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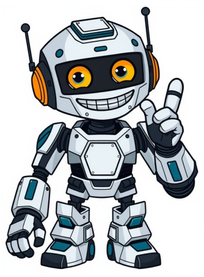

The word "tangent" means "to touch". The Latin word for the same is "tangere". In general, we can say that the line that intersects the circle exactly at one point on its circumference and never enters the circle's interior is a tangent. A circle can have many tangents. They are perpendicular to the radius. Let us learn more about the tangent meaning and theorems in this article. Tangent Meaning In geometry, a tangent is the line drawn from an external point and passes through a point on the curve. One real-life example of a tangent is when you ride a bicycle, every point on the circumference of the wheel makes a tangent with the road. Let us understand the concept of a tangent with an example. The following figure shows an arc S and a point P external to S. A tangent from P has been drawn to S. This is an example of a representation of a tangent. Tangent Definition: Tangent in geometry is defined as a line that touches a curve or a curved surface at exactly one point. Tangent of a Circle A tangent of a circle is defined as a straight line that touches or intersects the circle at only one point. A tangent is a line that never enters the circle’s interior. The following figure shows a circle with a point P. A tangent L passes through P has been drawn. This is an example of a tangent to circle. Point of Tangency The point of tangency is defined as the only point of intersection where the straight line touches or intersects the circle. In the above figure, point P represents the point of tangency. Tangent Properties The tangent has two important properties: A tangent touches a curve at only one point. A tangent is a line that never enters the circle’s interior. The tangent touches the circle’s radius at the point of tangency at a right angle. Apart from the above-listed properties, a tangent to the circle has mathematical theorems associated with it and those theorems are used while doing major calculations in geometry. Let us discuss a few tangents to circle theorems in detail. Tangent Theorems There are two most important theorems on the tangent of a circle. Those are the tangent to radius theorem, and the two tangents theorem. Let us discuss their statements and proof in detail. Tangent Radius Theorem: The tangent at any point of a circle is perpendicular to the radius through the point of contact. Given: Tangent PL to a circle S (with the center of circle O), and the point of contact is A. To prove: OA is perpendicular to the tangent PL. Proof: Point P lies outside the circle. On joining PO we get PO > OA (radius of a circle). This condition will apply to every point on the line PL except point A. PO > OA proves that OA is the shortest of all the distances of point O to the other points on PL. Hence proved, OA is perpendicular to PL. Two Tangents Theorem: Suppose that two tangents are drawn to a circle from an exterior point C. Let the points of contact be A and B, as shown in the image below. The theorem states the following: The lengths of these two tangents will be equal, that is, CA = CB. The two tangents will subtend equal angles at the center, that is, ∠COA = ∠COB. The angle between the tangents will be bisected by the line joining the exterior point and the center, that is, ∠ACO = ∠BCO. Proof: All the three parts will be proved if we show that ΔCAO is congruent to ΔCBO. Comparing the two triangles, we see that: OA = OB (radii of the same circle) OC = OC (common side) ∠OAC = ∠OBC = 90° (Tangent drawn to a circle is perpendicular to the radius at the point of tangency) Thus, by the RHS criterion, ΔCAO is congruent to ΔCBO, and the truth of all the three assertions follows. Tangent of Circle Formula Let us now learn about the equation of the tangent. Tangent is a line and to write the equation of a line we need two things, slope (m) and a point on the line. General equation of the tangent to a circle: 1) The tangent to a circle equation x2 + y2 = a2 for a line y = mx +c is given by the equation y = mx ± a √[1+ m2]. 