BarCharts, Inc.® WORLD'S #1 ACADEMIC OUTLINE

Quick Study® ACADEMIC

GEOMETRIC FORMULAS

segments.lines.planes.geometric formulas

[UNDEFINED Terms]

[1] Point; notation Point A is labeled with a capital letter, A in this case

[2] Line; notation Line KM is labeled either $\overleftrightarrow{KM}$ *or* $\overleftrightarrow{MK}$ or line l

[3] Plane; notation Plane N is labeled either plane n or plane ABC if points A, B, and C are on plane n

[DEFINED Terms]

[GENERAL Terms]

[1] ≅(congruent) Shapes are the same shape and size

[2] ~(similar) Shapes are the same shape, but can be different sizes

[3] =(equal) Sets of points or numerical measurements are exactly the same

[4] ∪(union) Describes the result when all of the points are put together

[5] ∩(intersection) Describes the points where indicated shapes touch

[6] Space The set of all points

[LINES]

[1] Collinear points are on the same line

[2] Non-collinear points are not on the same line

[3] Intersecting lines have one and only one point in common

[4] Perpendicular lines intersect and form 90° angles at the intersection; ⊥

[5] Skew lines are not in the same plane, never touch, and go in different directions

[6] Transversal lines intersect two or more co-planar lines at different points

[7] Parallel lines are co-planar (in the same plane), share no points in common, do not intersect, go in the same direction and never touch; ||

[LINE Segments]

[1] The set of any 2 points on a line and all of the collinear points between them; $\overline{AB}$ where A and B are the endpoints of the line segment

[2] The length is the distance between the 2 endpoints; it is a numerical value; AB means the length of

[3] The midpoint is a point exactly in the middle of the two endpoints

[4] The bisector intersects a line segment at its midpoint

[5] The perpendicular bisector intersects a line segment at its midpoint and forms 90° angles at the intersection

[RAYS]

[1] The set of collinear points going in one direction from one point (the endpoint of the ray) on a line; notation: $\overrightarrow{AB}$ where A is the endpoint; notice $\overrightarrow{AB} \neq \overrightarrow{BA}$ because they have different endpoints and contain different points on the line

[2] Opposite rays are collinear, share only a common endpoint and go in opposite directions

[ANGLES]

[1] The union of two rays that share one and only one point, the endpoint of the rays

a. The sides of the angle are the rays and the vertex is the endpoint of the rays

b. The interior is all the points between the two sides of the angle

c. $\angle ABC$ where B is the vertex or simply $\angle B$ if there is only one angle with vertex B

[2] Overlapping angles share some common interior points

[3] An acute angle measures less than 90°

[4] An obtuse angle measures more than 90°

[5] A right angle measures exactly 90°; it is indicated on diagrams by drawing a square in the corner by the vertex of the angle

[6] A straight angle measures exactly 180°

[7] Complementary angles are two angles whose measures total 90°

[8] Supplementary angles are two angles whose measures total 180°

[9] Vertical angles are two angles that share only a common vertex and whose sides form lines

[10] Adjacent angles are two angles that share exactly one vertex and one side, but no common interior points; i.e., they do not overlap

[11] An angle bisector is a ray or a line that contains the vertex of the angle, is in the interior, and separates the angle into two adjacent angles with equal measures

[TRANSVERSAL LINE Angles]

[1] Interior angles are formed with the rays from the 2 lines and the transversal, such that the interior regions of the angles are located between the 2 lines

[2] Alternate interior angles are interior angles with different vertexes and interior regions on opposite sides of the transversal

[3] Same-side interior angles are interior angles with different vertexes and interior regions on the same side of the transversal

[4] Exterior angles are formed with rays from the 2 lines and the transversal, such that the interior regions of the angles are not between the 2 lines

[5] Alternate exterior angles are exterior angles with different vertexes and interior regions on opposite sides of the transversal

[6] Corresponding angles have different vertexes; their interior regions are on the same side of the transversal and in the same positions relative to the lines and the transversal; one of the pair of corresponding angles is an interior angle and the other is an exterior angle

[POLYGONS]

