Continue

Definition of parallelogram :A parallelogram is a quadrilateral which has opposite sides parallel.Properties of parallelogram :Opposite sides are equal in lengthOpposite angles are equal in size.Diagonals bisect each other.Consecutive interior angles add upto 180. Problem 1 :For the parallelogram given below, solve for m and n. Solution :Since the given shape is a parallelogram, the diagonals will bisect each other. AO = OCm + 8 = 3m ---(1)8 = 3m - m2m = 8m = 4 BO = OD9 = 2n - 12n = 9 + 12n = 10n = 5 Problem 2 :For the parallelogram given below, solve for j and k. Solution : AO = OCk + 10 = 6k6k - k = 105k = 10k = 2 BO = OD5j - 9 = 3j5j - 3j = 92j = 9j = 4.5 Problem 3 :In parallelogram PQRS, solve for x and y. Solution : QT = ST2x + 8 = 182x = 18 - 82x = 10x = 10/2x = 5 PT = TR4y - 2 = 224y = 22 + 24y = 24y = 24/4y = 6 Problem 4 :Solve the n in the following parallelogram ABCD. Find length of the diagonal BD. Solution :Diagonals will bisect each other.AO = OC5n - 6 = 3n - 1223n - 5n = -122 + 6-2n = -116Dividing by 2 on both sides.n = 116/2n = 58Length of BD = 3n - 6 + 5n - 122= 8n - 128= 8(58) - 128= 464 - 128= 336So, the length of the diagonal BD is 336.Problem 5 :Length of the longer diagonal in the parallelogram FAST. Solution :FO = 5.5, then FS = 5.5(2) ==> 11TO = 3x - 1, OA = 2x + 73x - 1 = 2x + 73x - 2x = 7 + 1x = 8Length of diagonal TA = 3x - 1 + 2x + 7= 5x + 6= 5(8) + 6= 40 + 6= 46So, length of the longer diagonal is 46. A parallelogram is a quadrilateral in which both pairs of opposite sides are parallel. Some of the properties of a parallelogram are that its opposite sides are equal, its opposite angles are equal and its diagonals bisect each other.Let's consider the following parallelogram whose sides are known, say a and a. To find the length of one of its diagonals, we can use the cosine rule for triangles.What is a Diagonal?When students learn about quadrilaterals they get to learn about their various types and names. Quadrilaterals or polygons are geometric figures on a plane with 4 sides, 4 vertices, and 4 angles. Depending upon the length of the sides and the degree of the angle they form at the joining vertices they have been classified and named differently. The different types of quadrilaterals are as follows :Square: Having equal sides and angle of 90 degrees it is the most common type and simple quadrilateral that we are all familiar with.Rectangle: It is similar to square for having equal all 5 angles of 90 degrees but differs due to unequal sides. The opposite sides are equal but adjacent sides are unequal.Irregular Quadrilateral: It is the most irregular form with unequal sides and angles.Parallelogram: In a parallelogram the adjacent sides and angles are unequal but opposite sides and angles are equal to each other.Rhombus: Two sides adjacent to each other are equal in length. And only two angles opposite to each other are equal.Trapezoid or Trapezium: This is a quadrilateral with one pair of sides that are opposite to each other and vary in length and run parallel to each other. Isosceles Trapezium: It is one special type of Trapezium with the non-parallel sides having an equal length.These are some of the simple quadrilaterals we have studied in the previous class. Every quadrilateral has two diagonals that bisect each other at the center of a quadrilateral. Likewise, the diagonals of a parallelogram bisect each other but are not equal in length. Students can easily find out the diagonals of a parallelogram or any other quadrilateral by joining the opposite vertices. In square and rhombus, they always intersect perpendicular to each other while for others it is not perpendicular.(Image Will be Uploaded Soon)In \[\Delta\] ADC, using the cosine rule, we calculate the length of AC as follows.\[A{C^2} = A{D^2} + D{C^2} - 2 \times AD \times DC \times \cos \angle ADC \Rightarrow {q^2} = {a^2} + {b^2} - 2ab\cos \angle ADC\]Similarly in \[\Delta\] ADS \] we have the following equation.\[D{B^2} = A{D^2} + A{B^2} - 2 \times AD \times DB \times \cos \angle DAB \Rightarrow {q^2} = {a^2} + {b^2} - 2ab\cos \angle DAB\]We know that adjacent angles in a parallelogram are supplementary. So we have \[\cos \angle DAB = \cos \pi - \angle ADC = - \cos \angle ADC\]So we have the following property.\[{p^2} + {q^2} = {a^2} - 2ab\cos \angle ADC + {a^2} + {b^2} + 2ab\cos \angle ADC\]\[{p^2} + {q^2} = 2\left({{a^2} + {b^2}} \right)\]Therefore, to calculate the diagonal lengths individually, we can use the following formulas.p = \[\sqrt {{a^2} + {b^2} - 2ab\cos \theta }\]q = \[\sqrt {2\left({{a^2} + {b^2}} \right) - {p^2}} \] Also note that the longer diagonal is opposite to the larger of the parallelogram's angles, which is a direct result of the cosine rule.In the case of a rectangle, which is a type of parallelogram in which the interior angles are 90°, the diagonal formula reduces to the following. The following result can also be obtained by applying the Pythagorean theorem to the rectangle.