2) The tangent to a circle equation x2+ y2 = a2 at (\(a_1, b_1)\) is x\(a_1\)+y\(b _1\)= a2 Thus, the equation of the tangent can be given as xa1+yb1 = a2, where (\(a_1, b_1)\) are the coordinates from which the tangent is made. ☛ Related Topics Check these interesting articles related to the tangent and tangent to the circle. Tangent Line Calculator Tangent Line Tangent Function Example 1: TP and TQ are the two tangents to a circle with center O such that ∠POQ = 130°, then angle ∠PTQ is equal to? Solution: Given: TP and TQ are tangents. Using the tangent radius theorem, if the radius is drawn to the tangents TP and TQ it will be perpendicular to these tangents. Thus, OP is perpendicular to TP and QO is perpendicular to TQ. This implies, ∠OPT = 90° ∠OQT = 90° We know that sum of interior angles of a quadrilateral is 360°. Therefore, ∠POQ + ∠PTQ + ∠OPT + ∠OQT = 360° ∠PTQ = 360° - (130° + 90° + 90°) ∠PTQ = 50° Therefore, the value of ∠PTQ is 50°. Example 2: Consider a chord AB of length 10 cm in a circle of radius 6 cm. Tangents at A and B intersect at C, as shown below: What are the lengths of these tangents, CA and CB? Solution: Note that ∠ADC=90°. On comparing ΔOAC with ΔODA: ∠OAC=∠ODA=90° ∠DOA=∠COA (common) Thus, the two triangles ΔOAC and ΔODA are similar by the AA similarity criterion. Hence, OD: OA = AD: AC. We know that OA = 6 cm and AD is half of AB, which is 10 cm, so AD is 10/2 = 5 cm. Now we need to calculate the value of OD using the Pythagoras theorem: OD2 = OA2 − AD2 = 62 − (5)2 = 36 - 25 = 11 OD = √(11) = 3.316 cm We substitute this value into the similarity relation OD: OA = AD: AC to get: AC = (OA×AD)/OD = (6×5)/(3.316) ≈ 9.047 cm As per the two tangents theorem, tangents drawn from an external point to a circle measure the same. Thus, AC = CB. Therefore, AC = BC = 9.047 cm approximately. Example 3: Consider two concentric circles of radii 5 inches and 7 inches. A chord AB of the larger circle touches the smaller circle at C. What is the length of AB? Solution: Consider the following figure: Note that since AB is the tangent to the smaller circle at C, OC must be perpendicular to AB. Thus, ΔOAC is right-angled at C. Also, C is the midpoint of AB, so AC = BC = (1/2)AB. Using the Pythagoras theorem, we have: AC2 = OA2 − OC2 = 72 − 52 = 24 AC = 4.9 inches approx AB = 2 × AC = 9.8 inches Therefore, the length of the tangent AB is 9.8 inches approximately. View Answer > go to slidego to slidego to slide Have questions on basic mathematical concepts? Become a problem-solving champ using logic, not rules. Learn the why behind math with ourCuemath’s certified experts. Book a Free Trial Class FAQs on Tangent The "tangent" is derived from the Latin word "tangere", which means "to touch". Tangent in geometry is defined as a line or plane that touches a curve or a curved surface at exactly one point on the boundary of the curve. What is Tangent of a Circle? A tangent is a line that never enters the circle’s interior. Tangent to circle can be described as a straight line that passes through a point on a circle and is perpendicular to the radius. A tangent of the circle touches the circle at one point but does not enter the circle's interior. What are the Two Major Theorems of Tangent to Circle? The two major tangent to circle theorems are listed below: The tangent at any point of a circle is perpendicular to the radius through the point of contact. The lengths of the two tangents drawn from an external point to a circle are equal. What is the Formula for Tangent of a Circle? The general equation for tangent to circle can be expressed as: The tangent to a circle equation x2 + y2 = a2 for a line y = mx +c is given by the equation y = mx ± a √[1+ m2]. The tangent to a circle equation x2+ y2 = a2 at (a1, b1) is xa1 +yb1 = a2. Thus, the equation of the tangent can be given as xa1 + yb1 = a2, where (a1, b1) are the coordinates