The Pythagoras theorem is an important theorem used in geometry that shows the relationship between the lengths of the sides of a right-angled triangle. It is named after the famous Greek mathematician Pythagoras and is also known as the Pythagorean theorem. The Pythagoras theorem holds great significance in geometry and forms the base for solving various mathematical problems. It finds many real-life applications in the field of construction, navigation, surveying, architecture, etc. What is Pythagoras Theorem? The Pythagoras theorem states that the sum of the square of the two sides of a right-angle triangle is equal to the square of the third side called the hypotenuse. The equation formed as per the Pythagoras theorem is $a^2 + b^2 = c^2$, where a, b and c are the sides of a right triangle. The ability to find the length of a side when the other two sides' length is given makes the Pythagorean Theorem a beneficial construction and navigation technique. Here are 5 real-life applications of the Pythagorean Theorem 1. Architecture The Pythagorean Theorem is applicable to calculate the length of the diagonal connecting any two straight lines. This aspect of the Pythagorean theorem is pretty useful in designing and construction. For instance, while building a sloped roof, if you know the height and the length of the roof to cover, you can use the Pythagorean Theorem to find the diagonal length or to calculate the roof's slope. You can utilize this data to precisely cut beams to support the roof structure or to calculate the roof's total area. 2. Painting Walls Painters also make use of the Pythagoras theorem to paint buildings. They need to evaluate the ladder height and distance from the wall to complete the work without an accident. In this case, the ladder is the hypotenuse in terms of the theorem. 3. Navigation The Pythagorean theorem is useful in two-dimensional navigation, mostly used by ships to find the shortest routes. Sailors navigate using this theorem by making a horizontal and a vertical line from the current location to form a right angled triangle in order to find the shortest distance to the destination. The distances in each direction will be the two sides of the triangle, and the shortest line connecting them will be diagonal. The same law applies to other forms of navigation on land or the sky. For instance, a flight can use its altitude above sea level and its distance from the destination airport to find the exact geolocation to begin a safe descent to that airport. 4. Building Square & Angles Right angles and square shapes are quite common in building designs and construction work. Engineers use the basic property of the Pythagoras theorem, which states that if the sides satisfy the theorem condition, the triangle will always form a right angle. While laying out the building foundation or constructing a right-angled corner between two walls, engineers set out a triangle from three strings that correspond with sides lengths satisfying the theorem. 5. Surveying The Pythagorean Theorem is used to calculate many aspects of the terrain that otherwise are hard to assess, such as the steepness of slopes of mountains. A surveyor uses a telescope and a measuring stick at a fixed distance away, so when the telescope's line of sight and the measuring stick create a right angle, a triangle is formed. Since the surveyor has the information about the two sides of the triangle that are the height of the measuring stick and the horizontal distance of the stick from the telescope, he calculates the steepness of the hill by using the theorem to find the length of the slope that covers that distance. Conclusion The Pythagorean theorem is foundational in various branches of mathematics, physics, geology, architecture, and more. There are numerous interactive activities for kids to reinforce the Pythagoras theorem's understanding, like maths games, puzzles, and worksheets. Cuemath offers excellent learning resources for kids to gain a clear understanding of various concepts and their applications in our everyday life. Cuemath live online classes are designed to promote the real-life application of maths for kids to learn interestingly. Watch this space for updates in the Hacks category on Running Wolf's Rant. Like what you just read? Subscribe To Our Newsletter to stay in the loop. Feel free to explore our website, check out our Featured Articles or scroll down to see the articles that are related to this article below. We've been around since 2008, so there's plenty of content. Looking for a gift for that special person in your life? Check out Netflorist.co.za, South Africa's top online florist and gift service. They offer flowers, gifts, and hampers for all occasions AND reliable nationwide delivery. Pythagoras Theorem (also called Pythagorean Theorem) is an important topic in Mathematics, which explains the relation between the sides of a right-angled triangle. The sides of the right triangle are also called Pythagorean triples. The formula and proof of this theorem are explained here with examples. Pythagoras theorem is basically used to find the length of an unknown side and the angle of a triangle. By this theorem, we can derive the base, perpendicular and hypotenuse formulas. Let us learn the mathematics of the Pythagorean theorem in detail here. Pythagoras Theorem Statement Pythagoras theorem states that "In a right-angled triangle, the square of the hypotenuse side is equal to the sum of squares of the other two sides". The sides of this triangle have been named Perpendicular, Base and Hypotenuse. Here, the hypotenuse is the longest side, as it is opposite to the angle 90°. The sides of a right triangle (say a, b and c) which have positive integer values, when squared, are put into an equation, also called a Pythagorean triple. History The theorem is named after a Greek Mathematician called Pythagoras. Pythagoras Theorem Formula Consider the triangle given above: Where "a" is the perpendicular, "b" is the base, "c" is the hypotenuse. According to the definition, the Pythagoras Theorem formula is given as: Hypotenuse2 = Perpendicular2 + Base2 c2 = a2 + b2 The side opposite to the right angle (90°) is the longest side (known as Hypotenuse) because the side opposite to the greatest angle is the longest. Consider three squares of sides a, b, c mounted on the three sides of a triangle having the same sides as shown. By Pythagoras Theorem – Area of square "a" + Area of square "b" = Area of square "c" Example The examples of theorem and based on the statement given for right triangles is given below: Consider a right triangle, given below: Find the value of x. X is the side opposite to the right angle, hence it is a hypotenuse. Now, by the theorem we know; Hypotenuse2 = Base2 + Perpendicular2 x2 = 82 + 62 x2 = 64+36 = 100 x = √100 = 10 Therefore, the value of x is 10. Pythagoras Theorem Proof Given: A right-angled triangle ABC, right-angled at B. To Prove- AC2 = AB2 + BC2 Construction: Draw a perpendicular BD meeting AC at D. Proof: We know, △ADB ~ △ABC Therefore, (corresponding sides of similar triangles) Or, AB2 = AD × AC ……………………………………..