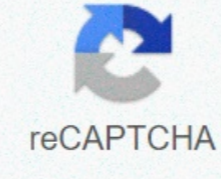




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## Area of triangle formula in coordinate geometry calculator

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The area of a triangle  $\$P(x_1, y_1)\$, \$Q(x_2, y_2)\$ and  $\$R(x_3, y_3)\$ is given by  $\$S_{triangle} = \frac{1}{2}(x_1(y_2 - y_3)) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\$$  If the area of triangle is zero, it means the points are collinear. If we code this in Python3, it will look like def triangle_area(x1, y1, x2, y2, x3, y3): return abs(0.5*(x1*(y2-y3)+x2*(y3-y1)+x3*(y1-y2))) If we code in js, it will look like this function triangle_area(x1, y1, x2, y2, x3, y3) { return Math.abs(0.5*(x1*(y2-y3)+x2*(y3-y1)+x3*(y1-y2))) } Online calculator to calculate the area and perimeter of a triangle given the coordinates of its vertices. The distance formula is used to find the distances between vertices then these distances are used to find the perimeter and area of the triangle. Formulas for Area and Perimeter Let A(xA , yA), B(xB , yB) and C(xC , yC) be the three vertices defining the triangle. The formula for the area of the triangle defined by the three vertices A, B and C is given by: where det is the determinant of the three by three matrix. The perimeter is found by first finding the three distances between the three vertices dAB, dBC and dCD given by dAB =  $\sqrt{(xA - xB)^2 + (yA - yB)^2}$  dBC =  $\sqrt{(xB - xC)^2 + (yB - yC)^2}$  dCD =  $\sqrt{(xC - xD)^2 + (yC - yD)^2}$  The perimeter is given by Perimeter =dAB + dBC + dCD How to use the calculator? Enter the x and y coordinates of the three vertices A, B and C of the triangle and press "calculate". The outputs are the area and perimeter of the triangle. More References and LinksOnline Geometry Calculators and Solvers. report this ad>Welcome to the orthocenter calculator - a tool where you can easily find the orthocenter of any triangle, be it right, obtuse or acute. If you're uncertain what the orthocenter of a triangle is, we've prepared a nice explanation, as well as an orthocenter definition. Afterward, you can learn how to find the orthocenter with a step by step set of instructions (or you can just use the orthocenter formula, fueled by trigonometry). And, when you've worked your way though all of this, there are some orthocenter properties waiting for you, and some bonus special cases... The orthocenter of a triangle is the point where the altitudes of the triangle intersect. The three altitudes of a triangle are always concurrent, meaning that they meet at the same point. As a quick reminder, the altitude is the line segment that is perpendicular to a side and touches the corner opposite to the side. Now that you've been introduced to the orthocenter definition, let's check how to find it. The easiest, most straightforward way to calculate the orthocenter of a triangle is to follow this step-by-step guide: To start, let's assume that the triangle ABC has the vertex coordinates A = (x<sub>1</sub>, y<sub>1</sub>), B = (x<sub>2</sub>, y<sub>2</sub>) and C = (x<sub>3</sub>, y<sub>3</sub>). Find the slope of one side of the triangle, e.g. AB. Use the slope formula: slope = (y<sub>2</sub> - y<sub>1</sub>) / (x<sub>2</sub> - x<sub>1</sub>) Calculate the slope that is perpendicular to side AB. That way, you'll find the slope of the triangle's altitude for that side. The equation for the altitude's slope is: perpendicular slope = -1 / slope Then you need to find the equation for the line containing the triangle's altitude - the one that goes through vertex C (x<sub>3</sub>, y<sub>3</sub>). Use the equation for the point slope formula: y - Y = m * (x - X) For our example it will be: y - y<sub>3</sub> = m * (x - x<sub>3</sub>), where m = -1 / slope = - (x<sub>2</sub> - x<sub>1</sub>) / (y<sub>2</sub> - y<sub>1</sub>) therefore, y = y<sub>3</sub> - (x<sub>2</sub> - x<sub>1</sub>) * (x - x<sub>3</sub>) / (y<sub>2</sub> - y<sub>1</sub>) Repeat the steps for another side, either AC or BC. y = y<sub>2</sub> - (x<sub>3</sub> - x<sub>1</sub>) * (x - x<sub>3</sub>) / (y<sub>3</sub> - y<sub>1</sub>) Solve the system of linear equations (two equations in slope intercept form) to find the orthocenter. The equations in the above paragraph may look scary, but you don't need to worry, it's not that difficult! Let's check how to find the orthocenter with an example, where our triangle ABC has the vertex coordinates: A = (1, 1), B = (3, 5), C = (7, 2). AB side slope = (5 - 1) / (3 - 1) = 2 Calculate the slope of the perpendicular line: perpendicular slope to AB side = - 1/2 . y - 2 = - 1/2 * (x - 7) so y = 5.5 - 0.5 * x Repeat for another side, e.g., BC; BC side slope = (2 - 5) / (7 - 3) = - 3/4 perpendicular slope to BC side = 4/3 . y - 1 = 4/3 * (x - 1) so y = -1/3 + 4/3 * x Solve the system of linear equations: y = 5.5 - 0.5 * x and y = -1/3 + 4/3 * x so 5.5 - 0.5 * x = -1/3 + 4/3 * x 35/6 = x * 11/6 x = 35/11 = 3.182. Substituting x into either equation will give us: y = 