Algebra Formulas

Geometry

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

$$Center = (h,k), \; Radius = r$$

Quadratic Function: $y = ax^2 + bx + c$,

$$Vertex = \left(-\frac{b}{2a}, \; c - \frac{b^2}{4a}\right)$$

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

Slope: $m = \dfrac{y_2 - y_1}{x_2 - x_1}$, Parallel lines: $m_1 = m_2$, Perpendicular lines: $m_1 = -\dfrac{1}{m_2}$

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

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

                           (m = 0)   *(m undefined)*

Standard Form: $Ax + By = C$

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

Quadratic Equation

$$ax^2 + bx + c = 0$$

Quadratic Formula

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

Factoring

Difference of Squares:

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

Difference of Cubes

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

Sum of Cubes

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

Perfect Square Binomials:

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

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

Perfect Cube Binomials

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

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

Exponents/Radicals

$b^m \cdot b^n = b^{m+n}$ $b^0 = 1, \; (b \neq 0)$

$\left(b^m\right)^n = b^{mn}$ $(ab)^n = a^n b^n$

$\dfrac{b^m}{b^n} = b^{m-n}$ $\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b^n}$

$b^{-n} = \dfrac{1}{b^n}$

$\dfrac{1}{b^{-n}} = b^n$ $\left(\dfrac{a}{b}\right)^{-n} = \left(\dfrac{b}{a}\right)^n$

$\sqrt[n]{b} = b^{\frac{1}{n}}$ $\sqrt[n]{ab} = \sqrt[n]{a}\sqrt[n]{b}$

$b^{n/m} = \sqrt[m]{b^n}$ $\sqrt[n]{\dfrac{a}{b}} = \dfrac{\sqrt[n]{a}}{\sqrt[n]{b}}, \; (b \neq 0)$

Imaginary Number

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

Absolute Value

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

$$|a| = \sqrt{a^2}$$

For a > 0,

$$|x| = a \Leftrightarrow x = -a \; or \; x = a$$
$$|x| < a \Leftrightarrow (x > -a \; \textbf{and} \; x < a)$$
$$\Leftrightarrow (-a < x < a)$$
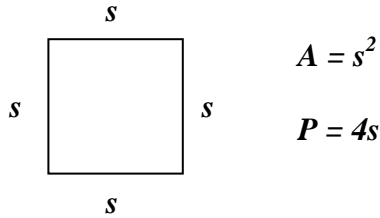$$|x| > a \Leftrightarrow x < -a \; \textbf{or} \; x > a$$

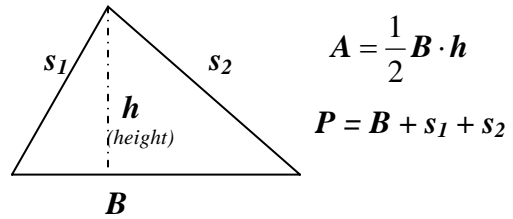## Area & Perimeter Formulas

Area (A) is the amount of *square units* of space an object occupies.

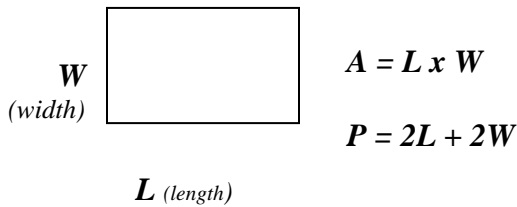***Perimeter (P)*** is the distance *around* a figure.

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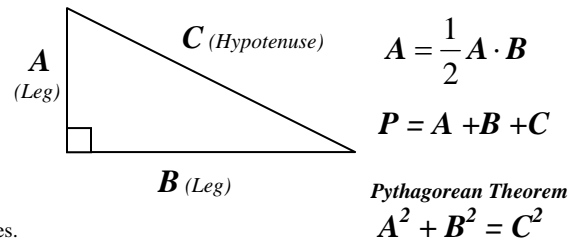
$$A = s^2$$

$$P = 4s$$

2.   **Triangle**: A *3-sided figure*

$$A = \frac{1}{2}B \cdot h$$

$$P = B + s_1 + s_2$$

h (height)

3.   **Rectangle**: A *quadrilateral* with four $90°$ *(right) angles.*

W (width)

L (length)

$$A = L \times W$$

$$P = 2L + 2W$$

4.   **Right Triangle**: *triangle with a $90°$ (right) angle*

A (Leg)   *C (Hypotenuse)*   *B (Leg)*

$$A = \frac{1}{2}A \cdot B$$

$$P = A + B + C$$

Pythagorean Theorem

$$A^2 + B^2 = C^2$$

5.   **Parallelogram**: A *quadrilateral* with equal opposite sides.

h (height)

B (base)

$$A = B \times h$$

$$P = 2B + 2s$$
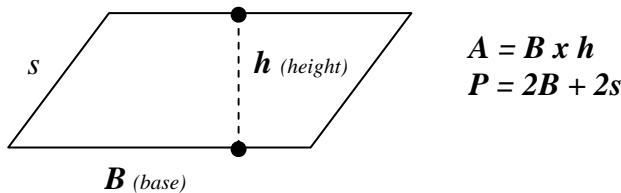
6.   **Trapezoid**: A *quadrilateral* with exactly one pair of *parallel* sides.

B_1 (base)

s_1   *h (height)*   *s_2*

B_2 (base)

$$A = \frac{1}{2}h(B_1 + B_2) \text{ and}$$

$$P = B_1 + B_2 + s_1 + s_2$$
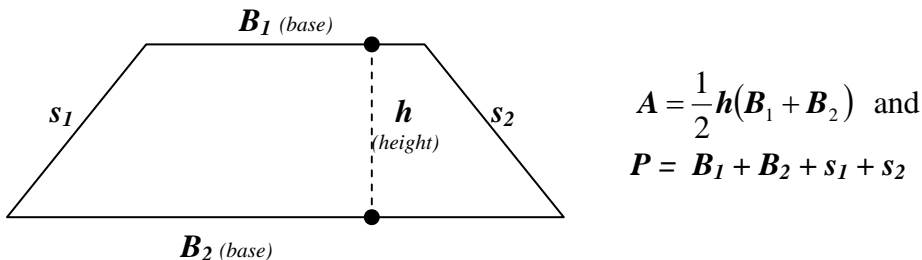
7.   **Circle**: A *set of points a constant distance (radius) from a given point (center).*

$$A = \pi r^2$$

$$C = 2\pi r$$

$$d = 2r \text{ or } r = \frac{d}{2}$$

Radius (r)
(distance from center to circle)

Diameter (d)
(distance across the circle)

Circumference (C)
(distance around the circle)

center