[1] Polygons are plan (flat), closed shapes that are formed by line segments that intersect only at their endpoints

a. Note They are named by listing the endpoints of the line segments in order, going either clockwise or counterclockwise, starting at any one of the endpoints

b. The sides are line segments

c. The interior is all of the points enclosed by the sides

d. The exterior is all of the points on the plane of the polygon, but neither on the sides nor in the interior

e. The vertices (or vertexes) are the endpoints of the line segments

f. Include all the points on the sides (line segments) and the vertices

g. The interior angles of a polygon have the same vertices as the vertices of the polygon, have sides that contain the sides of the polygon, and have interior regions that contain the interior of the polygon—every polygon has as many interior angles as it has vertices

h. Consecutive interior angles have vertices that are endpoints of the same side of the polygon

i. The exterior angles are formed when the sides of the polygon are extended; each has a vertex and one side that are also a vertex and contain one side of the polygon; the second side of the exterior angle is the extension of the other polygon side containing the angle vertex; the interior of the exterior angle is part of the exterior region of the polygon; exterior angles are supplements of their adjacent interior angles

j. Diagonals of a polygon are line segments with endpoints that are vertices of the polygon, but the diagonals are not sides of the polygon

[2] CONCAVE polygons have at least one interior angle measuring more than 180°

[3] CONVEX polygons have no interior angles more than 180° and all interior angles each measure less than 180°

[4] REGULAR polygons have all side lengths equal and all interior angle measures equal

[5] CLASSIFICATIONS OF POLYGONS

a. Classified by the number of sides; equal to the number of vertices

b. The side lengths and angle measures are not necessarily equal unless the word "regular" is also used to name the polygon

c. ***Categories***
- Triangles have three sides
- Quadrilaterals have four sides
- Pentagons have five sides
- Hexagons have six sides
- Heptagons have seven sides
- Octagons have eight sides
- Nonagons have nine sides
- Decagons have ten sides
- n-gons have n sides

[6] SPECIAL POLYGONS

a. Triangles
- Polygons with 3 sides and 3 vertices; the symbol for a triangle is Δ; triangle ABC is written ΔABC
- An altitude (height) is a line segment with a vertex of the triangle as one endpoint and the point on the line containing the opposite side of the triangle where the altitude is perpendicular to that line; every triangle has 3 altitudes
- A base is a side of the triangle on the line perpendicular to an altitude; every triangle has 3 bases
- Formula for area $A=\frac{1}{2}ab$ or $A=\frac{1}{2}hb$

  where a=altitude, b=base or where h=height (altitude), b=base
- ***Classified in 2 ways, by side lengths and by angle measurements***

  a] When classified by side lengths:
  - Scalene have no side lengths =,
  - Isosceles have at least 2 side lengths equal,
  - Equilateral have all 3 side lengths equal; note it is also an isosceles triangle

  b] When classified by angle measurements:
  - Obtuse have exactly one angle measurement more than 90°
  - Right have exactly one angle measurement equal to 90°
  - Acute have all 3 angles less than 90°; note that if all 3 angles are equal, then the triangle is called equiangular
- *Isosceles triangles*

  a] The vertex angle has sides containing the two congruent sides of the triangle

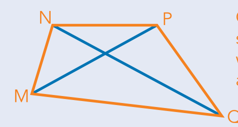
  b] The base is the side with a different length than the other two sides; not necessarily the side on the bottom of the triangle

  c] The base angles of an isosceles triangle have the base contained in one of their sides; they are always equal in measure
- *Right Triangles*

  a] The hypotenuse is opposite the right angle and is the longest side

  b] The legs are the 2 sides that are not the hypotenuse; the line segments contained in the sides of the right angle

b. Quadrilaterals
- 4-sided polygons
- Have 2 diagonals and 4 vertices



Quadrilateral MNPQ has sides $\overline{MN}$, $\overline{NP}$, $\overline{PQ}$ and $\overline{QM}$, with vertices M, N, P, and Q, and diagonals $\overline{NQ}$ and $\overline{MP}$.

- Trapezoids have exactly one pair of parallel sides; there is never more than one pair of parallel sides

  a] Parallel sides: bases

  b] Non-parallel sides: legs

  c] The 2 angles with vertices that are the endpoints of the same base are called base angles

  d] Isosceles trapezoids have legs that are the same length
- Parallelograms have 2 pairs of parallel sides

  a] Rectangles have 4 right angles

  b] Rhombuses (sing. rhombus) have 4 sides equal in length

  c] Squares have 4 equal sides and 4 equal angles; therefore, every square is both a rectangle and a rhombus

[CIRCLES]

[1] The set of points in a plane equidistant from the center of the circle, which lies in the interior of the circle and is not a point on the circle; 360°