from which the tangent is drawn. What are the Four Properties of Tangents to a Circle? The four major properties of a tangent to a circle are listed as follows: The tangent is a straight line that touches the circle at only one point. It is perpendicular to the radius at the point of tangency. It never enters the circle's interior. The lengths of two tangents to a circle from the same external point are equal. How Tangent is Important in Real Life? It is necessary to study tangents because it allows us to find out the slope of a curved function at a specific point. It is easy to find the slope of a line, but to find out the slope in a curved function, a study of the tangent to a circle is a must. A tangent can be used for different applications such as: In the differentials and approximations Architecture Engineering Constructions How do we Know if Two Circles are Tangent? We know that a line is considered as a tangent to a circle if it touches the circle exactly at a single point. Similarly, one circle can be tangent to the other circle, if the circles are meeting or touching exactly at one point. This page explains the sine, cosine, tangent ratio, gives on an overview of their range of values and provides practice problems on identifying the sides that are opposite and adjacent to a given angle. The Sine, Cosine and Tangent functions express the ratios of sides of a right triangle. Answer: sine of an angle is always the ratio of the $$\frac{opposite side}{hypotenuse} $$. $ sine(angle) = \frac{ \text{opposite side}}{\text{hypotenuse}} $ $$ sin(\angle \red L) = \frac{opposite }{hypotenuse} \\ sin(\angle \red L) = \frac{9}{15} $$ $$ sin(\angle \red K) = \frac{opposite }{hypotenuse} \\ sin(\angle \red K)= \frac{12}{15} $$ Remember: When we use the words 'opposite' and 'adjacent,' we always have to have a specific angle in mind. For those comfortable in "Math Speak", the domain and range of Sine is as follows. Domain of Sine = all real numbers Range of Sine = {-1 ≤ y ≤ 1} The sine of an angle has a range of values from -1 to 1 inclusive. Below is a table of values illustrating some key sine values that span the entire range of values. Angle Sine of the Angle 270° sin (270°) = -1 (smallest value that sine can have) 330° sin (330°) = -½ 0° sin(0°) = 0 30° sin(30°) = ½ 90° sin(90°) = 1 (greatest value that sine can have) The cosine of an angle is always the ratio of the (adjacent side/ hypotenuse). $ cosine(angle) = \frac{ \text{adjacent side}}{\text{hypotenuse}} $ $$ cos(\angle \red L) = \frac{adjacent }{hypotenuse} \\ cos(\angle \red L) = \frac{12}{15} $$ $$ cos(\angle \red K) = \frac{adjacent }{hypotenuse} \\ cos(\angle \red K) = \frac{9}{15} $$ For those comfortable in "Math Speak", the domain and range of cosine is as follows. Domain of Cosine = all real numbers Range of Cosine = {-1 ≤ y ≤ 1} The cosine of an angle has a range of values from -1 to 1 inclusive. Below is a table of values illustrating some key cosine values that span the entire range of values. Angle Cosine of the Angle 0° cos (0°) = 1 (greatest value that cosine can ever have) 60° cos (60°) =½ 90° cos(90°) = 0 120° cos(120°) = -½ 180° cos(180°) = -1 (smallest value that cosine can ever have) The tangent of an angle is always the ratio of the (opposite side/ adjacent side). $ tangent(angle) = \frac{ \text{opposite side}}{\text{adjacent side}} $ $$ tan(\angle \red L) = \frac{opposite }{adjacent } \\ tan(\angle \red L) = \frac{9}{12} $$ $$ tan(\angle \red K) = \frac{opposite }{adjacent } \\ tan(\angle \red K) = \frac{12}{9} $$ In the triangles below, identify the hypotenuse and the sides that are opposite and adjacent to the shaded angle. Hypotenuse = AB Opposite side = BC Adjacent side = AC Hypotenuse = AC Opposite side = BC Adjacent side = AB Hypotenuse = YX Opposite Side = ZX Adjacent Side = ZY Hypotenuse = I Side opposite of A = H Side adjacent to A = J Identify the hypotenuse, and the opposite and adjacent sides of $$ \angle ACB $$. First, remember