(1) Also, △BDC ~△ABC Therefore, (corresponding sides of similar triangles) Or, BC2= CD × AC ……………………………………..(2) Adding the equations (1) and (2) we get, AB2 + BC2 = AD × AC + CD × AC AB2 + BC2 = AC (AD + CD) Since, AD + CD = AC Therefore, AC2 = AB2 + BC2 Hence, the Pythagorean theorem is proved. Note: Pythagorean theorem is only applicable to Right-Angled triangle. Video Lesson on Pythagoras Theorem Applications of Pythagoras Theorem To know if the triangle is a right-angled triangle or not. In a right-angled triangle, we can calculate the length of any side if the other two sides are given. To find the diagonal of a square. Useful For Pythagoras theorem is useful to find the sides of a right-angled triangle. If we know the two sides of a right triangle, then we can find the third side. How to use Pythagoras Theorem? To use Pythagoras theorem, remember the formula given below: c2 = a2 + b2 Where a, b and c are the sides of the right triangle. For example, if the sides of a triangles are a, b and c, such that a = 3 cm, b = 4 cm and c is the hypotenuse. Find the value of c. We know, c2 = a2 + b2 c2 = 32+42 c2 = 9+16 c2 = 25 c = √25 c = 5 cm Hence, the length of hypotenuse is 5 cm. How to find whether a triangle is a right-angled triangle? If we are provided with the length of three sides of a triangle, then to find whether the triangle is a right-angled triangle or not, we need to use the Pythagorean theorem. Let us understand this statement with the help of an example. Suppose a triangle with sides 10cm, 24cm, and 26cm are given. Clearly, 26 is the longest side. It also satisfies the condition, 10 + 24 > 26 We know, c2 = a2 + b2 ………(1) So, let a = 10, b = 24 and c = 26 First we will solve R.H.S. of equation 1. a2 + b2 = 102 + 242 = 100 + 576 = 676 Now, taking L.H.S, we get; c2 = 262 = 676 We can see, LHS = RHS Therefore, the given triangle is a right triangle, as it satisfies the Pythagoras theorem. Related Articles Pythagorean Theorem Solved Examples Problem 1: The sides of a triangle are 5, 12 & 13 units. Check if it has a right angle or not. Solution: From Pythagoras Theorem, we have; Perpendicular2 + Base2 = Hypotenuse2 P2 + B2 = H2 Let, Perpendicular (P) = 12 units Base (B)= 5 units Hypotenuse (H) = 13 units {since it is the longest side measure} LHS = P2 + B2 ⇒ 122 + 52 ⇒ 144 + 25 ⇒ 169 RHS = H2 ⇒ 132 ⇒ 169 ⇒ 169 = 169 L.H.S. = R.H.S. Therefore, the angle opposite to the 13 units side will be a right angle. Problem 2: The two sides of a right-angled triangle are given as shown in the figure. Find the third side. Solution: Given; Perpendicular = 15 cm Base = b cm Hypotenuse = 17 cm As per the Pythagorean Theorem, we have; Perpendicular2 + Base2 = Hypotenuse2 ⇒152 + b2 = 172 ⇒225 + b2 = 289 ⇒b2 = 289 – 225 ⇒b2 = 64 ⇒b = √64 Therefore, b = 8 cm Problem 3: Given the side of a square to be 4 cm. Find the length of the diagonal. Solution- Given; Sides of a square = 4 cm To Find- The length of diagonal ac. Consider triangle abc (or can also be acd) (ab)2 +(bc)2 = (ac)2 (4)2 +(4)2= (ac)2 16 + 16 = (ac)2 32 = (ac)2 (ac)2 = 32 ac = 4√2. Thus, the length of the diagonal is 4√2 cm. Practice Problems on Pythagoras Theorem In a right triangle ABC, right-angled at B, the lengths of AB and BC are 7 units and 24 units, respectively. Find AC. If the length of the diagonal of a square is 10 cm, then find the length of the side of the square. A triangle is given whose sides are of length 11 cm, 60 cm, and 61 cm. Check whether these are the sides of a right-angled triangle. Stay tuned with BYJU'S – The Learning App to learn all the important mathematical concepts and also watch interactive videos to learn with ease. The formula for Pythagoras, for a right-angled triangle, is given by; P2 + B2 = H2 Pythagoras theorem states that, in a right triangle, the square of the hypotenuse is equal to the sum of the square of the other two sides. The hypotenuse is the longest side of the right-angled triangle, opposite to right angle, which is adjacent to base and perpendicular. Let base, perpendicular and hypotenuse be a, b and c respectively. Then the hypotenuse formula, from the Pythagoras statement will be; c = √(a2 + b2) No, this theorem is applicable only for the right-angled triangle. The theorem can be used to find the steepness of the hills or mountains. To find the distance between the observer and a point on the ground from the tower or a building above which the observer is viewing the point. It is mostly used in the field of construction. Yes, the diagonals of a square can be found using the Pythagoras theorem, as the diagonal divides the square into right triangles. Step 1: To find the unknown sides of a right triangle, plug the known values in the Pythagoras theorem formula. Step 2: Simplify the equation to find the unknown side. Step 3: Solve the equation for the unknown side. There are various approaches to prove the Pythagoras theorem. A few of them are listed below: Proof using similar triangles Proof using differentials Euclid's proof Algebraic proof, and so on. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. 