\[{p^2} = {q^2} = {l^2} + {b^2}\]p = q = \[\sqrt {{l^2} + {b^2}} \] Let's look at the following example to understand how to use these formulas.Question:If one of the angles of a parallelogram is 60° and its adjacent sides are 4 cm and 6 cm long, then evaluate the lengths of its diagonals.Solution:\[a = 4\,cm,\,\,b = 6\,cm,\,\,\theta = {60^ \circ }\]\p = \[\sqrt {{a^2} + {b^2} - 2ab\cos \theta } \]= \[\sqrt {{4^2} + {6^2} - 2 \times 4 \times 6 \times \cos {60} \times \frac{1}{2}} = \sqrt {16 + 52 - 48 \times \frac{1}{2}} = \sqrt {28} = 2\sqrt 7 \,cm q = \[\sqrt {2\left({{a^2} + {b^2}} \right)}\]= \[\sqrt {2 \times \left({{4^2} + {6^2}} \right) - {{\left({2\sqrt 7 } \right)}^2}} \]= \[\sqrt {104 - 28} = \sqrt {76} = 2\sqrt {19} \] ,cmWhy don't you try to solve the following problem to see if you have mastered these formulas?Question:One of the angles of a parallelogram is 135° and its diagonals are \[\$3\,cm\$ and \$3\sqrt 5 \,cm\$\] respectively. Find the perimeter of the parallelogram.Options:(a) 4\[\left({3 + \sqrt 2 } \right)\]cm (b) 3\[\left({2 + \sqrt 2 } \right)\]cm(c) 12cm(d) 6\[\left({1 + \sqrt 2 } \right)\]cmAnswer: (d)Solution:\[p = 3\,cm,\,\,q = 3\sqrt {5\,} \,cm\,\,\theta = {135^ \circ }\]\[{p^2} = {a^2} + {b^2} - 2ab\cos \theta\]\[\Rightarrow {\left({3\sqrt 5 } \right)^2} = {a^2} + {b^2} - 2ab\left({ - \frac{1}{{\sqrt 2 }}} \right) = 45 \]\[\Rightarrow {a^2} + {b^2} + \sqrt 2 ab = 45\]\[{p^2} + {q^2} = 2\left({{a^2} + {b^2}} \right)\]\[\Rightarrow {3^2} + {\left({3\sqrt 5 } \right)^2} = 2\left({{a^2} + {b^2}} \right)\]\[\Rightarrow {a^2} + {b^2} = \frac{{9 + 45}}{2} = 27\] Now, we can solve these two equations to calculate a and b.27 + \[\sqrt 2 ab\] = 45 \[\Rightarrow\] \[\sqrt 2 ab\] = 18 \Rightarrow\] ab = 9\[\sqrt 2\] \[\Rightarrow\] b = \[\frac{{9\sqrt 2 }}{a}\] Substituting in one of the equations, we get the following.\[{a^2} + {\left({\frac{{9\sqrt 2 }}{a}} \right)^2} = 27\]\[\Rightarrow {a^4} - 27{a^2} + 162 = 0\]Solving this quadratic and ignoring the negative answers because lengths cannot be negative), we get the following values. a = 3\,cm, 3\[\sqrt 2\] cm, 3cmTherefore, the dimensions of the parallelogram are \[3,cm and} 3\sqrt 2 ,cm\]. Hence, its perimeter is calculated as follows.\[\text{perimeter}} = 2\left({a + b} \right) = 2\left({3 + 3\sqrt 2 } \right) = 6\left({1 + \sqrt 2 } \right)\,cm\] How can financial brands set themselves apart through visual storytelling? Our experts explain how.Learn MoreThe Motorsport Images Collections captures events from 1895 to today's most recent coverage.Discover The CollectionCurated, compelling, and worth your time. Explore our latest gallery of Editors' Picks.Browse Editors' FavoritesHow can financial brands set themselves apart through visual storytelling? Our experts explain how.Learn MoreThe Motorsport Images Collections captures events from 1895 to today's most recent coverage.Discover The CollectionCurated, compelling, and worth your time. Explore our latest gallery of Editors' Picks.Browse Editors' Favorites To find the diagonal of a parallelogram, you can use the Law of Cosines. Given a parallelogram with sides of length @$\begin{align*}a\end{align*}@$ and @$\begin{align*}b\end{align*}@$ and an angle θ between them, the diagonal d can be found using the following formula: @$\begin{align*}d^2 = l^2 + b^2 - 2lb * cos(\theta)\end{align*}@$ To find the diagonal length, take the square root of both sides: @$\begin{align*}d = \sqrt{l^2 + b^2 - 2lb * cos(\theta)}\end{align*}@$ To learn more about law of cosines and its uses, click here! It has been suggested that Rhomboid be merged into this article. (Discuss) Proposed since March 2025. Quadrilateral with two pairs of parallel sides This article is about the quadrilateral. For the music album, see Parallelogram (album). ParallelogramThis parallelogram is a rhomboid as it has unequal sides and no right angles.TypeQuadrilateral, TrapeziumEdges and vertices4Symmetry groupC2, [2]+,Areab (base × height);ab sin θ (product of adjacent sides and sine of the vertex angle determined by them)PropertiesConvex polygon In Euclidean geometry, a parallelogram is a simple (non-self-intersecting) quadrilateral with two pairs of parallel sides. The opposite or facing sides of a parallelogram are of equal length and the opposite angles of a parallelogram are of equal measure. The congruence of opposite sides and opposite angles is a direct consequence of the Euclidean