that the middle letter of the angle name ($$ \angle A \red C B $$) is the location of the angle. Second: The key to solving this kind of problem is to remember that 'opposite' and 'adjacent' are relative to an angle of the triangle -- which in this case is the red angle in the picture. Identify the hypotenuse, and the opposite and adjacent sides of $$ \angle RPQ $$. First, remember that the middle letter of the angle name ($$ \angle R \red P Q $$) is the location of the angle. Second: The key to solving this kind of problem is to remember that 'opposite' and 'adjacent' are relative to an angle of the triangle -- which in this case is the red angle in the picture. Identify the hypotenuse, and the opposite and adjacent sides of $$ \angle BAC $$. First, remember that the middle letter of the angle name ($$ \angle B \red A C $$) is the location of the angle. Second: The key to solving this kind of problem is to remember that 'opposite' and 'adjacent' are relative to an angle of the triangle -- which in this case is the red angle in the picture. Identify the side that is opposite of $$\angle$$IHU and the side that is adjacent to $$\angle$$IHU. First, remember that the middle letter of the angle name ($$ \angle I \red H U $$) is the location of the angle. Second: The key to solving this kind of problem is to remember that 'opposite' and 'adjacent' are relative to an angle of the triangle -- which in this case is the red angle in the picture. SOHCAHTOA Home Further Reading: Sine, Cosine Tangent Ratios Images SOHCAHTOA HOME Tangent Function is among the six basic trigonometric functions and is calculated by taking the ratio of the perpendicular side and the hypotenuse side of the right-angle triangle.In this article, we will learn about Trigonometric ratios, Tangent formulas, related examples, and others in detail.Trigonometric RatiosTrigonometric ratios are ratios of sides in a triangle and there are six trigonometric ratios. In a right-angle triangle, the six trigonometric ratios are defined as:sin θ = (Opposite Side/Hypotenusecos θ = Adjacent Side/Hypotenusetan θ = Opposite side/adjacent sidecosec θ = 1/sin θ = Hypotenuse/Opposite Sidesec θ = 1/cos θ = Hypotenuse/Adjacent Sidecot θ = 1/tan θ = Adjacent Side/Opposite SideTangent FormulaTangent of an angle in a right-angled triangle is the ratio of the length of the opposite side to the length of the adjacent side to the given angle. We write a tangent function as "tan". Let us consider a right-angled triangle ABC and one of its acute angles is "θ". An opposite side is the side that is opposite to the angle "θ" and the adjacent side is the side that is adjacent to the angle "θ". Now, the tangent formula for the given angle "θ" is,Tangent FormulaSome Basic Tangent FormulaeTangent Function in QuadrantsThe tangent function is positive in the first and third quadrants and negative in the second and fourth quadrants.tan (2π + θ) = tan θ (1st quadrant)tan (π – θ) = – tan θ (2nd quadrant)tan (π + θ) = tan θ (3rd quadrant)tan (2π – θ) = – tan θ (4th quadrant)Tangent Function as a Negative FunctionThe tangent function is a negative function since the tangent of a negative angle is the negative of a tangent positive angle.tan (-θ) = - tan θTangent Function in Terms of Sine and Cosine FunctionTangent function in terms of sine and cosine functions can be written as,tan θ = sin θ/cos θWe know that, tan θ = Opposite side/Adjacent sideNow, divide both the numerator and denominator with hypotenusetan θ = (Opposite side/Hypotenuse)/(Adjacent side/Hypotenuse)We know that, sin θ = opposite side/hypotenusecos θ = adjacent side/hypotenuseHence, tan θ = sin θ/cos θTangent Function in Terms of Sine FunctionTangent function in terms of the sine function can be written as,tan θ = sin θ/(√1 – sin2 θ)We know that,tan θ = sin θ/cos θFrom the Pythagorean identities, we have,sin2 θ + cos2 θ = 1cos2 θ = 1 - sin2 θcos θ = √(1 - sin2 θ)Hence, tan θ = sin θ/(√1 – sin2 θ)Tangent Function in Terms of Cosine