\,dt$, then $F'(x) = f(x)$.

$\left(\int_a^{u(x)} f(t)dt\right)' = f(u(x)) \cdot u'(x)$

$\left(\int_{v(x)}^a f(t)dt\right)' = -f(v(x)) \cdot v'(x)$

Other Formulas

- Newton's Method: $x_{n+1} = x_n - \dfrac{f(x_n)}{f'(x_n)}$. $x_2 = x_1 - \dfrac{f(x_1)}{f'(x_1)}$
- Linearization of f at a: $L(x) = f(a) + f'(a)(x-a)$
- $\displaystyle\sum_{i=1}^{n} c = cn$
- $\displaystyle\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$
- $\displaystyle\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$

FTC P2: $\int_a^b f(x)dx = F(x)\Big|_a^b = F(b) - F(a)$

where F is an anti-D of f.