**Algebra Formulas**

**Geometry**

Equation of a circle: \((x - h)^2 + (y - k)^2 = r^2\),
Center = \((h, k)\), Radius = \(r\)

Quadratic Function: \(y = ax^2 + bx + c\),
Vertex = \(\left(-\frac{b}{2a}, -\frac{b^2}{4a}\right)\)

Distance Formula: 
\[d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\]

Slope: \(m = \frac{y_2 - y_1}{x_2 - x_1}\), Parallel lines: \(m_1 = m_2\), Perpendicular lines: \(m_1 \cdot m_2 = -1\)

Point-Slope Formula: \(y - y_1 = m(x - x_1)\)

Slope-Intercept Form: \(y = mx + b\), Horizontal Line: \(y = b\), Vertical Line: \(x = a\)

Standard Form: \(Ax + By = C\)

Midpoint Formula: \(\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)\)

**Factoring**

Difference of Squares:
\[a^2 - b^2 = (a - b)(a + b)\]
Perfect Square Binomials:
\[(1) \quad (a + b)^2 = a^2 + 2ab + b^2\]
\[(2) \quad (a - b)^2 = a^2 - 2ab + b^2\]

Difference of Cubes:
\[a^3 - b^3 = (a - b)(a^2 + ab + b^2)\]
Perfect Cube Binomials:
\[(1) \quad (a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3\]
\[(2) \quad (a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3\]

**Exponents/Radicals**

\[b^m \cdot b^n = b^{m+n}\]
\[b^0 = 1, \quad (b \neq 0)\]

\[(b^n)^m = b^{mn}\]
\[(ab)^n = a^n b^n\]
\[i^2 = -1\]
\[i^3 = -i\]
\[i^4 = 1\]

\[\frac{b^m}{b^n} = b^{m-n}\]
\[\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}\]
\[\frac{1}{b^n} = b^{-n}\]
\[\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n\]

\[\sqrt[n]{ab} = \sqrt[n]{a} \sqrt[n]{b}\]

\[\sqrt[n]{b} = b^{\frac{1}{n}}\]
\[\sqrt[n]{a b} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}, \quad (b \neq 0)\]

**Imaginary Number**

\[i = \sqrt{-1}\]
\[i^2 = -1\]
\[i^3 = -i\]
\[i^4 = 1\]

**Absolute Value**

\[|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}\]

For \(a > 0\),

\[|x| = a \iff x = -a \text{ or } x = a\]
\[|x| < a \iff (x > -a \text{ and } x < a)\]
\[\iff (-a < x < a)\]
\[|x| > a \iff x < -a \text{ or } x > a\]
**Area & Perimeter Formulas**

*Area (A)* is the amount of *square units* of space an object occupies.  
*Perimeter (P)* is the distance *around* a figure.

1. **Square:** A quadrilateral (4-sided figure) with four 90° (right) angles and four equal sides.  
   \[ A = s^2 \]  
   \[ P = 4s \]

2. **Triangle:** A 3-sided figure
   \[ A = \frac{1}{2} B \cdot h \]  
   \[ P = B_s_1 + s_2 \]

3. **Rectangle:** A quadrilateral with four 90° (right) angles.  
   \[ A = L \times W \]  
   \[ P = 2L + 2W \]

4. **Right Triangle:** triangle with a 90° (right) angle  
   \[ A = \frac{1}{2} A \cdot B \]  
   \[ P = A_s_1 + s_2 \]

5. **Parallelogram:** A quadrilateral with equal opposite sides.  
   \[ A = B \times h \]  
   \[ P = 2B + 2s \]

6. **Trapezoid:** A quadrilateral with exactly one pair of parallel sides.  
   \[ A = \frac{1}{2} h(B_1 + B_2) \] and  
   \[ P = B_1 + B_2 + s_1 + s_2 \]

7. **Circle:** A set of points a constant distance (radius) from a given point (center).
   \[ A = \pi r^2 \]  
   \[ C = 2\pi r \]  
   \[ d = 2r \text{ or } r = \frac{d}{2} \]  
   \[ \text{Radius (r)} \] (distance from center to circle)  
   \[ \text{Diameter (d)} \] (distance across the circle)  
   \[ \text{Circumference (C)} \] (distance around the circle)