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If we have a right triangle, and we construct squares using the edges or sides of the right triangle (gray triangle in the middle), the area of the largest square built on the hypotenuse (the longest side) is equal to the sum of the areas of the squares built on the other two sides. This is the Pythagorean Theorem in a nutshell. By the way, this is also known as the Pythagoras' Theorem. Notice that we square (raised to the second power) the variables [latex]a[/latex], [latex]b[/latex], and [latex]c[/latex] to indicate areas. The sum of the smaller squares (orange and yellow) is equal to the largest square (blue). The Pythagorean Theorem relates the three sides in a right triangle. To be specific, relating the two legs and the hypotenuse, the longest side. The Pythagorean Theorem can be summarized in a short and compact equation as shown below. Definition of Pythagorean Theorem For a given right triangle, it states that the square of the hypotenuse, [latex]c[/latex], is equal to the sum of the squares of the legs, [latex]a[/latex] and [latex]b[/latex]. That is, [latex]{a^{2} + {b^2} = {c^2}[/latex]. For a more general definition, we have: In right a triangle, the square of longest side known as the hypotenuse is equal to the sum of the squares of the other two sides. The Pythagorean Theorem guarantees that if we know the lengths of two sides of a right triangle, we can always determine the length of the third side. Here are the three variations of the Pythagorean Theorem formulas: Let's go over some examples! Examples of Applying the Pythagorean Theorem Example 1: Find the length of the hypotenuse. Our goal is to solve for the length of the hypotenuse. We are given the lengths of the two legs. We know two sides out of the three! This is enough information for the formula to work. For the legs, it doesn't matter which one we assign for [latex]a[/latex] or [latex]b[/latex]. The result will be the same. So if we let [latex]a=5[/latex], then [latex]b=7[/latex]. Substituting these values into the Pythagorean Formula equation, we get To isolate the variable [latex]c[/latex], we take the square roots of both sides of the equation. That eliminates the square (power of 2) on the right side. And on the left, we simply have a square root of a number which is no big deal. However, we need to be mindful here when we take the square root of a number. We want to consider only the principal square root or the positive square root since we are dealing with length. It doesn't make any sense to have a negative length, thus we disregard the negative length! Therefore, the length of the hypotenuse is [latex]\sqrt {74}[/latex] inches. If we wish to approximate it to the nearest tenth, we have [latex]8.6[/latex] inches. Example 2: Find the length of the leg. Just by looking at the figure above, we know that we have enough information to solve for the missing side. The reason is the measure of the two sides are given and the other leg is left as unknown. That's two sides given out of the possible three. Here, we can let [latex]a[/latex] or [latex]b[/latex] equal [latex]7[/latex]. It really doesn't matter. So, for this, we let [latex]a=7[/latex]. That means we are solving for the leg [latex]b[/latex]. But for the hypotenuse, there's no room for error. We have to be certain that we are assigning [latex]c[/latex] for the length, that is, for the longest side. In this case, the longest side has a measure of [latex]9[/latex] cm and that is the value we will assign for [latex]c[/latex], therefore [latex]c=9[/latex]. Let's calculate the length of leg [latex]b[/latex]. We have [latex]a=7[/latex] and [latex]c=9[/latex]. Therefore, the length of the missing leg is [latex]4\sqrt 2[/latex] cm. Rounding it to two decimal places, we have [latex]5.66[/latex] cm. Example 3: Do the sides [latex]17[/latex], [latex]15[/latex] and [latex]8[/latex] form a right triangle? If so, which sides are the legs and the hypotenuse? If these are the sides of a right triangle then it must satisfy the Pythagorean Theorem. The sum of the squares of the shorter sides must be equal to the square to the longest side. Obviously, the sides [latex]8[/latex] and [latex]15[/latex] are shorter than [latex]17[/latex] so we will assume that they are the legs and [latex]17[/latex] is the hypotenuse. So we let [latex]a=8[/latex], [latex]b=15[/latex], and [latex]c=17[/latex]. Let's plug these values into the Pythagorean equation and check if the equation is true. Since we have a true statement, then we have a case of a right triangle! We can now say for sure that the shorter sides [latex]8[/latex] and [latex]15[/latex] are the legs of the right triangle while the longest side [latex]17[/latex] is the hypotenuse. Example 4: A rectangle has a length of [latex]8[/latex] meters and a width of [latex]6[/latex] meters. What is the length of the diagonal of the rectangle? The diagonal of a rectangle is just the line segment that connects two non-adjacent vertices. In the figure below, it is obvious that the diagonal is the hypotenuse of the right triangle while the two other sides are the legs which are [latex]8[/latex] and [latex]6[/latex]. If we let [latex]a=6[/latex] and [latex]b=8[/latex], we can solve for [latex]c[/latex] in the Pythagorean equation which is just the diagonal. Therefore, the measure of the diagonal is [latex]10[/latex] meters. Example 5: A ladder is leaning against a wall. The distance from the top of the ladder to the ground is [latex]20[/latex] feet. If the base of the ladder is [latex]4[/latex] feet away from the wall, how long is the ladder? If you study the illustration, the length of the ladder is just the hypotenuse of the right triangle with legs [latex]20[/latex] feet and [latex]4[/latex] feet. Again, we just need to perform direct substitution into the Pythagorean Theorem formula using the known values then solve for [latex]c[/latex] or the hypotenuse. Therefore, the length of the ladder is [latex]4\sqrt {26}[/latex] feet or approximately [latex]20.4[/latex] feet. Example 6: In a right isosceles triangle, the hypotenuse measures [latex]12[/latex] feet. What is the length of each leg? Remember that a right isosceles triangle is a triangle that contains a 90-degree angle and two of its sides are congruent. In the figure below, the hypotenuse is [latex]12[/latex] feet. The two legs are both labeled as [latex]x[/latex] since they are congruent. Let's substitute these values into the formula then solve for the value of [latex]x[/latex]. We know that [latex]x[/latex] is just the leg of