[2] A radius is a line segment whose endpoints are the center of the circle and any point on the circle; the length of a radius is the distance of each point from the center

[3] A chord is a line segment whose endpoints are 2 points on the circle

[4] A diameter is a chord that contains the center of the circle; the length of a diameter is the distance from one point to another on the circle, going through the center

[5] A secant is a line intersecting a circle in two points

[6] A tangent is a line that is co-planar with a circle and intersects it at one point only, called the point of tangency

a. A common tangent is a line that is tangent to 2 co-planar circles
- Common internal tangents intersect between the two circles
- Common external tangents do not intersect between the circles

b. Two circles are tangent when they are co-planar and share the same tangent line at the same point of tangency; they may be externally or internally tangent

[7] Equal circles have equal-length radii

[8] Concentric circles lie in the same plane and have the same center

[9] An inscribed polygon has vertices that are points on the circle; in this same situation, the circle is circumscribed about the polygon

[10] A circumscribed polygon has sides that are segments of tangents to the circle; i.e., the sides of the polygon each contain exactly one point on the circle; in this same situation, the circle is inscribed in the polygon

[11] An arc is part of a circle

a. A semicircle is an arc whose endpoints are the endpoints of a diameter; 180°; exactly three points must be used to name a semicircle; notation: $\overset{\frown}{ABC}$ where A and C are the endpoints of the diameter

[THEOREMS & Relationships] Theorems are statements that have been proven

[LINES & Line Segments]

[1] Through a point not on a line, exactly one perpendicular can be drawn to the line

[2] The shortest distance from any point to a line or to a plane is the perpendicular distance

[3] Through a point not on a line, exactly one parallel can be drawn to the line

[4] Parallel lines are everywhere the same distance apart

[5] If three or more parallel lines cut off equal segments on one transversal, then they cut off equal segments on every transversal they share

[6] A line and a plane are parallel if they do not touch or intersect

[7] Two or more planes are parallel if they do not touch or intersect

[8] If two parallel planes are both intersected by a third plane, then the lines of intersection are parallel

[9] If a point lies on the perpendicular bisector of a line segment, then the point is equidistant (equal distances) from the endpoints of the line segment

[10] If a point is equidistant from the endpoints of a line segment, then the point lies on the perpendicular bisector of the line segment

[11] To trisect a line segment, separate it into three other congruent (equal in length) line segments, such that the sum of the lengths of the three segments is equal to the length of the original line segment

[RAYS]

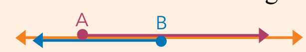
[1] If two rays do not intersect, then the union of the rays is simply all of the points on both rays

[2] If two rays intersect in one and only one point, but not at the endpoint, then the union is all of the points on both rays; the intersection is that one point where they touch

[3] If two rays intersect in one and only one point, the endpoint, then the union is an angle; the intersection is the endpoint

$\overrightarrow{AB} \cup \overrightarrow{AC} = \measuredangle CAB$
$\overrightarrow{AB} \cap \overrightarrow{AC} = A$

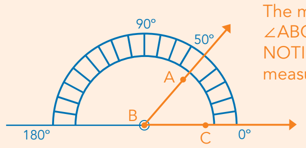
[4] If two rays intersect in more than one point, then the union is a line; the intersection is a line segment



$\overrightarrow{AB} \cup \overrightarrow{BA} = \overleftrightarrow{AB}$
$\overrightarrow{AB} \cap \overrightarrow{BA} = \overline{AB}$

[ANGLES]

[1] Angles are measured using a protractor and degree measurements: There are 360° in a circle; placing the center of a protractor at the vertex of an angle and counting the degree measure is like putting the vertex of the angle at the center of a circle and comparing the angle measure to the degrees of the circle



The measure of $\angle ABC = m\angle ABC = 50°$
NOTICE: $m\angle ABC$ means the measure of the angle in degrees

[2] If two angles are complements of the same angle, then they are equal in measure (congruent)

[3] If two angles are complements of congruent angles, then they are congruent

[4] If two angles are supplements of the same angle, then they are congruent

[5] If two angles are supplements of congruent angles, then they are congruent

[6] Vertical angles are congruent and have equal measures

[7] If a point lies on the bisector of an angle, then the point is equidistant (equal distances) from the sides of the angle

a. Note Distance from a point to a line is always the length of the perpendicular line segment that has the point as one endpoint and a point on the line as the other

