Complex Numbers $i = \sqrt{-1}$ and $i^2 = -1.$

**Quadratic Formula** The equation $ax^2 + bx + c = 0$ has roots $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$

**Absolute Value** Let $k$ represent a positive real number.
1. $|u| = k$ is equivalent to $u = k$ or $u = -k.$
2. $|u| = 0$ is equivalent to $u = 0.$
3. $|u| = -k$ has no solution.
4. $|u| < k$ is equivalent to $-k < u < k.$
5. $|u| > k$ is equivalent to $u < -k$ or $u > k.$

**Distance formula** between points $(x_1, y_1)$ and $(x_2, y_2)$ is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$

**The Midpoint formula** between the points is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$

**Finding $x$ and $y$ intercepts** To find $x$ intercepts, set $y$ equal to zero and solve for $x.$ To find $y$ intercepts, set $x$ equal to zero and solve for $y.$

**Standard form for a circle** of radius $r$ centered at $(h, k)$ is $(x - h)^2 + (y - k)^2 = r^2.$

**The slope** of a line passing through points $(x_1, y_1)$ and $(x_2, y_2)$ is $m = \frac{y_2 - y_1}{x_2 - x_1}.$

**Slope intercept form** is $y = mx + b,$ where $m$ is the slope and $b$ is the $y$ intercept.

**Point slope form** is $y - y_1 = m(x - x_1).$

Two lines are **parallel** if they have the same slope. Two lines are **perpendicular** if one slope is equal to the opposite reciprocal of the other slope.

A function is **even** if $f(-x) = f(x).$ A function is **odd** if $f(-x) = -f(x).$

**Composition of functions** $f(x)$ and $g(x)$ is $(f \circ g)(x) = f(g(x)).$

**The difference quotient** of a function is $\frac{f(x + h) - f(x)}{h}.$

**Vertex form** of a quadratic function $f(x) = ax^2 + bx + c$ is $f(x) = a(x - h)^2 + k$ where $(h, k)$ is the vertex. Also $h = -\frac{b}{2a}.$

**Remainder Theorem** If a polynomial $f(x)$ is divided by $x - c,$ then the remainder is $f(c).$

**Factor Theorem** If $f(x)$ is a polynomial, then $x - c$ is a factor of $f(x)$ if and only if $f(c) = 0.$

**Conjugate Zero Theorem** If $f(x)$ is a polynomial with real coefficients and $a + bi$ is a complex zero of $f(x),$ then its conjugate $a - bi$ is also a zero of $f(x).$

**Interest** If $P$ dollars are invested or borrowed at an annual interest $r$ for $t$ years then:
- simple interest is $I = Prt$; future value compounded $n$ times per year is $A = P \left(1 + \frac{r}{n}\right)^{nt};$
- future value compounded continuously is $A = Pe^{rt}.$
Logarithmic Function to base \( b \) where \( y = \log_b x \) is equivalent to \( b^y = x \).

Logarithm Properties

1. \( \log_b 1 = 0 \) and \( \log_b b = 1 \)

2. \( \log_b(b^x) = x \) and \( b^{\log_b x} = x \).

3. \( \log_b(xy) = \log_b x + \log_b y \).

4. \( \log_b \left(\frac{x}{y}\right) = \log_b x - \log_b y \).

5. \( \log_b(x^p) = p \log_b x \).

Exponential growth and decay models \( y = y_0 e^{kt} \) where \( y_0 \) represent the initial value of \( y \). The model represent exponential growth if \( k > 0 \) and exponential decay if \( k < 0 \).

Elementary row operations
1. Interchange two rows; 2. Multiply a row by a nonzero constant; 3. Add a nonzero multiple of one row to another row.

Ellipse
Standard form with center \((h, k)\) is \(\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1\). The major axis is horizontal if \(a > b\) and it is vertical if \(a < b\). The foci are \(c\) units, where \(c^2 = |a^2 - b^2|\), from the center along the major axis.

Parabola
Standard form for vertical axis of symmetry is \((x-h)^2 = 4p(y-k)\). For horizontal axis of symmetry is \((y-k)^2 = 4p(x-h)\). In either case \((h, k)\) is the vertex of the parabola, the focus is located inside the parabola \(|p| \) units away from the vertex, and the directrix is perpendicular to the axis of symmetry located \(|p| \) units away from the vertex outside the parabola.

Arithmetic sequence
general term is \(a_n = a_1 + (n-1)d\), where \(d\) is the common difference. The sum of the first \(n\) terms in an arithmetic sequence is \(S_n = \frac{n}{2}(a_1 + a_n)\).

Geometric sequence
general term is \(a_n = a_1 r^{n-1}\), where \(r\) is the common ratio. The sum of the first \(n\) terms in a geometric sequence is \(S_n = \frac{a_1(1-r^n)}{1-r}\), \(r \neq 1\). The infinite sum of a geometric series is \(S_\infty = \frac{a_1}{1-r}\) if \(-1 < r < 1\). Otherwise the sum does not exist.

Binomial Theorem
\((a + b)^n = \sum_{k=1}^{n} \binom{n}{k} a^{n-k} b^k\).

The \(k^{th}\) term is \(\binom{n}{k-1} a^{n-(k-1)} b^{k-1}\).