parallel postulate and neither condition can be proven without appealing to the Euclidean parallel postulate or one of its equivalent formulations. By comparison, a quadrilateral with at least one pair of parallel sides is a trapezoid in American English or a trapezium in British English. The three-dimensional counterpart of a parallelogram is a parallelepiped. The word "parallelogram" comes from the Greek παραλληλό-γραμμον, parallēló-grammon, which means "a shape of parallel lines". Rectangle – A parallelogram with four right angles. Rhombus – A parallelogram with four sides of equal length. Any parallelogram that is a rectangle or a rhombus was traditionally called a rhomboid but this term is not used in modern mathematics.[1] Square – A parallelogram with four sides of equal length and four right angles. A simple (non-self-intersecting) quadrilateral is a parallelogram if and only if any one of the following statements is true:[2][3] Two pairs of opposite sides are parallel (by definition). Two pairs of opposite sides are equal in length. Two pairs of opposite angles are equal in measure. The diagonals bisect each other. One pair of opposite sides is parallel and equal in length. Adjacent angles are supplementary. Each diagonal divides the quadrilateral into two congruent triangles. The sum of the squares of the sides equals the sum of the squares of the diagonals. (This is the parallelogram law.) It has rotational symmetry of order 2. The sum of the distances from any interior point to the sides is independent of the location of the point.[4] (This is an extension of Viviani's theorem.) There is a point X in the plane of the quadrilateral with the property that every straight line through X divides the quadrilateral into two regions of equal area.[5] Thus, all parallelograms have all the properties listed above, and conversely, if just any one of these statements is true in a simple quadrilateral, then it is considered a parallelogram. Opposite sides of a parallelogram are parallel (by definition) and so will never intersect. The area of a parallelogram is twice the area of a triangle created by one of its diagonals. The area of a parallelogram is also equal to the magnitude of the vector cross product of two adjacent sides. Any line through the midpoint of a parallelogram bisects the area.[6] Any non-degenerate affine transformation takes a parallelogram to another parallelogram. A parallelogram has rotational symmetry of order 2 (through 180°) (or order 4 if a square). If it also has exactly two lines of reflectional symmetry then it must be a rhombus or an oblong (a non-square rectangle). If it has four lines of reflectional symmetry, it is a square. The perimeter of a parallelogram is 2(a + b) where a and b are the lengths of adjacent sides. Unlike any other convex polygon, a parallelogram cannot be inscribed in any triangle with less than twice its area.[7] The centers of four squares all constructed either internally or externally on the sides of a parallelogram are the vertices of a square.[8] If two lines parallel to sides of a parallelogram are constructed concurrent to a diagonal, then the parallelograms formed on opposite sides of that diagonal are equal in area.[8] The diagonals of a parallelogram divide it into four triangles of equal area. A parallelogram can be rearranged into a rectangle with the same area. Animation for the area formula K = b h {\displaystyle K=bh} . All of the area formulas for general convex quadrilaterals apply to parallelograms. Further formulas are specific to parallelograms: A parallelogram with base b and height h can be divided into a trapezoid and a right triangle, and rearranged into a rectangle, as shown in the figure to the left. This means that the area of a parallelogram is the same as that of a rectangle with the same base and height: K = b h . {\displaystyle K=bh.} The area of the parallelogram is the area of the blue region, which is the interior of the parallelogram The base × height area formula can also be derived using the figure to the right. The area K of the parallelogram to the right (the blue area) is the total area of the rectangle less the area of the two orange triangles. The area of the rectangle is K rect = (B + A) × H {\displaystyle K_{\text{rect}}=(B+A)\times H,\,} and the area of a single triangle is K tri = A 2 × H . {\displaystyle K_{\text{tri}}={\frac {A}{2}}\times H.\,} Therefore, the area of the parallelogram is K = K rect − 2 × K tri = ((B + A) × H) − (A × H) = B × H . {\displaystyle K=K_{\text{rect}}-2\times K_{\text{tri}}=((B+A)\times H)-(A\times H)=B\times H.} Another area formula, for two sides B and C and angle θ, is K = B ⋅ C ⋅ sin ⁡ θ . {\displaystyle K=B\cdot C\cdot \sin \theta .