[8] If a point is equidistant from the sides of an angle, then the point lies on the bisector of the angle

[9] An angle is trisected by rays or lines that contain the vertex of the angle and separate the angle into three adjacent angles (in pairs) that all have equal measures

[TRANSVERSAL Line Angles]

[1] If lines are parallel, then the alternate interior angles of a transversal are congruent

[2] If the alternate interior angles of a transversal are congruent, then the lines are parallel

[3] If lines are parallel, then the same side interior angles of a transversal are supplementary

[4] If the same-side interior angles of a transversal are supplementary, then the lines are parallel

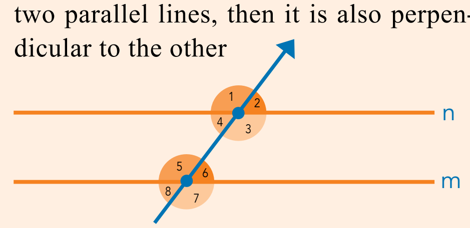
[5] If lines are parallel, then the corresponding angles of a transversal are congruent

[6] If the corresponding angles of a transversal are congruent, then the lines are parallel

[7] If lines are parallel, then the alternate exterior angles of a transversal are congruent

[8] If the alternate exterior angles of a transversal are congruent, then the lines are parallel

[9] If a transversal is perpendicular to one of two parallel lines, then it is also perpendicular to the other



alternate interior ∡s: 4–6; 5–3
same-side interior ∡s: 4–5; 3–6
corresponding ∡s: 1–5; 4–8; 3–7; 2–6
alternate exterior ∡s: 1–7; 2–8

b. A minor arc length is less than the length of the semicircle; only two points may be used to name a minor arc; notation: $\overset{\frown}{DE}$ where D and E are the endpoints of the arc

c. A major arc length is more than the length of the semicircle; exactly three points are used to name a major arc; notation: $\overset{\frown}{FGH}$ where F and H are the endpoints of the arc

[12] A central angle vertex is the center of the circle with sides that contain radii of the circle

[13] A inscribed-angle vertex is on a circle with sides that contain chords of the circle

[POSTULATES]

Statements that have been accepted without formal proof

[1] A line contains at least 2 points, and any 2 points locate exactly one line

[2] Any 3 non-collinear points locate exactly one plane

[3] A line and one point not on the line locate exactly one plane

[4] Any 3 points locate at least one plane

[5] If 2 points of a line are in a plane, then the line is in the plane

[6] If 2 points are in a plane, then the line containing the 2 points is also in the plane

[7] If 2 planes intersect, then the intersection is a line

[POLYGONS]

[1] The sum of the measures of the interior angles of a convex polygon with n sides is $(n-2)180$ degrees

Note To find the measure of each interior angle of a regular polygon, find the sum of all of the interior angles and divide by the number of interior angles, thus, the formula $\frac{(n-2)180}{n}$

[2] The sum of the measures of the exterior angles of any convex polygon, using one exterior angle at each vertex, is 360°

[3] TRIANGLES

a. The 3-angle total measurement =180°

b. If two angle measurements of one triangle = two angle measurements of another triangle, then the measurements of the third angles are also =

c. Each angle of an equilateral triangle is 60°

d. There can be no more than one right or obtuse angle in any one triangle

e. The acute angles of a right triangle are complementary

f. The measurement of an exterior angle = the sum of the measurements of the two remote (not having the same vertex as the exterior angle) interior angles

g. If two sides of a triangle are equal, then the angles opposite to those sides are also equal; and, if two angles are equal, then the sides opposite those angles are also equal

h. SAS Inequality Theorem If two sides of one triangle are equal in length to two sides of another, but the included angle of one triangle is larger than the included angle of the other triangle, then the longer third side of the triangles is opposite the larger included angle of the triangles

i. SSS Inequality Theorem If two sides of one triangle are equal to two sides of another, but the third side of one is longer than the third side of the other, then the larger included angle (included between the two equal sides) is opposite to the longer third side of the triangles

j. Triangle Proportionality Theorem
If a line is parallel to one side and intersects the other two sides, then it divides those two sides proportionally, and creates 2 similar triangles

k. If a ray bisects an angle of a triangle, it divides the opposite side into segments proportional to the other two sides

l. The line segment that joins the midpoints of two sides of a triangle has two properties:
- It is parallel to the third side, and
- It is half the length of the third side