FunctionTangent function in terms of the cosine function can be written as,tan θ = (√1 -cos2 θ)/cos θWe know that,tan θ = sin θ/cos θFrom the Pythagorean identities, we have,sin2 θ + cos2 θ = 1sin2 θ = 1 - cos2 θsin θ = √(1 - cos2 θ)Hence, tan θ = (√1 - cos2 θ)/cos θTangent Function in Terms of Cotangent FunctionTangent function in terms of the cotangent function can be written as,tan θ = 1/cot θortan θ = cot (90° - θ) (or) cot (π/2 - θ)Tangent Function in Terms of Cosecant FunctionTangent function in terms of the cosecant function can be written as,tan θ = 1/√(cosec2 θ – 1)From the Pythagorean identities, we have,cosec2 θ – cot2 θ = 1cot2 θ = cosec2 θ - 1cot θ = √(cosec2 θ - 1)We know that,tan θ = 1/cot θHence, tan θ = 1/√(cosec2 θ - 1)Tangent Function in Terms of Secant FunctionTangent function in terms of the secant function can be written as,tan θ = √sec2 θ – 1From the Pythagorean identities, we have,sec2 θ – tan2 θ = 1tan θ = sec2 θ - 1Hence, tan θ = √(sec2 θ – 1)Tangent Function in Terms of Double AngleTangent function for a double angle is,tan 2θ = (2 tan θ)/(1 - tan2 θ)Tangent Function in Terms of Triple AngleTangent function for a triple angle is, tan 3θ = (3 tan θ - tan3θ) / (1 - 3 tan2θ)Tangent Function in Terms of Half-AngleTangent function for a half-angle is,tan (θ/2) = ± √[(1 - cos θ) / (1 + cos θ)]tan (θ/2) = (1 - cos θ) / (sin θ)Sum and difference formulas for a tangent function are,tan (A + B) = (tan A + tan B)/(1 - tan A tan B)tan (A - B) = (tan A - tan B)/(1 + tan A tan B)Article Related to Tangent Formula:Examples on Tangent FormulasExample 1: Find the value of tan θ if sin θ = 2/5 and θ is the first quadrant angle.Solution:Given, From the Pythagorean identities we have,sin2 θ + cos2 θ = 1cos2 θ = 1 - sin2 θ = 1 - (2/5)2cos2 θ = 1 - (4/5) = 21/25cos θ = ±√21/5Since θ is the first quadrant angle, cos θ is positive.cos θ = √21/5We know that, tan θ = sin θ/cos θ= (2/5)/(√21/5) = 2/√21tan θ = 2√21 /21So, value of tan θ when sin θ = 2/5 and θ is in first quadrant is (2√21) /(21)Example 2: Find the value of tan x if sec x = 13/12 and x is the fourth quadrant angle.Solution:Given, sec x = 13/12From the Pythagorean identities, we have,sec2 x – tan2 x = 1tan2 x = sec2 x - 1= (13/12)2 - 1tan2 x = (169/144) - 1= 25/144tan x = ± 5/12Since x is the fourth quadrant angle, tan x is negative.tan x = - 5/12Hence, tan x = - 5/12Example 3: If tan X = 2/3 and tan Y = 1/2, then what is the value of tan (X + Y)?Solution:Given,tan X = 2/3 and tan Y = 1/2We know that,tan (X + Y) = (tan X + tan Y)/(1 - tan X tan Y)tan (X + Y) = [(2/3) + (1/2)]/[1 - (2/3)×(1/2)]= (7/6)/(2/3) = 7/4Hence, tan (X + Y) = 7/4Example 4: Calculate the tangent function if the adjacent and opposite sides of a right-angled triangle are 4 cm and 7 cm, respectively.Solution:Given,Adjacent side = 4 cmOpposite side = 7 cmWe know that,tan θ = Opposite side/Adjacent sidetan θ = 7/4 = 1.75Hence, tan θ = 1.75Example 5: A man is looking at a clock tower at a 60° angle to the top of the tower, whose height is 100 m. What is the distance between the man and the foot of the tower?Solution:Given,Height of tower = 100 m and θ = 60°Let distance between man and foot of tower = dWe have,tan θ = Opposite side/Adjacent sidetan 60° = 100/d√3 = 100/d [Since, tan 60° = √3]d = 100/√3Therefore, distance between the man and the foot of tower is 100/√3Example 6: Find the value of tan θ if sin θ = 7/25 and sec θ = 25/24.Solution:Given,sin θ = 7/25sec θ = 25/24We know that,sec θ = 1/cos θ 25/24 = 1/cos θ cos θ = 24/25We have,tan θ = sin θ/cos θ= (7/25)/(24/25)= 7/24Hence, tan θ = 7/24Example 7: Find the value of tan θ if cosec θ = 5/3, and θ is the first quadrant angle.Solution:Given, cosec θ = 5/3From the Pythagorean identities, we have,cosec2 θ – cot2 θ = 1cot2 θ = cosec2 θ - 1cot θ = (5/3)2 - 1 = (25/9) - 1 = 16/9cot θ = ±√16/9 = ± 4/3Since θ is the first quadrant angle, both cotangent and tangent functions are positive.cot θ = 4/3We know that,cot θ = 1/tan θ 4/3 = 1/tan θtan