\,} Provided that the parallelogram is not a rhombus, the area can be expressed using sides B and C and angle γ {\displaystyle \gamma } at the intersection of the diagonals:[9] K = | tan ⁡ γ | 2 ⋅ | B 2 − C 2 | . {\displaystyle K={\frac {|\tan \gamma |}{2}}\cdot \left|B^{2}-C^{2}\right|.} When the parallelogram is specified from the lengths B and C of two adjacent sides together with the length D1 of either diagonal, then the area can be found from Heron's formula. Specifically it is K = 2 S (S − B) (S − C) (S − D 1) = 1 2 (B + C + D 1) (− B + C + D 1) (B − C + D 1) (B + C − D 1) , {\displaystyle K=2{\sqrt {S(S-B)(S-C)(S-D_{1})}}={\frac {1}{2}}{\sqrt {(B+C+D_{1})(-B+C+D_{1})(B-C+D_{1})(B+C-D_{1})}},} where S = (B + C + D 1) / 2 {\displaystyle S=(B+C+D_{1})/2} and the leading factor 2 comes from the fact that the chosen diagonal divides the parallelogram into two congruent triangles. Let vectors a , b ∈ R 2 {\displaystyle \mathbf {a} ,\mathbf {b} \in \mathbb {R} ^{2}} and let V = [a 1 a 2 b 1 b 2] ∈ R 2 × 2 {\displaystyle V={\begin{bmatrix}a_{1}&a_{2}\\b_{1}&b_{2}\end{bmatrix}}\in \mathbb {R} ^{2\times 2}} denote the matrix with elements of a and b. Then the area of the parallelogram generated by a and b is equal to | det ⁡ (V) | = | a 1 b 2 − a 2 b 1 | . {\displaystyle |\det(V)|=|a_{1}b_{2}-a_{2}b_{1}|.\,} Let vectors a , b ∈ R n {\displaystyle \mathbf {a} ,\mathbf {b} \in \mathbb {R} ^{n}} and let V = [a 1 a 2 … a n b 1 b 2 … b n] ∈ R 2 × n {\displaystyle V={\begin{bmatrix}a_{1}&a_{2}&\dots &a_{n}\\b_{1}&b_{2}&\dots &b_{n}\end{bmatrix}}\in \mathbb {R} ^{2\times n}} . Then the area of the parallelogram generated by a and b is equal to det ⁡ (V V T) {\displaystyle {\sqrt {\det(VV^{\mathrm {T} })}}} . Let points a , b , c ∈ R 2 {\displaystyle a,b,c\in \mathbb {R} ^{2}} . Then the signed area of the parallelogram with vertices at a, b and c is equivalent to the determinant of a matrix built using a, b and c as rows with the last column padded using ones as follows: K = | a 1 a 2 1 b 1 b 2 1 c 1 c 2 1 | . {\displaystyle K=\left|{\begin{matrix}a_{1}&a_{2}&1\\b_{1}&b_{2}&1\\c_{1}&c_{2}&1\end{matrix}}\right|.} Parallelogram ABCD To prove that the diagonals of a parallelogram bisect each other, we will use congruent triangles: ∠ A B E ≅ ∠ C D E {\displaystyle \angle ABE\cong \angle CDE} (alternate interior angles are equal in measure) ∠ B A E ≅ ∠ D C E {\displaystyle \angle BAE\cong \angle DCE} (alternate interior angles are equal in measure). (since these are angles that a transversal makes with parallel lines AB and DC). Also, side AB is equal in length to side DC, since opposite sides of a parallelogram are equal in length. Therefore, triangles ABE and CDE are congruent (ASA postulate, two corresponding angles and the included side). Therefore, A E = C E {\displaystyle AE=CE} B E = D E . {\displaystyle BE=DE.} Since the diagonals AC and BD divide each other into segments of equal length, the diagonals bisect each other. Separately, since the diagonals AC and BD bisect each other at point E, point E is the midpoint of each diagonal. Parallelograms can tile the plane by translation. If edges are equal, or angles are right, the symmetry of the lattice is higher. These represent the four Bravais lattices in 2 dimensions. Lattices Form Square Rectangle Rhombus Rhomboid System Square(tetragonal) Rectangular(orthorhombic) Centered rectangular(orthorhombic) Oblique(monoclinic) Constraints α=90°, a=b α=90° a=b None Symmetry p4m, [4,4], order 8n p2mm, [∞,2,∞], order 4n p1, [∞+,2,∞+], order 2n Form An automedian triangle is one whose medians are in the same proportions as its sides (though in a different order). If ABC is an automedian triangle in which vertex A stands opposite the side a, G is the centroid (where the three medians of ABC intersect), and AL is one of the extended medians of ABC with L lying on the circumcircle of ABC, then BGCL is a parallelogram. Main article: Varignon's theorem Proof without words of Varignon's theorem Varignon's theorem holds that the midpoints of the sides of an arbitrary quadrilateral are the vertices of a parallelogram, called its Varignon parallelogram. If the quadrilateral is convex or concave (that is, not self-intersecting), then the area of the Varignon parallelogram is half the area of the quadrilateral. Proof without words (see figure): An arbitrary quadrilateral and its diagonals. Bases of similar triangles are parallel to the blue diagonal. Ditto for the red diagonal. The base pairs form a parallelogram with half the area of the quadrilateral, Aq, as the sum of the areas of the four large triangles, Al is 2 Aq (each of the two pairs reconstructs the quadrilateral) while