# 2D & 3D Geometric Shapes

## Square

### Formula

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area $A$</td>
<td>$a^2$</td>
</tr>
<tr>
<td>Perimeter $P$</td>
<td>$4a$</td>
</tr>
<tr>
<td>Diagonal $D$</td>
<td>$\sqrt{2} \ a$</td>
</tr>
<tr>
<td>Side $a$</td>
<td>$\frac{P}{4}$</td>
</tr>
</tbody>
</table>

- $a$ → length of side
- $P$ → Perimeter

---

## Rectangle

---
Area $A = wh$

Perimeter $P = 2(l + w)$

Diagonal $D = \sqrt{w^2 + l^2}$

Length $l = \frac{A}{w}$

Width $w = \frac{A}{l}$

$I$ → length $A$ → Area

$w$ → width $D$ → Diagonal

$P$ → Perimeter

**Circle**
**Circle Formula**

Area \( A \) = \( \pi r^2 \)  
Circumference \( C \) = \( 2\pi r \)  
Diameter \( d \) = \( 2r \)  
Radius \( r \) = \( \sqrt{\frac{A}{\pi}} \)

- \( r \) \( \rightarrow \) radius  
- \( C \) \( \rightarrow \) circumference  
- \( A \) \( \rightarrow \) Area

**Triangle Formula**

Area \( A \) = \( \frac{bh}{2} \)  
Perimeter \( P \) = \( a + b + c \)

- \( b \) \( \rightarrow \) base  
- \( h \) \( \rightarrow \) height  
- \( a \) \( \rightarrow \) side  
- \( c \) \( \rightarrow \) side
Cube

**Formula**

Volume $V = a^3$

Surface area $A = 6a^2$

Diagonal $d = \sqrt{3}a$

Edges $a = \sqrt[3]{V}$

---

Sphere
Volume \( V \) = \( \frac{4}{3} \pi r^3 \)

Surface area \( A \) = \( 4\pi r^2 \)

Diameter \( d \) = 2r

Radius \( r \) = \( \frac{d}{2} \)

\( r \rightarrow \) radius

\( d \rightarrow \) diameter

Cylinder
Volume $V = \pi r^2 h$

Surface area $A = 2\pi rh + 2\pi r^2$

Lateral area $A_L = 2\pi rh$

Base area $A_B = \pi r^2$

Height $h = \frac{V}{\pi r^2}$

Radius $r = \sqrt{\frac{V}{\pi h}}$

$r \rightarrow$ radius

$V \rightarrow$ Volume

$h \rightarrow$ height

Pyramid
Volume \( V \) = \( \frac{lwh}{3} \)

Surface area \( A \) = \( lw + l\sqrt{\left(\frac{w}{2}\right)^2 + h^2} + w\sqrt{\left(\frac{l}{2}\right)^2 + h^2} \)

Lateral area \( A_L \) = \( l\sqrt{\left(\frac{w}{2}\right)^2 + h^2} + w\sqrt{\left(\frac{l}{2}\right)^2 + h^2} \)

Base area \( A_B \) = \( lw \)

\( l \rightarrow \) length
\( w \rightarrow \) width
\( h \rightarrow \) height

Tank Capacity
**Rectangular Tank:**

Volume \( V \) \( = \) \( l \times w \times h \)

Surface area \( A \) \( = \) \( 2(lw + lh + wh) \)

- \( l \) → length
- \( w \) → width
- \( h \) → height

**Cylinder Tank:**

Volume \( V \) \( = \) \( \pi r^2 h \)

Surface area \( A \) \( = \) \( 2\pi r( h + r ) \)

- \( r \) → radius
- \( h \) → height

**Cone**
Volume $V = \frac{\pi r^2 h}{3}$

Surface area $A = \pi r (r + \sqrt{h^2 + r^2})$

Lateral area $A_L = \pi r \sqrt{h^2 + r^2}$

Base area $A_B = \pi r^2$

Height $h = 3 \frac{V}{\pi r^2}$

Radius $r = \sqrt{3 \frac{V}{\pi h}}$

Slant height $L = \sqrt{r^2 + h^2}$

**Hemisphere**
**Formula**

Volume $V = \frac{2}{3} \pi r^3$

Surface area $A = 2\pi r^2$

$r \rightarrow$ radius

Hemisphere

**Prism**
**Rectangular Prism:**

Volume \( V \) = \( lwh \)

Surface area \( A \) = \( 2(lw + lh + wh) \)

- \( l \rightarrow \) length
- \( w \rightarrow \) width
- \( h \rightarrow \) height