m. The 3 bisectors of the angles of a triangle intersect in one point, which is equidistant from the 3 sides

n. The perpendicular bisectors of the sides of a triangle intersect in one point, equidistant from the 3 vertices

o. The medians (line segments whose endpoints are one vertex of the triangle and the midpoint of the side opposite that vertex) of a triangle intersect in one point two-thirds of the distance from each vertex to the midpoint of the opposite side

p. If two sides of a triangle are unequal in length, then the opposite angles are unequal and the larger angle is opposite to the longer side; and conversely, if two angles of a triangle are unequal, then the sides opposite those angles are unequal and the longer side is opposite the larger angle

q. The sum of the lengths of any two sides is greater than the length of the third side; the difference of the lengths of any two sides is less than the length of the third side

r. Isosceles and equilateral triangles
- An equilateral triangle is also equiangular; and, an equiangular triangle is also equilateral
- An equilateral triangle has three 60-degree angles
- The bisector of the vertex angle of an isosceles triangle is the perpendicular bisector of the base of the triangle

s. Right triangles
- Pythagorean Theorem In a right triangle, $a^2+b^2=c^2$, where a and b are the lengths of the legs and c is the length of the hypotenuse
- If the square of the hypotenuse is equal to the sum of the squares of the other two sides, then the triangle is a right triangle
- If the square of the longest side is greater than the sum of the squares of the other two sides, then it is an obtuse triangle; if it is less than the sum of the squares of the other two sides, then it is an acute triangle
- 45-45-90 Theorem In a 45-45-90 triangle, the legs have equal lengths and the length of the hypotenuse is $\sqrt{2}$ times the length of one of the legs
- 30-60-90 Theorem In a 30-60-90 triangle, the length of the shortest leg is $^1/_2$ the length of the hypotenuse, and the length of the longer leg is $\sqrt{3}$ times the length of the shortest leg
- The midpoint of the hypotenuse of a right triangle is equidistant from the three vertices
- When an altitude is drawn to the hypotenuse of a right triangle
  - a] The two triangles formed are similar to each other and to the original right triangle
  - b] The altitude is the geometric mean between the lengths of the two segments of the hypotenuse
  - c] Each leg is the geometric mean between the hypotenuse and the length of the segment of the hypotenuse adjacent (touches) to the leg

t. Congruent triangles
- SSS Postulate If three sides of one triangle are congruent to three sides of another, then the triangles are congruent
- SAS Postulate If two sides and the included angle of one triangle are congruent to two sides and the included angle of another, then the triangles are congruent
- ASA Postulate If two angles and the included side of one triangle are congruent to two angles and the included side of another, then the triangles are congruent
- AAS Theorem If two angles and a non-included side of one triangle are congruent to the two corresponding angles and non-included side of another, then the triangles are congruent
- HL Theorem If the hypotenuse and one leg of a right triangle are congruent to the hypotenuse and the corresponding leg of another, then the two right triangles are congruent

u. Similar triangles
- AA Similarity Postulate If two angles of one triangle are congruent to two angles of another, then the triangles are similar (same shape but not necessarily the same size)
- SSS Similarity Theorem If the sides of one triangle are proportional to the corresponding sides of another, then the triangles are similar
- SAS Similarity Theorem If two sides of one triangle are proportional to two sides of another and the included angles of each triangle are congruent, then the triangles are similar

[4] QUADRILATERALS

a. Trapezoids

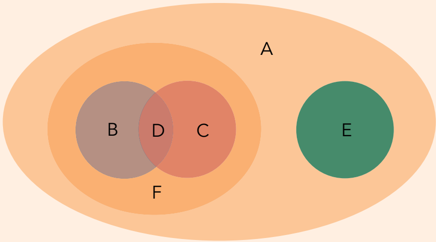
- The median (the line segment whose endpoints are the midpoints of the 2 non-parallel sides) is parallel to the bases, and its length is equal to half the sum of the lengths of the 2 bases
- The area may be calculated by averaging the length of the bases and multiplying by the height (altitude that is the length of the line segment that forms 90-degree angles with the bases); thus, the formula:

$$A=\frac{(b_1+b_2)h}{2}=\frac{(b_1+b_2)h}{2}=\frac{1}{2}(b_1+b_2)h$$

where the 2 bases are b_1 and b_2 and the height is h
- Two angles with vertices that are the endpoints of the same leg of a trapezoid are supplementary
- All 4 interior angle measures of all trapezoids total 360°
- Isosceles trapezoid
  - a] The base angles are congruent (has congruent legs)
  - b] Opposite angles are supplementary