that of the small triangles, As is a quarter of Al (half linear dimensions yields quarter area), and the area of the parallelogram is Aq minus As. For an ellipse, two diameters are said to be conjugate if and only if the tangent line to the ellipse at an endpoint of one diameter is parallel to the other diameter. Each pair of conjugate diameters of an ellipse has a corresponding tangent parallelogram, sometimes called a bounding parallelogram, formed by the tangent lines to the ellipse at the four endpoints of the conjugate diameters. All tangent parallelograms for a given ellipse have the same area. It is possible to reconstruct an ellipse from any pair of conjugate diameters, or from any tangent parallelogram. A parallelepiped is a three-dimensional figure whose six faces are parallelograms. parallelogon, generalisation encompassing hexagons as well as quadrilaterals zonogon, generalisation to polygons with any even number of sides Antiparallelogram Levi-Civita parallelogramoid ^ "CIMT - Page no longer available at Plymouth University servers" (PDF). www.cimt.plymouth.ac.uk. Archived from the original (PDF) on 2014-05-14. ^ Owen Byer, Felix Lazebnik and Deirdre Smeltzer, Methods for Euclidean Geometry, Mathematical Association of America, 2010, pp. 51-52. ^ Zalman Usiskin and Jennifer Griffin, "The Classification of Quadrilaterals. A Study of Definition", Information Age Publishing, 2008, p. 22. ^ Chen, Zhibo, and Liang, Tian. "The converse of Viviani's theorem", The College Mathematics Journal 37(5), 2006, pp. 390–391. ^ Problem 5, 2006 British Mathematical Olympiad, [1]. ^ Dunn, J.A., and J.E. Pretty, "Halving a triangle", Mathematical Gazette 56, May 1972, p. 105. ^ Weisstein, Eric W. "Triangle Circumscribing". Wolfram Math World. ^ a b Weisstein, Eric W. "Parallelogram." From MathWorld--A Wolfram Web Resource. ^ Mitchell, Douglas W., "The area of a quadrilateral", Mathematical Gazette, July 2009. Wikimedia Commons has media related to Parallelograms. Parallelogram and Rhombus - Animated course (Construction, Circumference, Area) Weisstein, Eric W. "Parallelogram". MathWorld. Interactive Parallelogram --sides, angles and slope Area of Parallelogram at cut-the-knot Equilateral Triangles On Sides of a Parallelogram at cut-the-knot Definition and properties of a parallelogram with animated applet Interactive applet showing parallelogram area calculation interactive applet Retrieved from " Sign Up Now &Daily Live Classes3000+ TestsStudy Material & PDFQuizzes With Detailed Analytics+ More BenefitsGet Free Access Now Let's consider the following parallelogram: To find the diagonals of this parallelogram, we can use the following formulas: $latex d_{1}=\sqrt{{{a}^{2}+{b}^{2}-2ab\cos(A)}$ $latex d_{1}=\sqrt{{{a}^{2}+{b}^2}+2ab\cos(B)}$ $latex d_{2}=\sqrt{{{a}^2}+{b}^2}+2ab\cos(A)}$ $latex d_{2}=\sqrt{{{a}^{2}+{b}^2}-2ab\cos(B)}$ $latex {{d_{1}}^{2}+{{d_{2}}^{2}=2({{a}^{2}+{b}^{2})$ where, $latex d_{1}, ~d_{2}$ are the lengths of the diagonals$latex a, ~b$ are the lengths of the sides In the following examples, we use the diagonal formulas to find the lengths of the diagonals of the parallelograms. Try to solve the exercises yourself before looking at the answer. Find the diagonal of a parallelogram with sides 6 m and 10 m and an angle of 30°. We have the following values: Side 1, $latex a=6$ mSide 2, $latex b=10$ mAngle, $latex A=30$° Therefore, we use the diagonal formula with these values: $latex d_{1}=\sqrt{{{a}^{2}+{b}^{2}-2ab\cos(A)}$ $$d_{1}=\sqrt{{{6}^{2}+{{10}^{2}-2(6)(10)\cos(30°)}$$ $latex d_{1}=\sqrt{36+100-2(6)(10)(0.5)}$ $latex d_{1}=\sqrt{136-60}$ $latex d_{1}=\sqrt{76}$ $latex d_{1}=8.72$ The diagonal has a length of 8.72 m. What is the length of the diagonal of a parallelogram with sides of length 10 m and 13 m and an angle that measures 40°? We can identify the following: Side 1, $latex a=10$ mSide 2, $latex b=13$ mAngle, $latex A=40$° Therefore, we plug these values into the formula: $latex d_{1}=\sqrt{{{a}^{2}+{b}^{2}-2ab\cos(A)}$ $$d_{1}=\sqrt{{{10}^{2}+{{13}^{2}-2(10)(13)\cos(40°)}$$ $$d_{1}=\sqrt{100+169-2(10)(13)(0.643)}$$ $latex d_{1}=\sqrt{269-167.18}$ $latex d_{1}=\sqrt{101.82}$ $latex d_{1}=10.09$ The diagonal has a length of 10.09 m. A parallelogram has sides of length 8 m and 14 m with an angle measuring 45°. What is the length of its diagonal? We have the following information: Side 1, $latex a=8$ mSide 2, $latex b=14$ mAngle, $latex A=45$° Using these values in the formula, we have: $latex d_{1}=\sqrt{{{a}^{2}+{b}^{2}-2ab\cos(A)}$ $$d_{1}=\sqrt{{{8}^{2}+{{14}^{2}-2(8)(14)\cos(45°)}$$ $$d_{1}=\sqrt{64+196-2(8)(14)(0.707)}$$ $latex d_{1}=\sqrt{260-158.368}$ $latex d_{1}=\sqrt{101.632}$ $latex d_{1}=10.08$ The diagonal has a length of 10.08 m. What is the length of the diagonal of a parallelogram that has sides of length 5 m and 7 m and an angle that measures 40°? We have the following information: Side 1, $latex a=5$ mSide 2, $latex b=7$ mAngle, $latex A=40$° Therefore, we use the diagonal formula with these values: $latex d_{1}=\sqrt{{{a}^{2}+{b}^{2}-2ab\cos(A)}$ $$d_{1}=\sqrt{{{5}^{2}+{{7}^{2}-2(5)(7)\cos(40°)}$$ $latex d_{1}=\sqrt{25+49-2(5)(7)(0.643)}$ $latex d_{1}=\sqrt{74-45.01}$ $latex d_{1}=\sqrt{76}$ $latex d_{1}=5.38$ The diagonal has a length of 5.38 m. Solve the following problems using the formula for the diagonal of a parallelogram. Select your answer and click "Check" to check your answer. Look at the solved examples above in case you need help. Interested in learning more about parallelograms? Take a look at these pages: .author-box {margin: 70px 0; padding: 30px; background-color: #f9fcff; border-radius: 15px; box-shadow: 0px 0px 10px #ccc; max-width:1100px; margin-left:auto !important; margin-right:0px !important; } .author-box img {margin:auto; border-radius: 50%;} .author-box h3 {margin-top: 20px; font-size:19px;} .author-box p {margin: 10px 0; text-align:left; } .author-box a {display: inline-block; margin-right: 10px; color: black; text-decoration: none;} { "@context": " ", "@type": "Person", "name": "Jefferson Huera Guzman", "image": " , "url": " , "description": "Jefferson is the lead author and administrator of Neurochispas.com.", "sameAs": [" , "], "email": "", "worksFor": { "@type": "Organization", "name": "Interacti Digital LLC"}, "alumniOf": { "@type": "CollegeOrUniversity", "name": "The University of Manchester"}, "knowsAbout": ["Algebra", "Calculus", "Geometry", "Mathematics", "Physics"] } To find the diagonal of a parallelogram, we can use the Law of Cosines. Let's say the sides of the parallelogram are @$\begin{align*}AB=a\end{align*}@$ and @$\begin{align*}BC=b\end{align*}@$, and the angle between them is @$\begin{align*}\theta\end{align*}@$. The diagonal @$\begin{align*}AC=d\end{align*}@$ can be found using: @$\begin{align*} d^2 = a^2 + b^2 - 2ab \cos{\theta} \end{align*}@$ To find the diagonal, take the square root of both sides: @$\begin{align*} \boldsymbol{d = \sqrt{a^2 + b^2 - 2ab \cos{\theta}}} \end{align*}@$ This calculator computes the diagonals of a parallelogram and adjacent angles from side lengths and angles between sides. It is done with the help of law of cosines Check the picture. First, we use the law of cosines to find out d1, then we find the second angle of a parallelogram, which is , then we again use the law of cosines to find out d2. The remaining angles are found from the same law of cosines. After that, we find diagonal intersection angles using the fact that the sum of triangle angles is 180. Calculation precisionDigits after the decimal point: 2Second parallelogram angle The diagonal of a parallelogram is the line segment that connects its non-adjacent vertices. A parallelogram has 2 diagonals and the length of the diagonals of a parallelogram can be found by using various formulas depending on the given parameters and dimensions. Let us learn more about the diagonals of a parallelogram in this article. What is the Diagonal of Parallelogram? The diagonals of a parallelogram can be drawn by joining the two non-adjacent vertices of the parallelogram. It should be noted that the 2 diagonals of a parallelogram bisect each other and they divide the parallelogram into congruent triangles. Diagonal of Parallelogram Formula The formula for the diagonals of a parallelogram is used to calculate the length of the diagonals of a given parallelogram. There are different formulas for different kinds of parallelograms. Observe the figure given below which shows a parallelogram along with its diagonals. Here 'p' and 'q' are the diagonals and 'x' and 'y' are the two sides of the parallelogram. The simple formula for finding the length of the diagonals of a parallelogram is given below. For this formula, we need the length of the sides and any of the known angles. If we follow the figure given above, we can observe that: p and q are taken to be the length of the diagonals respectively. x and y are the sides of the parallelogram. Angle A and Angle B are two interior angles of the parallelogram. Formula 1: For any parallelogram, the formula for the length of the diagonals is expressed as: \(p = \sqrt{x^2 + y^2 - 2xy \cos A} = \sqrt{x^2 + y^2 + 2xy \cos B} \) \(q = \sqrt{x^2 + y^2 + 2xy \cos A} = \sqrt{x^2 + y^2 - 2xy \cos B} \) Formula 2: Another formula which expresses the relationship between the length of the diagonals and sides of the parallelogram is: p2 + q2 = 2(x2 + y2) Where, p and q are