the right isosceles triangle which is the unknown that we are trying to solve for. Therefore, the leg of the right isosceles triangle is [latex]6\sqrt 2[/latex] feet. If we want an approximate value, it is [latex]8.49[/latex] feet, rounded to the nearest hundredth. Example 7: The diagonal of the square below is [latex]2\sqrt 2[/latex]. Find its area. We know the area of the square is given by the formula [latex]A=s^2[/latex] where [latex]s[/latex] is the side of the square. So that means we need to find the side of the square given its diagonal. If we look closely, the diagonal is simply the hypotenuse of a right triangle. More importantly, the legs of the right triangle are also congruent. Since the legs are congruent, we can let it equal to [latex]x[/latex]. Substitute these values into the Pythagorean Theorem formula then solve for [latex]x[/latex]. We calculated the length of the leg to be [latex]2[/latex] units. It is also the side of the square. So to find the area of the square, we use the formula [latex]A = {s^2}[/latex] That means, the area is [latex]A = {s^2} = {\left(2 \right)^2} = 4[/latex] Therefore, the area of the square is [latex]4[/latex] square units. You might also like these tutorials: Pythagorean Theorem Calculator helps to find the unknown side length of a right-angled triangle when two side lengths are known. The Pythagorean Theorem gives the relation among the three sides of a right triangle and hence, is one of the most fundamental concepts of Geometry. What is the Pythagorean Theorem Calculator? Pythagorean Theorem Calculator is an online tool to determine any side of a right-angled triangle when the other two sides are given. Pythagorean Theorem sees use in several sister subjects such as Trigonometry. To use the Pythagorean Theorem calculator choose the side to be computed from the drop-down menu and enter the values in the input boxes. Pythagorean Theorem Calculator What is Pythagorean Theorem? In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides. The hypotenuse is the side of the triangle opposite to the right angle. Furthermore, the length of the hypotenuse is greater than the length of the altitude and the length of the base. However, the length of the hypotenuse will be lesser than the sum of lengths of the remaining two sides. The Pythagorean Theorem is used in the field of architecture to ensure that the structures created are strong and robust. In the given \(\Delta ABC \), \[\begin{align} \text{BC}^2 &= \text{AB}^2 +\text{AC}^2 \end{align}\] where, \(\text{AB}\) is the base, \(\text{AC}\) is the altitude or the height, and \(\text{BC}\) is the hypotenuse. To calculate the hypotenuse we simply plug in the values into the above equation. However, if we want to find the value of the base or the altitude we have to follow the steps given below. Suppose we need to determine the value of the altitude. We have to shift the base (AB2) to the left-hand side of the equation. We then subtract the base from the hypotenuse (BC2 - AB2). We now have to take the square root of this value to get the length of the altitude. The same steps can be used if we have to find the length of the base. How to Use the Pythagorean Theorem Calculator? Follow these steps which will help you to use the calculator. Step 1: Select the side of the right-angled triangle to be calculated, from the drop-down list. Step 2: Enter the value for the other two sides in the corresponding input boxes. Step 3: Click on "Calculate" to find the unknown side of the triangle. Step 4: Click on "Reset" to clear the fields and enter the new values. Want to find complex math solutions within seconds? Use our free online calculator to solve challenging questions. With Cuemath, find solutions in simple and easy steps. Book a Free Trial Class Solved Examples on Pythagorean Theorem Calculator Example 1: A right-angled triangle ABC, has base BC = 12 units, height AB = 5 units. What is the length of AC? Solution: By Pythagoras theorem we know that, AB2 + BC2 = AC2 AC2 = 52 + 122 AC = (52 + 122)½ = √(52 + 122) AC = 13 units. Answer: The length of AC is 13 units. Example 2: A right-angled triangle PQR, has angle Q = 90°. PQ = 8 units. PR = 10 units. Find QR. Solution: By Pythagoras Theorem we know that, PR2= PQ2 + QR2 102 = 82 + QR2 QR2 = 102 - 82 QR = (102 - 82)½ = √(102 - 82) QR = 6 units. Answer: The length of QR is 6 units. Similarly, you can use the Pythagorean Calculator calculator to find the hypotenuse of right-angled triangles with: Side a = 6 units and side b = 8 units. Side a = 12 units and side b = 5 units. Side a = 3 units and side b = 4 units. ☛ Related Articles: Pythagoras Theorem Right Angled Triangle ☛ Math Calculators: Want to give your brand videos a cinematic edge? Join our visual experts and special guests for an info-packed hour of insights to elevate your next video project. Tune in on June 24 at 11am ET.Register NowEnjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. Your generated images will be more polished than ever.See What's NewExplore how consumers want to see climate stories told today, and what that means for your visuals.Download Our Latest VisualGPS ReportWant to give your brand videos a cinematic edge? Join our visual experts and special guests for an info-packed hour of insights to elevate your next video project. Tune in on June 24 at 11am ET.Register NowEnjoy sharper detail, more accurate color, lifelike lighting, believable backgrounds, and more with our new model update. 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Let's check if the areas are the same: 32 + 42 = 52 Calculating this becomes: 9 + 16 = 25 It works ... like Magic! Why Is This Useful? When we know two side lengths of a right triangle we can find the third side length. How Do I Use it? Write it down as an equation: Then we use algebra to find any missing value, as in these examples: Start with:a2 + b2 = c2 Put in what we know:52 + 122 = c2 Calculate squares:25 + 144 = c2 25+144=169:169 = c2 Swap sides:c2 = 169 Square root of both sides:c = √169 Calculate:c = 13 Read about Squares and Square Roots to discover why √169 = 13 Start with:a2 + b2 = c2 Put in what we know:92 + b2 = 152 Calculate squares:81 + b2 = 225 Take 81 from both sides: 81 − 81 + b2 = 225 − 81 Calculate: b2 = 144 Square root of both sides:b = √144 Calculate:b = 12 Start with:a2 + b2 = c2 Put in what we know:12 + 12 = c2 Calculate squares:1 + 1 = c2 1+1=2: 2 = c2 Swap sides: c2 = 2 Square root of both sides:c = √2 Which is about:c = 1.4142... There are practical uses! Read Builder's Mathematics. Is it a Right Angle? It works the other way around, too: when the three sides of a triangle make a2 + b2 = c2, then the triangle is right angled. Does a2 + b2 = c2 ? a2 + b2 = 102 + 242 = 100 + 576 = 676 c2 = 262 = 676 They are equal, so ... Yes, it does have a Right Angle! Does 82 + 152 = 162 ? 