Algebra Formula Sheet

Quadratic Function

$f(x) = ax^2 + bx + c = a(x-h)^2 + h$

Vertex (h,k) *of a Parabola*:

$(h,k) = \left(-\frac{b}{2a}, f(-\frac{b}{2a})\right)$

Factoring

$(a^2 - b^2) = (a-b)(a+b)$

$(a^4 - b^4) = (a-b)(a+b)(a^2+b^2)$

$(a^3 + b^3) = (a+b)(a^2 - ab + b^2)$

$(a^3 - b^3) = (a-b)(a^2 + ab + b^2)$

Absolute Value

$$|x| = \begin{cases} x & x \geq 0 \\ -x & < 0 \end{cases}$$

Quadratic Formula

If $ax^2 + bx + c = 0$, *then* x

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Pythogorean Theorem

$a^2 + b^2 = c^2$

Midpoint & Distance Formula

Two points: $P_1(x_1, y_1)$ *and* $P_1(x_2, y_2)$

Midpoint of $\overline{P_1P_2}$: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$\overline{P_1P_2} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Complex Numbers

$a + ib$ *is a complex number*

Where $i = \sqrt{-1} \Rightarrow i^2 = -1$

$\sqrt{-b} = i\sqrt{b}$ *for* $b > 0$

n^{th} root of x^n

$$\sqrt[n]{x^n} = \begin{cases} |x| & \text{if } n \text{ even} \\ x & \text{if } n \text{ is odd} \end{cases}$$

Arithmetic Sequence and Series

$a_n = a_1 + (n-1)d$

$S_n = \frac{n}{2}(a_1 + a_n) = \frac{n}{2}[2a_1 + (n-1)d]$

Geometric Sequence and Series

$a_n = a_1 r^{n-1}$

$S_n = \frac{a_1(1 - r^n)}{(1-r)}$, $S_\infty = \frac{a_1}{(1-r)}$ *where* $|r| < 1$

Binomial Theorem

$(a+b)^n = \binom{n}{0}a^n + \binom{n}{1}a^2 b + \cdots \binom{n}{r}a^{n-r}b^r + \cdots + \binom{n}{r}a^{n-r}b^r + \binom{n}{r}b^n$ *where* $\binom{n}{r-1} + \binom{n}{r} = \binom{n+1}{r}$

$(a+b)^2 = a^2 + 2ab + b^2$

$(a+b)^3 = \binom{3}{0}a^3 + \binom{3}{1}a^2 b + \binom{3}{2}ab^2 + \binom{3}{3}a^3 = a^3 + 3a^2 b + 3ab^2 + a^3$

$(a+b)^4 = \binom{4}{0}a^4 + \binom{4}{1}a^3 b^1 + \binom{4}{2}a^2 b^2 + \binom{4}{3}ab^3 + \binom{4}{4}b^4 = a^4 + 4a^3 b^1 + 6a^2 b^2 + 4ab^3 + b^4$

Exponential Properties

$b^0 = 1$	$b^m b^n = b^{m+n}$
$\frac{b^m}{b^n} = b^{m-n}$	$(b^m)^n = b^{mn}$
$b^{-n} = \frac{1}{b^n}$	$(ab)^n = a^n b^n$
$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$
$b^{\frac{1}{n}} = \sqrt[n]{b}$	$b^{\frac{m}{n}} = \sqrt[n]{b^m} = \left(\sqrt[n]{b}\right)^m$

Forms for the Equation of a line

$y = mx + b$	*Slope intercept form* *Slope* $= m$, $P(x_0, y_0)$
$y - y_0 = m(x - x_0) + b$	*Point slope form* $P(x_0, y_0)$, *Slope* $= m$,
$\frac{x}{a} + \frac{y}{b} = 1$	*Intercept form* $x -$ *intercept form* $(a, 0)$ $y -$ *intercept form* $(0, b)$
$Ax + By = C$	*Standard form*: A, B & *are integers*
$x = a$ $y = b$	*Vertical line*: *Contains* $P(a, 0)$ *Horizontal line*: *Contains* $P(0, b)$

Logarithm Properties

$b^E = N \Leftrightarrow log_b N = E$	$log_b X + log_b Y = log_b XY$
$e^E = N \Leftrightarrow E = lnN$	$log_b X - log_b Y = log_b \frac{X}{Y}$

$log_b b = 1$	$log_b a = \frac{log(a)}{log(b)}$	$log_b a = \frac{1}{log_a b}$	$log_b \frac{1}{a} = -\ log_b a$
$log_b X^n = n log_b X$	$b^{log_b N} = N$	$log_{\left(\frac{1}{a}\right)} b = -log_a b$	$log_a b \cdot log_b c = log_a c$