43/11 = 3.909 Of course, you'll obtain the same result from our orthocenter calculator! Just type the three triangle vertices and we'll calculate the orthocenter coordinates for you. A more compact formula for find a triangle's orthocenter exists, but you need to be familiar with the concept of the tangent. To find the orthocenter coordinates H = (x, y), you need to solve these equations: x = (x<sub>1</sub> * tan(α) + x<sub>2</sub> * tan(β) + x<sub>3</sub> * tan(γ)) / (tan(α) + tan(β) + tan(γ)) y = (y<sub>1</sub> * tan(α) + y<sub>2</sub> * tan(β) + y<sub>3</sub> * tan(γ)) / (tan(α) + tan(β) + tan(γ)) While those orthocenter formulas may look way easier than the previous instructions on how to find the coordinates of the center, you probably don't have the triangle's angles, α, β, and γ, provided, do you? So you'll probably need to find them first. Use the Pythagorean theorem to find the length of the triangle's sides. Then apply the law of cosines to find the angles of the triangle. Our orthocenter calculator has all of this built in. There are some interesting orthocenter properties! The orthocenter: coincides with the circumcenter, incenter and centroid for an equilateral triangle, coincides with the right-angled vertex for right triangles, lies inside the triangle for acute triangles, lies outside the triangle in obtuse triangles. Did you know that... three triangle vertices and the triangle orthocenter of those points form the orthocentric system. If you make a triangle out of any three of these points, the remaining one will be its orthocenter, reflection of the orthocenter over any of the three sides lies on the circumcircle of the triangle, the angle formed at the orthocenter is supplementary to the angle at the vertex. In every non-equilateral triangle, there's a line going through all important triangle centers (orthocenter, centroid, circumcenter, nine-point circle) - it's called Euler's line. home / math / triangle calculator Please provide 3 values including at least one side to the following 6 fields, and click the "Calculate" button. When radians are selected as the angle unit, it can take values such as pi/2, pi/4, etc. A triangle is a polygon that has three vertices. A vertex is a point where two or more curves, lines, or edges meet in the case of a triangle, the three vertices are joined by three line segments called edges. A triangle is usually referred to by its vertices. Hence, a triangle with vertices a, b, and c is typically denoted as Δabc. Furthermore, triangles tend to be described based on the length of their sides, as well as their internal angles. For example, a triangle in which all three sides have equal lengths is called an equilateral triangle while a triangle in which two sides have equal lengths is called isosceles. When none of the sides of a triangle have equal lengths, it is referred to as scalene, as depicted below. Tick marks on an edge of a triangle are a common notation that reflects the length of the side, where the same number of ticks means equal length. Similar notation exists for the internal angles of a triangle, denoted by differing numbers of concentric arcs located at the triangle's vertices. As can be seen from the triangles above, the length and internal angles of a triangle are directly related, so it makes sense that an equilateral triangle has three equal internal angles, and three equal length sides. Note that the triangle provided in the calculator is not shown to scale; while it looks equilateral (and has angle markings that typically would be read as equal), it is not necessarily equilateral and is simply a representation of a triangle. When actual values are entered, the calculator output will reflect what the shape of the input triangle should look like. Triangles classified based on their internal angles fall into two categories: right or oblique. A right triangle is a triangle in which one of the angles is 90°, and is denoted by two line segments forming a square at the vertex constituting the right angle. The longest edge of a right triangle, which is the edge opposite the right angle, is called the hypotenuse. Any triangle that is not a right triangle is classified as an oblique triangle and can either be obtuse or acute. In an obtuse triangle, one of the angles of the triangle is greater than 90°, while in an acute triangle, all of the angles are less than 90°, as shown below. Triangle facts, theorems, and laws It is not possible for a triangle to have more than one vertex with internal angle greater than or equal to 90°, or it would no longer be a triangle. The interior angles of a triangle always add up to 180° while the exterior angles of a triangle are equal to the sum of the two interior angles that are not adjacent to it. Another way to calculate the exterior angle of a triangle is to subtract the angle of the vertex of interest from 180°. The sum of the lengths of any two sides of a triangle is always larger than the length of the third side Pythagorean theorem: The Pythagorean