the diagonals respectively. x and y are the sides of the parallelogram. It should be noted that a square, a rectangle, and a rhombus come under the category of parallelograms. And since they have different properties, the formula that is used to find their diagonals is also different. For example, the diagonal of a square (d) = a√2; where 'd' is the diagonal and 'a' is the side of the square. The diagonal of a rectangle (d) = √(l2 + w2), where l = length of the rectangle and w = width of the rectangle. Therefore, the formula for the diagonal of a parallelogram varies for different kinds of parallelograms. Properties of Diagonal of Parallelogram The following points show the properties of the diagonals of a parallelogram. Since a parallelogram includes a square, a rectangle, a rhombus, the diagonals of these figures have a few common properties and a few different ones. The diagonals of a parallelogram always bisect each other. In a square, the diagonals are equal and bisect each other at right angles. In a rectangle, the diagonals are equal and they bisect each other but not at right angles. In a rhombus, the diagonals may not be necessarily equal, but they are perpendicular to each other. ☛ Related Articles Example 1: Find the length of the diagonals of the rhombus of side length 4 inches, if the interior angles are 120° and 60°. Solution: Given, Interior angle A = 120°, and angle B = 60°. x = 4, y = 4 Using diagonal of parallelogram formula, \(p = \sqrt{x^2 + y^2 - 2xy \cos A} \) \(q = \sqrt{x^2 + y^2 + 2xy \cos A}\) Putting the values in the formula for p: \(\begin{align} p &= \sqrt{4^2 + 4^2 - (2 \times 4 \times 4 \times \cos 60)} \\ &= \sqrt{32 - 16} \\ p &= 4 \end{align}\) Now, doing same for q, \(\begin{align} q &= \sqrt{4^2 + 4^2 + (2 \times 4 \times 4 \times \cos 60)} \\ &= \sqrt{32 + 16} \\ p &= \sqrt {48} \\ p &= 6.92 \end{align}\) Answer: The length of the diagonals are 4 in and 6.92 in. Example 2: For a parallelogram ABCD, if the length of the adjacent sides is 35 ft and 82 ft. If one of the interior angles is 37°. Find the length of any diagonal. Solution: Given, Interior angle A = 37° x = 35 ft, y = 82 ft Using diagonal of parallelogram formula, \(p = \sqrt{x^2 + y^2 - 2xy \cos A}\) Putting the values in the formula for p: \(\begin{align} p &= \sqrt{35^2 + 82^2 - (2 \times 35 \times 82 \times \cos 37)} \\ &= \sqrt{3365} \\ p &= 58 \end{align}\) Answer: The length of the diagonal is 58 ft. Example 3: Calculate the length of the diagonal of a parallelogram with sides 4 units, 6 units and an interior angle A which is equal to 60 degrees. Solution: Given, a = 4 units, b = 6 units, angle A = 60° Using diagonal of parallelogram formula, \(p = \sqrt{x^2 + y^2 - 2xy \cos A}\) Putting the values in the formula for p: \(p = \sqrt{4^2 + 6^2 - 24}\)= \(\sqrt28\) = 5.291 Answer: Diagonal of parallelogram = 5.291 units. 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 our certified experts Book a Free Trial Class FAQs on Diagonal of Parallelogram The diagonal of a parallelogram is the line segment that joins the two non-adjacent vertices of the parallelogram. It is to be noted that 2 diagonals can be drawn in a parallelogram. What is the Diagonal of a Parallelogram Formula? A simple formula which is used to find the length of the diagonals of a parallelogram needs the value of the interior angles and the length of the sides. For any parallelogram, the formula for the length of the diagonals is expressed as, \(p = \sqrt{x^2 + y^2 - 2xy \cos A} = \sqrt{x^2 + y^2 + 2xy \cos B} \) and \(q = \sqrt{x^2 + y^2 + 2xy \cos A} = \sqrt{x^2 + y^2 - 2xy \cos B} \), where p and q are the lengths of the diagonals, angle A and angle B are the given interior angles and x and y are the sides of the parallelogram. How to Use the Diagonal of a Parallelogram Formula? For any parallelogram, let p and q be the lengths of the diagonals and x and y be the sides of the parallelogram then Step 1: Check for the given parameters, the values of the sides of the parallelograms, and the corresponding angles. Step 2: Substitute the values in the formula, \(p = \sqrt{x^2 + y^2 - 2xy \cos A} = \sqrt{x^2 + y^2 + 2xy \cos B} \) and \(q = \sqrt{x^2 + y^2 + 2xy \cos A} = \sqrt{x^2 + y^2 - 2xy \cos B} \). What are the Components of the Diagonal of Parallelogram Formula? The formula for the diagonal of parallelogram helps to find the length of the diagonals by using the length of the sides and any of the known angles. Thus, its components include the sides of the parallelogram and the corresponding angles. Do the Diagonals of a Parallelogram Bisect Each Other? Yes, the diagonals of a parallelogram bisect each other. This means that the diagonals of a parallelogram divide