82 + 152 = 64 + 225 = 289, but 162 = 256 So, NO, it does not have a Right Angle Does a2 + b2 = c2 ? Does (√3)2 + (√5)2 = (√8)2 ? Does 3 + 5 = 8 ? Yes, it does! So this is a right-angled triangle Get paper pen and scissors, then using the following animation as a guide: Draw a right angled triangle on the paper, leaving plenty of space Draw a square along the hypotenuse (the longest side) Draw the same sized square on the other side of the hypotenuse Draw lines as shown on the animation, like this: Cut out the shapes Arrange them so that you can prove that the big square has the same area as the two squares on the other sides Another, Amazingly Simple, Proof Here is one of the oldest proofs that the square on the long side has the same area as the other squares. Watch the animation, and pay attention when the triangles start sliding around. You may want to watch the animation a few times to understand what is happening. The purple triangle is the important one. becomes We also have a proof by adding up the areas. Historical Note: while we call it Pythagorean Theorem, it was also known by Indian, Greek, Chinese and Babylonian mathematicians well before he lived. 511,512,617,618, 1145, 1146, 1147, 2359, 2360, 2361 Activity: Pythagorean Theorem Activity: A Walk in the Desert Copyright © 2025 Rod Pierce TutrsStringent selection, robust training, and continuous upskilling.To match your child's unique personality and learning style.Exam prep, Homework help, Advanced learning, and Remedial support.Helping 200,000+ students succeed!Received prestigious President's Education Awards Program from the President of US. Tops her class with an outstanding score of 77.5/80.Received prestigious Pradhan Mantri Rashtriya Bal Puraskar from the Prime Minister of India.Got Level 5 in the STAAR exam at the Renaissance Institute for Competitive Exams.Secured Rank 1 at SOF IMO Level 1 2023, by scoring an outstanding 100/100! Received prestigious President's Education Awards Program from the President of US. 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After 4-5 classes, I could see her asking for homework. She started liking math again and has now developed a lot of interest.Cuemath keeps introducing new methods, systems, & make it interesting for learners. Unlike the traditional teaching system, it has innovated a different way of teaching.My son has been taking coaching from Cuemath and is showing consistent improvement. It is mainly because of the standard curriculum, mentoring, supervision, & teaching.Have been a great platform with multiple avenues to augment my 8yr old's math skills. Good support from teacher too!My son started Cuemath in Grade 1 & now he is in Grade 7. All these years, I have been reassured for math subject! I'm sure he will continue with Cuemath till it serves!Cuemath has helped my kids learn math concepts and practice them in an online setting. It is a great online platform with 1:1 learning experience.Our daughter was losing interest in math. After 4-5 classes, I could see her asking for homework. 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We couldn't find such a teacher even locally.Private 1-to-1 tutoring that just works1-3 classes per week, with hassle-free scheduling.Customized learning plan for every child.Get regular insights on your child's progress.What is the frequency and duration of your classes?Typically, the number of classes is two per week for grades K to 8, and three per week for high school. But the schedule is flexible, according to your child's requirements and availability. Also, each class runs for 55 minutes, extendable to an hour.What devices do I need for attending your classes?A desktop or laptop computer that supports video calling is necessary for attending our classes. We also highly recommend a writing tablet for the best learning experience.My child has specific learning requirements. Is your program flexible enough?Absolutely. Our tutors will always customize the classes according to what your child needs - be it homework help, exam or test prep, remedial support for past gaps, or advanced learning.Can your tutors teach the topics covered in my child's school or curriculum?Our tutors are trained to teach according to various curricula across countries. Further, we have a fully customizable curriculum, tailored to your child's needs.Can my child join anytime of the year?Yes. Our tutors always customize the learning plan according to your child's needs, and the time left in the current academic year. If you wish to cover additional topics in the same time, you can always schedule extra classes.What if I don't like the tutor?In the rare case that happens, please raise a ticket with our helpdesk. We'll be happy to diagnose the issue, and find you a different tutor that aligns better with your child's needs.What if I do not like your classes after I enroll? Will I get my money back?We have a no questions asked refund policy. If you're unhappy with the experience, you can cancel anytime for a full refund of the unused classes.What happens if my child misses a Cuemath class?We have a flexible leave policy that allows for both planned and unplanned leaves. Just keep your tutor informed.How can I keep track of my child's maths progress?We have a dedicated parent app, that lets you track the progress of your child, and also lets you connect with their tutor.How do I enroll for your classes?Please tap on the 'Get Started' button. We'll ask you a few questions about your child to understand their needs better. Once we receive the details, our admissions counselor will call you to match your child with the right tutor, and schedule a free trial class as per your availability. If