θ = 3/4Hence, tan θ = 3/4Example 8: Find tan 3θ if sin θ = 3/7 and θ is the first quadrant angle.Solution:Given, sin θ = 12/13From the Pythagorean identities we have,sin2θ + cos2θ = 1cos2θ = 1 - sin2θ = 1 - (12/13)2cos2 θ = 1 - (144/169) = 25/169cos θ = ±√25/169 = ±5/13Since θ is the first quadrant angle, cos θ is positive.cos θ = 5/13We know that,tan θ = sin θ/cos θ= (12/25)/(5/13) = 12/5Hence, tan θ = 12/5Now, We know that ,tan 3θ = (3 tan θ - tan3θ) / (1 - 3 tan2θ)tan 3θ = 3 × (12/5) Three Functions, but same idea. Sine, Cosine and Tangent are the main functions used in Trigonometry and are based on a Right-Angled Triangle. Before getting stuck into the functions, it helps to give a name to each side of a right triangle: "Opposite" is opposite to the angle θ "Adjacent" is adjacent to (next to) the angle θ "Hypotenuse" is the long one Opposite is always opposite the angle And Adjacent is always next to the angle Sine, Cosine and Tangent (often shortened to sin, cos and tan) are each a ratio of sides of a right angled triangle: For a given angle θ each ratio stays the same no matter how big or small the triangle is To calculate them: Divide the length of one side by another side Using this triangle (lengths are only to one decimal place): sin(35°) = OppositeHypotenuse = 2.84.9 = 0.57... cos(35°) = AdjacentHypotenuse = 4.04.9 = 0.82... tan(35°) = OppositeAdjacent = 2.84.0 = 0.70... Size Does Not Matter The triangle can be large or small and the ratio of sides stays the same. Only the angle changes the ratio. Play with the triangle: Drag point A to see how changing the angle affects the ratios Drag point B to change the size algebra/images/sin-cos-tan.js Good calculators have sin, cos and tan on them, to make it easy for you. Just put in the angle and press the button. But you still need to remember what they mean! In picture form: Practice Here: geometry/images/triangle-q.js How to remember? Think "Sohcahtoa"! It works like this: Soh... Sine = Opposite / Hypotenuse ...cah... Cosine = Adjacent / Hypotenuse ...toa Tangent = Opposite / Adjacent You can read more about sohcahtoa. Remember it, as it may help in an exam ! Move the mouse around to see how different angles (in radians or degrees) affect sine, cosine and tangent. algebra/images/circle-triangle.js In this animation the hypotenuse is 1, making the Unit Circle, which is like a map for trigonometry. Notice that the adjacent side and opposite side can be positive or negative, which makes the sine, cosine and tangent change between positive and negative values also. "Why didn't sin and tan go to the party?" "... just cos!" The classic 30° triangle has a hypotenuse of length 2, an opposite side of length 1 and an adjacent side of√3: Now we know the lengths, we can calculate the functions: Sine sin(30°) = 1 / 2 = 0.5 Cosine cos(30°) = 1.732 / 2 = 0.866... Tangent tan(30°) = 1 / 1.732 = 0.577... (get your calculator out and check them!) The classic 45° triangle has two sides of 1 and a hypotenuse of √2: Sine sin(45°) = 1 / 1.414 = 0.707... Cosine cos(45°) = 1 / 1.414 = 0.707... Tangent tan(45°) = 1 / 1 = 1 With these three magical functions, we're equipped to solve all sorts of real-world questions, because they let us: work out angles when we know sides work out sides when we know angles Example: Use the sine function to find "d" We know: The cable makes a 39° angle with the seabed The cable has a 30 meter length And we want to know "d" (the distance down). Start with:sin 39° = opposite/hypotenusesin 39° = d/30Swap Sides:d/30 = sin 39° Use a calculator to find sin 39°: d/30 = 0.6293... Multiply both sides by 30:d = 0.6293... x 30 d = 18.88 to 2 decimal places. The depth "d" is 18.88 m Exercise Try this paper-based exercise where you can calculate the sine function for all angles from 0° to 360°, and then graph the result. It will help you to understand these relativelysimple functions. You can also see Graphs of Sine, Cosine and Tangent. And play with a spring that