b. *Parallelograms*

- Opposite sides are parallel and congruent
- Opposite angles are congruent
- All 4 interior angles total 360°
- Consecutive interior angles (their vertices are endpoints for the same side) are supplementary
- Diagonals bisect each other
- A quadrilateral is a parallelogram if:
  - a] One pair of opposite sides is congruent and parallel
  - b] Both pairs of opposite sides are congruent
  - c] Both pairs of opposite angles are congruent
  - d] The diagonals bisect each other
- The area can be calculated by multiplying the base and the height; that is, $A=bh=hb$
  - a] Note Since opposite sides are both parallel and equal, any side can be the base; the height (altitude) is any line segment perpendicular to the base whose endpoints are on the base and the side opposite the base
- Special parallelograms
  - a] Rectangles
    - Parallelograms with 4 right angles
    - Diagonals are congruent and bisect each other
    - The area equals lw or hb where l=length, w=width, h=height, and b=base
    - If the 4 sides are all equal, then the rectangle is more specifically called a square
  - b] Rhombuses or Rhombi
    - Parallelograms with 4 congruent sides
    - Opposite angles are congruent
    - All 4 angle measures total 360°
    - Any 2 consecutive angles are supplementary
    - If 4 interior angles each equal 90°, then the rhombus is more specifically called a square
    - The diagonals are perpendicular bisectors of each other
    - Each diagonal bisects the pair of opposite angles whose vertices are the endpoints of the diagonal
  - c] Squares
    - 4 equal sides and 4 equal angles; every square is both a rectangle and a rhombus
    - The diagonals are congruent, bisect each other, are perpendicular to each other and bisect the interior angles

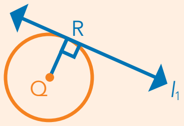


Note This Venn diagram indicates the relationships of quadrilaterals

A = Quadrilaterals
B = Rhombi
C = Rectangles
D = Squares
E = Trapezoids
F = Parallelograms

[CIRCLES]

[1] If a line is tangent to a circle, then it is perpendicular to the radius whose endpoint is the point of tangency (the point where the tangent line intersects the circle)



l_1 is a tangent to ⊙Q at point R, so radius $\overline{QR}\perp l_1$

[2] If two tangents to the same circle intersect in the exterior region, then the line segments whose endpoints are the point of intersection of the tangent lines and the two points of tangency are equal in length; or, line segments drawn from a co-planar exterior point of a circle to points of tangency on the circle are congruent

[3] If a line in the plane of a circle is perpendicular to a radius at its outer endpoint, then the line is tangent to the circle

[4] The measure of a minor arc is equal to the measure of its central angle

[5] The measure of a semicircle is 180°

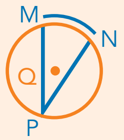
[6] The measure of a major arc is equal to 360° minus the measure of its corresponding minor arc

[7] In the same circle or in equal circles, equal chords have equal arcs and equal arcs have equal chords

[8] A diameter perpendicular to a chord bisects the chord and its arc

[9] In the same circle or in equal circles, congruent chords are the same distance from the center, and chords the same distance from the center are congruent

[10] An inscribed angle is equal to half of its intercepted arc (the arc which lies in the interior of the inscribed angle and whose endpoints are on the sides of the angle)



$m\angle MPN=\frac{1}{2}m\overset{\frown}{MN}$

[11] If two inscribed angles intercept the same arc, then the angles are congruent

[12] If a quadrilateral is inscribed in a circle, then opposite angles are supplementary

[13] An angle inscribed in a semicircle is always a right angle

[14] An angle formed by a chord and a tangent is equal to half of the measure of its intercepted arc

[15] An angle formed by two chords intersecting inside a circle = to half the sum of the intercepted arcs

[16] An angle formed by two secants, or two tangents, or a secant and a tangent, that intersect at a point outside of the circle is equal to half the difference of the intercepted arcs

[17] When two chords intersect inside a circle, the product of the segment lengths of one chord = to the product of the segment lengths of the other chord

[18] When two secant line segments are drawn to a circle from the same exterior endpoint, the product of one secant and its external segment length = the product of the other secant and its external segment length

[19] When a tangent and a secant line segment are drawn to a circle from the same exterior point, the square of the length of the tangent segment = to the product of the secant and its external segment length