you like the experience, you can choose a plan and make the payment to begin your classes.Affordable and personalized. Try a class for free. Pythagorean theoremThe sum of the areas of the two squares on the legs (a and b) equals the area of the square on the hypotenuse (c). In mathematics, the Pythagorean theorem or Pythagoras's theorem[permanent dead link] is a statement about the sides of a right triangle. One of the angles of a right triangle is always equal to 90 degrees. This angle is the right angle. The two sides next to the right angle are called the legs and the other side is called the hypotenuse. The hypotenuse is the side opposite to the right angle, and it is always the longest side. The Pythagorean theorem says that the area of a square on the hypotenuse is equal to the sum of the areas of the squares on the legs. In this picture, the area of the blue square added to the area of the red square makes the area of the purple square. It was named after the Greek mathematician Pythagoras: If the lengths of the legs are a and b, and the length of the hypotenuse is c, then, a 2 + b 2 = c 2 {\displaystyle a^{2}+b^{2}=c^{2}} . There are many different proofs of this theorem. They fall into four categories: Those based on linear relations: the algebraic proofs. Those based upon comparison of areas: the geometric proofs. Those based upon the vector operation. Those based on mass and velocity: the dynamic proofs.[1] One proof of the Pythagorean theorem was found by a Greek mathematician, Eudoxus of Cnidus. The proof uses three lemmas: Triangles with the same base and height have the same area. A triangle which has the same base and height as a side of a square has the same area as a half of the square. Triangles with two congruent sides and one congruent angle are congruent and have the same area. The proof is: The blue triangle has the same area as the green triangle, because it has the same base and height (lemma 1). Green and red triangles both have two sides equal to sides of the same squares, and an angle equal to a straight angle (an angle of 90 degrees) plus an angle of a triangle, so they are congruent and have the same area (lemma 3). Red and yellow triangles' areas are equal because they have the same heights and bases (lemma 1). Blue triangle's area equals area of yellow triangle's area, because A b l u e = A g r e e n = A r e d = A y e l l o w {\displaystyle {\color {blue}A_{blue}}={\color {green}A_{green}}={\color {red}A_{red}}={\color {yellow}A_{yellow}}} The brown triangles have the same area for the same reasons. Blue and brown each have a half of the area of a smaller square. The sum of their areas equals half of the area of the bigger square. Because of this, halves of the areas of small squares are the same as a half of the area of the bigger square, so their area is the same as the area of the bigger square. We can get another proof of the Pythagorean theorem by using similar triangles. d a = a c ⇒ a 2 = d c (1) {\displaystyle {\frac {d}{a}}={\frac {a}{c}}\quad \Rightarrow \quad {a^{2}}={dc}\quad (1)} e b = b c ⇒ b 2 = e c (2) {\displaystyle {\frac {e}{b}}={\frac {b}{c}}\quad \Rightarrow \quad {b^{2}}={ec}\quad (2)} From the image, add equations (1) and (2): a 2 + b 2 = d c + e c ⇒ a 2 + b 2 = c (d + e) ⇒ a 2 + b 2 = c (c) {\displaystyle {a^{2}}+{b^{2}}={dc+ec}\quad \Rightarrow a^{2}+b^{2}=c(d+e)\quad \Rightarrow a^{2}+b^{2}=c(c)} And we get: c 2 = a 2 + b 2 . {\displaystyle c^{2}=a^{2}+b^{2}\,\!.} Pythagorean triples or triplets are three whole numbers which fit the equation a 2 + b 2 = c 2 {\displaystyle a^{2}+b^{2}=c^{2}} . The triangle with sides of 3, 4, and 5 is a well known example. If a=3 and b=4, then 3 2 + 4 2 = 5 2 {\displaystyle 3^{2}+4^{2}=5^{2}} because 9 + 16 = 25 {\displaystyle 9+16=25} . This can also be shown as 3 2 + 4 2 = 5. {\displaystyle {\sqrt {3^{2}+4^{2}}}=5.} The three-four-five triangle works for all multiples of 3, 4, and 5. In other words, numbers such as 6, 8, 10 or 30, 40 and 50 are also Pythagorean triples. Another example of a triple is the 12-5-13 triangle, because 12 2 + 5 2 = 13 {\displaystyle {\sqrt {12^{2}+5^{2}}}=13} . A Pythagorean triple that is not a multiple of other triples is called a primitive Pythagorean triple. Any primitive Pythagorean triple can be found using the expression (2 m n , m 2 − n 2 , m 2 + n 2) {\displaystyle (2mn,m^{2}-n^{2},m^{2}+n^{2})} , but the following conditions must be satisfied. They place restrictions on the values of m {\displaystyle m} and n {\displaystyle n} . m {\displaystyle m} and n {\displaystyle n} are positive whole numbers m {\displaystyle m} and n {\displaystyle n} have no common factors except 1 m {\displaystyle m} and n {\displaystyle n} have opposite parity. m {\displaystyle m} and n {\displaystyle n} have opposite parity when m {\displaystyle m} is even and n {\displaystyle n} is odd, or m {\displaystyle m} is odd and n {\displaystyle n} is even. m > n {\displaystyle m>n} . If all four conditions are satisfied, then the values of m {\displaystyle m} and n {\displaystyle n} create a primitive Pythagorean triple. m = 2 {\displaystyle m=2} and n = 1 {\displaystyle n=1} create a primitive Pythagorean triple. The values satisfy all four conditions. 2 m n = 2 × 2 × 1 = 4 {\displaystyle 2mn=2\times 2\times 1=4} , m 2 − n 2 = 2 2 − 1 2 = 4 − 1 = 3 {\displaystyle m^{2}-n^{2}=2^{2}-1^{2}=4-1=3} and m 2 + n 2 = 2 2 + 1 2 = 4 + 1 = 5 {\displaystyle m^{2}+n^{2}=2^{2}+1^{2}=4+1=5} , so the triple (3 , 4 , 5) {\displaystyle (3,4,5)} is created. ↑ Loomis, Elisha S. 1927. The Pythagorean proposition: its proofs analysed and classified and bibliography of sources. Cleveland, Ohio. Retrieved from " The Pythagorean Theorem, also known as Pythagoras theorem is a mathematical relation between the 3 sides of a right triangle, a triangle in which one of 3 angles is 90°. It was discovered and named after the Greek philosopher and mathematician of Samos, Pythagoras. Does Pythagorean Theorem Work on All Triangles No, the Pythagorean Theorem works only for right triangles. Thus, it helps to test whether a triangle is right triangle or not. The theorem is also used to find the length of one side of a right triangle when the other two sides are known. The theorem was first evident on a 4000-year-old