makes a sine wave. Less Common Functions To complete the picture, there are 3 other functions where we divide one side by another, but they are not so commonly used. They are equal to 1 divided by cos, 1 divided by sin, and 1 divided by tan: Secant Function: sec(θ) = HypotenuseAdjacent (=1/cos) Cosecant Function: csc(θ) = HypotenuseOpposite (=1/sin) Cotangent Function: cot(θ) = AdjacentOpposite (=1/tan) 1494, 1495, 724, 725, 1492, 1493, 726, 727, 2362, 2363 Copyright © 2025 Rod Pierce A line which touches a circle or ellipse at just one point. Below, the blue line is a tangent to the circle c. Note the radius to the point of tangency is always perpendicular to the tangent line. For more on this see Tangent to a circle. 2. Trigonometry One of the trigonometry functions. In a right triangle, the tangent of an angle is the opposite side over the adjacent side. For more on this see Trigonometry tangent function. (C) 2011 Copyright Math Open Reference. All rights reserved home / trigonometry / trigonometric functions / tangentTangent, written as tan(θ), is one of the six fundamental trigonometric functions. Tangent definition Tangent, like other trigonometric functions, is typically defined in terms of right triangles and in terms of the unit circle. The right-angled triangle definition of trigonometric functions is most often how they are introduced, followed by their definitions in terms of the unit circle. Right triangle definition For a right triangle with one acute angle, θ, the tangent value of this angle is defined to be the ratio of the opposite side length to the adjacent side length. This is sometimes referred to as the tangent formula, and is written as follows: The sides of the right triangle are referenced as follows: Adjacent: the side next to θ that is not the hypotenuse Opposite: the side opposite θ. Hypotenuse: the longest side of the triangle opposite the right angle. The other two most commonly used trigonometric functions are cosine and sine, and they are defined as follows: Tangent is related to sine and cosine as: How to find tangent Given a triangle and the tangent formula above, we can find the tangent as shown in the following examples. Example: Find tan(θ) for the right triangle below. We can also use the tangent function when solving real world problems involving right triangles. Example: Jack is standing 17 meters from the base of a tree. Given that the angle from Jack's feet to the top of the tree is 49°, what is the height of the tree, h? If the tree falls towards Jack, will it land on him? Since we know the adjacent side and the angle, we can use to solve for the height of the tree. h = 17 × tan(49°) ≈ 19.56 So, the height of the tree is 19.56 m. If Jack does not move, the tree will land on him if it falls in his direction, since 19.56 > 17. Unit circle definition Trigonometric functions can also be defined with a unit circle. A unit circle is a circle of radius 1 centered at the origin. The right triangle definition of trigonometric functions allows for angles between 0° and 90° (0 and in radians). Using the unit circle definitions allows us to extend the domain of trigonometric functions to all real numbers. Refer to the figure below. On the unit circle, θ is the angle formed between the initial side of an angle along the x-axis and the terminal side of the angle formed by rotating the ray either clockwise or counterclockwise. On the unit circle, tan(θ) is the length of the line segment formed by the intersection of the line x=1 and the ray formed by the terminal side of the angle as shown in blue in the figure above. Unlike the definitions of trigonometric functions based on right triangles, this definition works for any angle, not just acute angles of right triangles, as long as it is within the domain of tan(θ), which is undefined at odd multiples of 90° (). Thus, the domain of tan(θ) is θ∈R, . The range of the tangent function is -∞

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