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GEOMETRY ULTIMATE CHEAT SHEET

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1. Lines, Angles & Parallel Lines

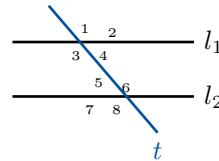
Angle Types:

- **Acute:** $0^\circ < \theta < 90^\circ$
- **Right:** $\theta = 90^\circ$
- **Obtuse:** $90^\circ < \theta < 180^\circ$
- **Straight:** $\theta = 180^\circ$

Angle Relationships:

- **Complementary:** $\alpha + \beta = 90^\circ$
- **Supplementary:** $\alpha + \beta = 180^\circ$
- **Vertical Angles:** Equal ($a = b$)

Parallel Lines Cut by Transversal:



- **Corresponding:** $\angle 1 = \angle 5, \angle 2 = \angle 6$
- **Alternate Interior:** $\angle 3 = \angle 6, \angle 4 = \angle 5$
- **Consecutive Interior:** $\angle 3 + \angle 5 = 180^\circ$

2. Triangles (2D Geometry)

Fundamental Formulas:

- **Sum of Angles:** $\alpha + \beta + \gamma = 180^\circ$
- **Area:** $A = \frac{1}{2}bh = \frac{1}{2}ab \sin(\theta)$
- **Heron's Formula:** $A = \sqrt{s(s-a)(s-b)(s-c)}$
where $s = \frac{a+b+c}{2}$

Right Triangle Theorems:

- **Pythagorean Theorem:** $a^2 + b^2 = c^2$
- **Trigonometric Ratios:**

$$\sin \theta = \frac{\text{Opp}}{\text{Hyp}}, \quad \cos \theta = \frac{\text{Adj}}{\text{Hyp}}, \quad \tan \theta = \frac{\text{Opp}}{\text{Adj}}$$

Laws of Triangles:

- **Law of Sines:** $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$
- **Law of Cosines:** $c^2 = a^2 + b^2 - 2ab \cos C$

Special Centers:

- **Centroid (G):** Intersection of medians (2:1 ratio).
- **Incenter (I):** Intersection of angle bisectors.
- **Circumcenter (O):** Perpendicular bisectors.
- **Orthocenter (H):** Intersection of altitudes.

3. Quadrilaterals & Polygons

Common Quadrilaterals:

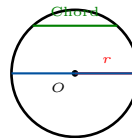
- **Rectangle:** $A = w \cdot l, \quad P = 2(w + l)$
- **Parallelogram:** $A = b \cdot h$
- **Trapezoid:** $A = \frac{1}{2}(a + b)h$
- **Rhombus:** $A = \frac{1}{2}d_1d_2$

Polygon Properties (N sides):

- **Sum of Interior Angles:** $(n - 2) \times 180^\circ$

- **Sum of Exterior Angles:** 360°
- **Each Interior Angle (Regular):** $\frac{(n-2) \times 180^\circ}{n}$
- **Number of Diagonals:** $\frac{n(n-3)}{2}$

4. Circles



- **Circumference:** $C = 2\pi r = \pi d$
- **Area:** $A = \pi r^2$
- **Arc Length (s):** $s = r\theta$ (in radians) / $s = \frac{\theta}{360} \cdot 2\pi r$
- **Sector Area:** $A_{sec} = \frac{1}{2}r^2\theta = \frac{\theta}{360} \cdot \pi r^2$
- **Equation of Circle:** $(x - h)^2 + (y - k)^2 = r^2$

Circle Theorems:

- **Inscribed Angle Theorem:** Angle at center is double the angle at the circumference (2θ).
- **Thales' Theorem:** Inscribed angle subtended by diameter is 90° .
- **Tangent-Radius:** Tangent is $\perp$ to radius at point of contact.

5. 3D Solid Geometry

Solid	Volume (V)	Surface Area (SA)
Cube	a^3	$6a^2$
Rect. Prism	lwh	$2(lw + lh + wh)$
Cylinder	$\pi r^2 h$	$2\pi r h + 2\pi r^2$
Cone	$\frac{1}{3}\pi r^2 h$	$\pi r s + \pi r^2$
Sphere	$\frac{4}{3}\pi r^3$	$4\pi r^2$
Pyramid	$\frac{1}{3}Bh$	$B + \text{Lateral Area}$

6. Analytic Coordinate Geometry

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

- **Midpoint Formula:** $M = (\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$
- **Slope (m):** $m = \frac{y_2-y_1}{x_2-x_1} = \tan \theta$
- **Parallel Lines:** $m_1 = m_2$
- **Perpendicular Lines:** $m_1 \cdot m_2 = -1$
- **Point-Line Distance:** $d = \frac{|Ax_0+By_0+C|}{\sqrt{A^2+B^2}}$

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