Babylonian tablet (beginning about 1900 B.C.) now known as Plimpton 322. Much later in 570–500/490 BCE, the relationship was popularized when Pythagoras stated it explicitly. When a triangle has a right angle (90°) and squares are made on each of the 3 sides, then the biggest square has an area equal to the sum of the areas of the other 2 squares. Thus, the Pythagorean Theorem states that the area of the square formed by the longest side of the right triangle (the hypotenuse) is equal to the sum of the area of the squares formed by the other two sides. Derivation of Pythagoras Theorem In the above figure, Area of □ A = a2 Area of □ B = b2 Area of □ C = c2 The Pythagorean Theorem Now, according to the Pythagorean Theorem, Area of □ A + Area of □ B = Area of □ C (a × a) + (b × b) = (c × c) a2 + b2 = c2 The above relation is useful to find an unknown side of a right triangle when the lengths of the other 2 sides are known. The equation that represents the Pythagorean Theorem in mathematical form is given below: Pythagorean Theorem Let us find out how it works using an example. Consider a right triangle with side lengths 3, 4, 5. Pythagorean Theorem Example 1 In the above figure, let us use the Pythagorean Theorem 32 + 42 = 52 => 9 + 16 =25 9, 16, & 25 are the areas of the three squares This proves how the Pythagorean Theorem works Let us solve an example to understand the concept better Find the hypotenuse of a right-angle triangle with the other 2 sides 15 cm and 20 cm.Solution:As we know,In a right angle triangle,a2 + b2 = c2, here c = length of the hypotenuse, a = 15 cm, c = 20 cm=> 152 + 202 = c2=> 225 + 400 = c2=> c2 = 625=> c = 25 cmThus, the hypotenuse of a right triangle with sides 15 cm and 20 cm is 25 cm Find b in the given right angle triangle.Solution:As we know,In a right angle triangle,a2 + b2 = c2, here c = 5, a = 3 cm=> 32 + b2 = 52=> b2 = 52 – 32=> b2 = 25 – 9=> b2 = 16=> b = 4 cm Find whether it is a right angle triangle.Solution:As we know,In a right angle triangle,a2 + b2 = c2, here a = 9, b = 12, c = 15 cm=> 92 + 122=> 81 + 144=> 225As, 152 = 225Thus, the above relation holds true for the Pythagorean Theorem, thus it is a right angle triangle. Does an 8, 15, 16 triangle have a Right Angle?Solution:As we know,In a right angle triangle,a2 + b2 = c2Here,=> 82 + 152=> 64 + 225=> 289But, 162 = 256Thus, the above relation does not hold true for the Pythagorean Theorem, thus it is not a right-angle triangle. The Pythagorean Theorem can be proved in many ways. The 2 most common ways of proving the theorem are described below: This method helps us to prove the Pythagorean Theorem by using the side lengths. Let us consider 4 right triangles with side lengths a, b, & c, where c is the length of the hypotenuse and 'a' and 'b' are the lengths of the other 2 sides Pythagorean Theorem Proof Algebraic Method If we arrange the 4 right triangles in a square of length (a + b), we can derive the equation of the Pythagorean Theorem as shown below: Area of □ EFGH = c × c = c2 Again, Area of □ ABCD = Area of □ EFGH + Area of 4 right △s => (a + b)2 = c2 + 4(1/2 × b × a) => (a + b)2 = c2 + 2ab => a2 + b2 + 2ab = c2 + 2ab => a2 + b2 = c2 This proves the Pythagorean Theorem Pythagorean Theorem Proof Using Similar Triangles As we know, △ADB ~ △ABC ∴ CD/CB = CB/CA (Corresponding Sides of Similar Triangles are Equal) => CB2 = CD × CA …….. (1) Similarly, △BDA ~ △CBA ∴ AD/BA = BA/CA (Corresponding Sides of Similar Triangles are Equal) => BA2 = AD × CA …….. (2) Adding equations (1) and (2), we get CB2 + BA2 = (CD × CA) + (AD × CA) => CB2 + BA2 = CA (CD + AD) Since, CD + AD = CA ∴ CA2 = CB2 + BA2 This proves the Pythagorean Theorem Through learning the basic concepts of the Pythagorean Theorem is important to determine whether a triangle is a right triangle or not. But, we are even more curious in understanding the applications of the Pythagorean Theorem. Some common real-life applications of the Pythagorean Theorem are given below: Two-dimensional navigation where it is used for calculate the distance between the ship and the point of navigation. The same principles are also used for air navigation. For example, a plane can use its height above the ground and its distance from the source to its destination.Cartographers use to calculate and survey the numerical distances and heights between different points before a map is drawn. It is also used to calculate the steepness of slopes of hills or mountains.Given 2 straight lines, it is used for calculating the length of the diagonal line connecting them. This application is frequently used in architecture, woodworks, or other physical construction projects. It is also used for laying out square angles for making design in buildings.In oceanography, it is used for calculating speed of sound waves in water.Making of tv screens, computer screens, and solar panelsWorks to determine the height of ladder required to painta wall of certain height Last modified on June 8th, 2024 To provide the best experiences, we use technologies like cookies to store and/or access device information. Consenting to these technologies will allow us to process data such as browsing behaviour or unique IDs on this site. Not consenting or withdrawing consent, may adversely affect certain features and functions. Privacy policy. Functional Functional Always active The technical storage or access is strictly necessary for the legitimate purpose of enabling the use of a specific service explicitly requested by the subscriber or user, or for the sole purpose of carrying out the transmission of a communication over an electronic communications network. Preferences Preferences The technical storage or access is necessary for the legitimate purpose of storing preferences that are not requested by the subscriber or user. Marketing and statistics Marketing and statistics The technical storage or access that is required to create user profiles to send advertising, or to track the user on a website or across several websites for similar marketing purposes, and used for statistical purposes. See marketing and statistics(/functional) cookies we use in our cookie table, at . The technical storage or access that is used exclusively for anonymous statistical purposes. Without a