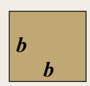
[GEOMETRIC Formulas]

Area The area, A, of a two-dimensional shape is the number of square units that can be put in the region enclosed by the sides

Note Area is obtained through some combination of multiplying heights and bases, which always form 90º angles with each other, except in circles

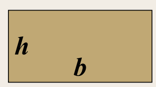
Square Area: $A = b^2$

If $b = 8$, then:
$A = 64$ square units



Rectangle Area: $A = hb$, or $A = lw$

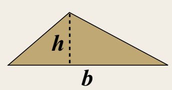
If $h = 4$ and $b = 12$, then:
$A = (4)(12)$, $A = 48$ square units



Triangle Area: $A = \frac{1}{2}bh$

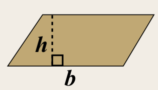
If $h = 8$ and $b = 12$, then:

$A = \frac{1}{2}(8)(12)$, $A = 48$ square units



Parallelogram Area: $A = hb$

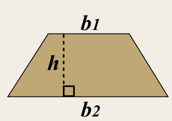
If $h = 6$ and $b = 9$, then:
$A = (6)(9)$, $A = 54$ square units



Trapezoid Area: $A = \frac{1}{2}h(b_1 + b_2)$

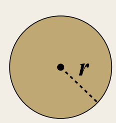
If $h = 9$, $b_1 = 8$ and $b_2 = 12$, then:

$A = \frac{1}{2}(9)(8 + 12)$, $A = \frac{1}{2}(9)(20)$, $A = 90$ square units



Circle Area: $A = \pi r^2$

$A = \pi r^2$; if $r = 5$, then:
$A = \pi\, 5^2 = (3.14)25 = 78.5$ square units

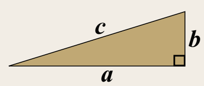


Circumference: $C = 2\pi r$

If $r = 5$, then:
$C = (2)(3.14)(5) = 10(3.14) = 31.4$ units

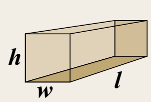
Pythagorean Theorem:

If a right triangle has hypotenuse c and legs a and b, then: $c^2 = a^2 + b^2$



Rectangular Prism Volume: $V = lwh$

If $l = 12$, $w = 3$ and $h = 4$, then:
$V = (12)(3)(4)$, $V = 144$ cubic units

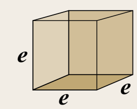


Perimeter The perimeter, P, of a two-dimensional shape is the sum of all side lengths

Volume The volume, V, of a three-dimensional shape is the number of cubic units that can be put in the space enclosed by all the sides

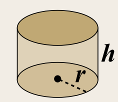
Cube Volume: $V = e^3$

Each edge length, e, is equal to the other edge in a cube; if $e = 8$, then:
$V = (8)(8)(8)$, $V = 512$ cubic units



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

If radius $r = 9$ and $h = 8$, then:
$V = \pi(9)^2(8)$, $V = (3.14)(81)(8)$,
$V = 2034.72$ cubic units

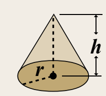


Cone Volume: $V = \frac{1}{3}\pi r^2 h$

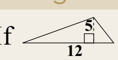
If $r = 6$ and $h = 8$, then:

$V = \frac{1}{3}\pi(6)^2(8)$, $V = \frac{1}{3}(3.14)(36)(8)$,

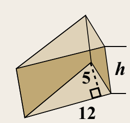
$V = 301.44$ cubic units



Triangular Prism Volume: $V = $ (area of triangle)h

If  has an area equal to $\frac{1}{2}(5)(12)$, then:

$V = 30h$ and if $h = 8$, then:
$V = (30)(8)$, $V = 240$ cubic units

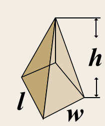


Rectangular Pyramid Volume: $V = \frac{1}{3}$(area of rectangle)h

If $l = 5$ and $w = 4$, the rectangle has an area of 20, then:

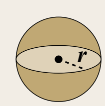
$V = \frac{1}{3}(20)h$ and if $h = 9$, then:

$V = \frac{1}{3}(20)(9)$, $V = 60$ cubic units



Sphere Volume: $V = \frac{4}{3}\pi r^3$

If radius $r = 5$, then:
$V = \frac{4}{3}(3.14)(5)^3$, $V = 523.3$ cubic units



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