**Triangular Prism:**

Volume \( V \) = \( \frac{bhl}{2} \)

Surface area \( A \) = \( 2B + Ph \)

- \( b \rightarrow \) base
- \( h \rightarrow \) height
- \( l \rightarrow \) length
- \( P \rightarrow \) Perimeter of base
- \( B \rightarrow \) Area of base

**Circle Sector - Arc**
**Formula**

\[ A = \frac{\pi r^2 \theta}{360} \]

\[ L = \frac{2\pi r \theta}{360} \]

- A → Area of circle sector
- L → Length of circle sector
- r → radius
- \( \theta \) → Angle

---

**Ellipse**

**Formula**

Area \( A = \pi ab \)

Perimeter \( P = 2\pi \sqrt{\frac{a^2 + b^2}{2}} \)

- a → Major axis length
- b → Minor axis length

---

**Hyperbola**
F(x, y) = (x_0 + \sqrt{a^2 + b^2}, y_0)

F'(x, y) = (x_0 - \sqrt{a^2 + b^2}, y_0)

Eccentricity = \sqrt{a^2 + b^2}

Asymptotes \( H' L = \frac{b}{a} x + \left( y_0 - \frac{b}{a} x_0 \right) \)

Asymptotes \( L' H = -\frac{b}{a} x + \left( y_0 + \frac{b}{a} x_0 \right) \)

Hyperbola

Trapezoid
Distance between Two Points

Formula

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

(\( x_1, y_1 \)) \rightarrow \text{Point 1}
(\( x_2, y_2 \)) \rightarrow \text{Point 2}

Distance between 2 points

\( d \) \rightarrow \text{distance between (} x_1, y_1 \text{) & (} x_2, y_2 \text{)}

Line Slope

Area \( A = \frac{h(b_1 + b_2)}{2} \)

Perimeter \( P = b_1 + b_2 + s_1 + s_2 \)

Height \( h = \sqrt{s^2 - (b_1 - b_2)^2} \)

\( s_1 \) \rightarrow \text{Side 1}
\( s_2 \) \rightarrow \text{Side 2}
\( h \) \rightarrow \text{Height}
\( b_1 \) \rightarrow \text{Base 1}
\( b_2 \) \rightarrow \text{Base 2}
**Rectangular - Polar Coordinates**

**Formula**

Rectangular to Polar co-ordinates:

\[
\text{Angle } \theta = \tan^{-1}\left(\frac{y}{x}\right)
\]

\[
\text{Radius } r = \sqrt{x^2 + y^2}
\]

Polar to Rectangular co-ordinates:

\[
x = r \cos \theta
\]

\[
y = r \sin \theta
\]

**Line Mid Point**
Hexagon

**Formula**

\[
(x, y) = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)
\]

\((x_1, y_1) \rightarrow \text{point 1}\)

\((x_2, y_2) \rightarrow \text{point 2}\)

\((x, y) \rightarrow \text{Mid point between} \ (x_1, y_1) \ & \ (x_2, y_2)\)

---

**Hexagon**

**Formula**

Area \(A = \frac{3\sqrt{3} s^2}{2}\)

Perimeter \(P = 6s\)

Side \(s = 3^{\frac{1}{4}} \sqrt{\frac{2A}{9}}\)

\(s \rightarrow \text{side length}\)

\(P \rightarrow \text{Perimeter}\)

\(A \rightarrow \text{Area}\)

---

Octagon
**Octagon**

**Formula**

\[
\text{Area } A = 2 \left(1 + \sqrt{2}\right) s^2 \\
\text{Perimeter } P = 8s \\
\text{Side } s = \sqrt{\frac{\sqrt{2}}{2} \left(\frac{A}{2} - \frac{A}{2}\right)}
\]

\[S \rightarrow \text{side length} \]
\[P \rightarrow \text{Perimeter} \]
\[A \rightarrow \text{Area} \]

**Rhombus**

**Formula**

\[
\text{Area } A = \frac{S}{2 \tan\left(\frac{180}{n}\right)} \\
\text{Perimeter } P = S n
\]

\[S \rightarrow \text{Side length} \]
\[n \rightarrow \text{No of sides} \]
\[A \rightarrow \text{Area} \]
\[P \rightarrow \text{Perimeter} \]
Area $A = \frac{D_1 D_2}{2}$

Perimeter $P = 4a$

$D_1 \rightarrow$ Diagonal 1

$D_2 \rightarrow$ Diagonal 2

$a \rightarrow$ Side

Rhombus