subpoena, voluntary compliance on the part of your Internet Service Provider, or additional records from a third party, information stored or retrieved for this purpose alone cannot usually be used to identify you. Marketing Marketing The technical storage or access is required to create user profiles to send advertising, or to track the user on a website or across several websites for similar marketing purposes. In a right angled triangle the square of the long side is equal to the sum of the squares of the other two sides. It is stated in this formula: a2 + b2 = c2 Note: the long side is called the hypotenuse. Written By Livia Ferrao Last Modified 19-10-2022 Pythagoras Theorem Formula: Pythagorean theorem is another name for it. illustrates how the sides of a right-angled triangle are related. Pythagorean triples refer to the sides of a right triangle. The Pythagoras theorem can be used in a variety of situations, including trigonometry and other mathematical ideas. This theorem makes everything so simple that no one can help but fall in love with it. So, let us learn about the Pythagorean theorem and the Pythagorean theorem equation's origins. In this article with illustrations, the Pythagoras formula and proof of this theorem are explained. The Pythagoras theorem is a formula for calculating the length of an unknown side and the angle of a triangle. We can derive the base, perpendicular, and hypotenuse formulas using this theorem. Let's take a closer look at the Pythagorean theorem equations using Pythagorean theorem examples. The Pythagorean theorem takes its name from the ancient Greek mathematician Pythagoras. He perhaps was the first one to proving Pythagorean theorem. But this special relationship between the sides of a right-angled triangle was probably known long before Pythagoras. Ancient Babylonian master builders used the Pythagoras theorem in construction though it wasn't really called the Pythagorean equation theorem, its principles were used. How do we know that? Some ancient clay tablets from Babylonia indicate that the Babylonians in the second millennium B.C., 1000 years before Pythagoras, had rules for generating Pythagorean triples. They understood the relationship between the sides of a right-angled triangle. They could even solve hypotenuse of an isosceles right-angled triangle, in which they would come up with an approximation of the final value up to five decimal places. They did this because the lengths would often represent some multiple of the formula: 1^2 + 1^2 = (sqrt of two)^2. Indian mathematicians in the ancient times knew the Pythagorean theorem, they also used something called the Sulbasutras (of which the earliest date from (ceremonial axe)ca. 800-600 B.C.) that discuss the theorem in the context of strict requirements for the orientation, shape, and area of altars for religious purposes. The ancient Mayas used variations of Pythagorean triples in their 'Long Count calendar'. Apart from India, the Chinese and the Egyptians also used this theorem in construction. This is how many of the Egyptian pyramids are built. The Egyptians wanted a perfect 90-degree angle to build the pyramids which were actually two right-angle triangles whose hypotenuse forms the edges of the pyramids. There are some clues that the Chinese had also developed the Pythagoras theorem using the areas of the sides long before Pythagoras himself. But they did not actually write them down and so Pythagoras gets the credit for simply writing them down. Pythagoras was born around 5000 BC, on an island called Samos in Greece. There is not much information about his youth though he did a lot of travelling to study is all that is known. Latter Pythagoras settled in Crotone(a city and comune in Calabria), where he started his cult or group called the Pythagoreans. The Pythagoreans loved maths so much that it was like a god to them, they pretty much-worshipped maths. They believed that numbers ruled the universe with their mystical and spiritual qualities. Now, whether it was really Pythagoras or another person among the Pythagoreans who discovered the theorem is unknown since it isn't recorded in any of their writings. But when this theorem was discovered and proved the Pythagorean sacrificed the huge number of bulls to their number of gods. Well, they were quite serious about maths ☺ Here are some of the frequently asked questions (FAQs) on the origin of Pythagoras Theorem: Q1: Is Pythagoras' theorem only used for right triangles?Ans: Pythagoras' theorem only works for right-angled triangles, so you can use it to test whether a triangle has a right angle or not. Q2: Did Indian Mathematicians use Pythagoras theorem in ancient India?Ans: Indian mathematicians in the ancient times knew the Pythagorean theorem, they also used something called the Sulbasutras that discuss the theorem in the context of strict requirements for the orientation, shape, and area of altars for religious purposes. The ancient Mayas used variations of Pythagorean triples in their 'Long Count calendar. Q3: When and where was the Pythagoras born?Ans: Pythagoras was born around 5000 BC, on an island called Samos in Greece. Q4: From where does the Pythagoras Theorem derive its name?Ans: The Pythagorean theorem takes its name from the ancient Greek mathematician Pythagoras. He perhaps was the first one to offer proof of the theorem. Q5 Where did the Pythagoras theorem originate from?Ans: The Pythagorean theorem first originated in ancient Babylon and Egypt (beginning about 1900 B.C.). Some ancient clay tablets from Babylonia indicate that the Babylonians in the second millennium B.C., 1000 years before Pythagoras, had rules for generating Pythagorean triples. They understood the relationship between the sides of a right-angled triangle. It sure is amazing to know such a story behind such a simple proof of Pythagoras' theorem. To know more about such amazing stories stay with us on Embibe. We not only make education fun but also help you score higher in your exams. So don't forget to practice and take tests on Embibe, absolutely! We hope you find the article on the Origins of Pythagoras theorem helpful. If you have any doubt regarding this article, kindly drop your comments below and we will get back to you at the earliest.