theorem is a theorem specific to right triangles. For any right triangle, the square of the length of the hypotenuse equals the sum of the squares of the lengths of the two other sides. It follows that any triangle in which the sides satisfy this condition is a right triangle. There are also special cases of right triangles, such as the 30° 60° 90°, 45° 45° 90°, and 3 4 5 right triangles that facilitate calculations. Where a and b are two sides of a triangle, and c is the hypotenuse, the Pythagorean theorem can be written as: a<sup>2</sup> + b<sup>2</sup> = c<sup>2</sup> EX: Given a = 3, c = 5, find b: 3<sup>2</sup> + b<sup>2</sup> = 5<sup>2</sup> 9 + b<sup>2</sup> = 25 b<sup>2</sup> = 16 ⇒ b = 4 Law of sines: the ratio of the length of a side of a triangle to the sine of its opposite angle is constant. Using the law of sines makes it possible to find unknown angles and sides of a triangle given enough information. Where sides a, b, c, and angles A, B, C are as depicted in the above calculator, the law of sines can be written as shown below. Thus, if b, B and C are known, it is possible to find c by relating b/sin(B) and c/sin(C). Note that there exist cases when a triangle meets certain conditions, where two different triangle configurations are possible given the same set of data. Given the lengths of all three sides of any triangle, each angle can be calculated using the following equation. Refer to the triangle above, assuming that a, b, and c are known values. Area of a Triangle There are multiple different equations for calculating the area of a triangle, dependent on what information is known. Likely the most commonly known equation for calculating the area of a triangle involves its base, b, and height, h. The "base" refers to any side of the triangle where the height is represented by the length of the line segment drawn from the vertex opposite the base, to a point on the base that forms a perpendicular. Given the length of two sides and the angle between them, the following formula can be used to determine the area of the triangle. Note that the variables used are in reference to the triangle shown in the calculator above. Given a = 9, b = 7, and C = 30°: Another method for calculating the area of a triangle uses Heron's formula. Unlike the previous equations, Heron's formula does not require an arbitrary choice of a side as a base, or a vertex as an origin. However, it does require that the lengths of the three sides are known. Again, in reference to the triangle provided in the calculator, if a = 3, b = 4, and c = 5: Median, inradius, and circumradius Median The median of a triangle is defined as the length of a line segment that extends from a vertex of the triangle to the midpoint of the opposing side. A triangle can have three medians, all of which will intersect at the centroid (the arithmetic mean position of all the points in the triangle) of the triangle. Refer to the figure provided below for clarification. The medians of the triangle are represented by the line segments ma, mb, and mc. The length of each median can be calculated as follows: Where a, b, and c represent the length of the side of the triangle as shown in the figure above. As an example, given that a=2, b=3, and c=4, the median ma can be calculated as follows: Inradius The inradius is the radius of the largest circle that will fit inside the given polygon, in this case, a triangle. The inradius is perpendicular to each side of the polygon. In a triangle, the inradius can be determined by constructing two angle bisectors to determine the incenter of the triangle. The inradius is the perpendicular distance between the incenter and one of the sides of the triangle. Any side of the triangle can be used as long as the perpendicular distance between the side and the incenter is determined, since the incenter, by definition, is equidistant from each side of the triangle. For the purposes of this calculator, the inradius is calculated using the area (Area) and semiperimeter (s) of the triangle along with the following formulas: where a, b, and c are the sides of the triangle Circumradius The circumradius is defined as the radius of a circle that passes through all the vertices of a polygon, in this case, a triangle. The center of this circle, where all the perpendicular bisectors of each side of the triangle meet, is the circumcenter of the triangle, and is the point from which the circumradius is measured. The circumcenter of the triangle does not necessarily have to be within the triangle. It is worth noting that all triangles have a circumcircle (circle that passes through each vertex), and therefore a circumradius. For the purposes of this calculator, the circumradius is calculated using the following formula: Where a is a side of the triangle, and A is the angle opposite of side a Although side a and angle A are being used, any of the sides and their respective opposite angles can be used in the formula.$$

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