2D Shapes

Rectangle

- **Area**: $A = l \cdot w$ (length $\times$ width)
- **Perimeter**: $P = 2(l + w)$
- **Diagonal**: $d = \sqrt{l^2 + w^2}$

Square

- **Area**: $A = s^2$ (side length squared)
- **Perimeter**: $P = 4s$
- **Diagonal**: $d = s\sqrt{2}$

Triangle

- **Area**: $A = \frac{1}{2}bh$ (base $\times$ height)
- **Perimeter**: $P = a + b + c$ (sum of side lengths)
- **Heron's Formula for Area**: $A = \sqrt{s(s-a)(s-b)(s-c)}$, where $s = \frac{a+b+c}{2}$ (semi-perimeter)
- **Pythagorean Theorem** (for right triangles): $a^2 + b^2 = c^2$ (legs a, b, hypotenuse c)

Circle

- **Area**: $A = \pi r^2$ (radius squared)
- **Circumference**: $C = 2\pi r$
- **Sector Area**: $A = \frac{\theta}{360}\pi r^2$ (θ in degrees)
- **Arc Length**: $L = \frac{\theta}{360} \cdot 2\pi r$ (θ in degrees)

Parallelogram

- **Area**: $A = bh$ (base $\times$ height)
- **Perimeter**: $P = 2(a + b)$ (adjacent sides a and b)

Trapezoid

- **Area**: $A = \frac{1}{2}(a + b)h$ (average of parallel sides $\times$ height)
- **Perimeter**: $P = a + b + c + d$ (sum of all sides)

3D Shapes

Cube

- **Volume**: $V = s^3$ (side length cubed)
- **Surface Area**: $SA = 6s^2$
- **Space Diagonal**: $d = s\sqrt{3}$

Rectangular Prism

- **Volume**: $V = l \cdot w \cdot h$ (length $\times$ width $\times$ height)
- **Surface Area**: $SA = 2(lw + lh + wh)$
- **Space Diagonal**: $d = \sqrt{l^2 + w^2 + h^2}$

Sphere

- **Volume**: $V = \frac{4}{3}\pi r^3$ (radius cubed)
- **Surface Area**: $SA = 4\pi r^2$

Cylinder

- **Volume**: $V = \pi r^2 h$ (radius squared $\times$ height)
- **Surface Area**: $SA = 2\pi r^2 + 2\pi rh$ (base areas + lateral area)

Cone

- **Volume**: $V = \frac{1}{3}\pi r^2 h$ (one-third base area $\times$ height)
- **Surface Area**: $SA = \pi r^2 + \pi rl$ (base area + lateral area, where $l = \sqrt{r^2 + h^2}$ is slant height)

General Geometry Rules

Angles

- **Sum of Angles in a Triangle**: $180°$
- **Sum of Angles in a Quadrilateral**: $360°$
- **Sum of Interior Angles in a Polygon**: $(n-2) \cdot 180°$ (n is number of sides)
- **Sum of Exterior Angles in a Polygon**: $360°$

Similarity and Congruence

- **Similar Figures**: Corresponding angles are equal, and corresponding sides are proportional.
- **Congruent Figures**: Corresponding angles and sides are equal.
- **AA Similarity for Triangles**: If two angles of one triangle are equal to two angles of another, the triangles are similar.

Coordinate Geometry

- **Distance Formula**: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
- **Midpoint Formula**: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
- **Slope Formula**: $m = \frac{y_2 - y_1}{x_2 - x_1}$