each other into 2 equal parts. Are the Diagonals of a Parallelogram Equal? A parallelogram includes a square, a rectangle, and a rhombus. While the diagonals of a square and rectangle are equal, the diagonals of a rhombus may not be necessarily equal. How to Find the Diagonals of a Parallelogram without Angles? The length of the diagonals of a parallelogram can be calculated even when the interior angles are not given. For example, if the parallelogram is a rectangle, we know that the diagonals of a rectangle form a right-angled triangle. So, in this case, if the sides of the rectangle are known, the length of the diagonal can be calculated using the Pythagoras theorem because the diagonal becomes the hypotenuse. This method can also be applied if the given parallelogram is a square. Line segments connecting two non-adjacent vertices of a parallelogram are called "diagonals of a parallelogram." A quadrilateral with opposite sides that are parallel and equal is known as a parallelogram. Its opposite angles are also equal. A parallelogram has two diagonals. The diagonals of a parallelogram connect the opposite vertices. Square, rectangle, rhombus are examples of a parallelogram. Diagonals of a parallelogram bisect each other. The diagonals of a square bisect each other at right angles. The diagonals of a rectangle bisect each other, but not at right angles. The diagonals of a rhombus are perpendicular to each other. Each diagonal divides the parallelogram in two congruent triangles. Let's discuss two important formulas. The above figure shows a parallelogram and its two diagonals. p & q are diagonals. x & y are two adjacent sides of a parallelogram. $\angle \text{A}$ & $\angle\text{B}$ are the interior angles of a given parallelogram. How can we calculate the length of diagonals of a parallelogram? The length of the diagonal of the parallelogram can be calculated by using the following formulas: $p = \sqrt{x^{2} + y^{2}\;-\;2xy\; cos\;(A)} = \sqrt{x^{2} + y^{2} + 2xy\; cos\;(B)}$ $q = \sqrt{x^{2} + y^{2} + 2xy\; cos\;(A)} = \sqrt{x^{2} + y^{2} \;-\; 2xy\; cos\;(B)}$ If the measurement of two sides and one interior angle is given the above formula can be used for finding the length of diagonal of the parallelogram. $p^{2} + q^{2} = 2 (x^{2} + y^{2})$ Here, Here, p & q are the diagonals of parallelogram x & y are the adjacent sides of a parallelogram If the measurement of two adjacent sides & one diagonal is given then the above formula can be used for finding the length of another diagonal of the parallelogram. The diagonals of a parallelogram bisect each other at the point of intersection. The length of the diagonals of a parallelogram is not equal. This article gives a brief description of the diagonals of parallelograms, and how to calculate the length of diagonals of parallelograms. Let's solve a few examples and practice problems. 1. Determine the length of diagonals of a parallelogram with side lengths 4 ft, 8 ft, and angle 60°. Solution: Here x $= 4$ ft & y $= 8$ ft $\text{m} \angle \text{A} = 60^{\circ}$ Formula for calculating the length of diagonals is given as, $p = \sqrt{x^{2} + y^{2}\;-\;2xy\; cosA}$ $= \sqrt{4^{2} + 8^{2} \;-\; 2(4)(8)\; cos(60^{\circ})}$ $= 6.92$ ft $q = \sqrt{x^{2} + y^{2} + 2xy\; cosA}$ $ = \sqrt{4^{2} + 8^{2} + 2(4)(8)\; cos(60^{\circ})}$ $= 10.58$ ft 2. Determine the length of diagonals of a parallelogram with sides 3 inches and 6 inches, and the interior angle is 300. Solution: Here, x $= 3$ inches & y $= 6$ inches Also, $\text{m}\;\angle\text{A} =30^{\circ}$ Formula for calculating the length of diagonals of the parallelogram is given as, $p = \sqrt{x^{2} + y^{2}\;-\;2xy\; cosA}$ $= \sqrt{3^{2} + 6^{2}\;-\;2(3)(6)\; cos\;30^{\circ}}$ $= 3.71$ inches $q = \sqrt{x^{2} + y^{2} + 2xy\; cosA}$ $= \sqrt{3^{2} + 6^{2} + 2(3)(6)\; cos\;(30^{\circ})}$ $= 8.72$ inches 3. Determine the length of any one diagonal of a parallelogram if the length of the sides of a parallelogram and interior angle are 4 ft, 7 ft and 50o. Solution: Given: Here, x $= 4$ ft and y $= 7$ ft Also, $\angle\text{A} = 50^{\circ}$ Formula for calculating the length of diagonals of the parallelogram is given as, $p = \sqrt{x^{2} + y^{2}\;-\;2xy\; cosA}$ $= \sqrt{4^{2} + 7^{2}\;-\;2(4)(7)\; cos(50^{\circ})}$ $= 5.38$ ft 4. Determine the length of any one of the diagonals of a parallelogram having a length of sides 5ft, 7 ft, and one of the interior angles 450. Solution: Here, x $= 5$ ft & y $= 7$ ft Also, $\angle\text{A} = 45^{\circ}$ Formula for calculating the length of diagonals of the parallelogram is given as, $p = \sqrt{x^{2} + y^{2}\;-\;2xy\; cos(A)}$ $= \sqrt{5^{2} + 7^{2}\;-\;2(5)(7)\; cos(45^{\circ})}$ $= 4.95$ ft 5. Determine the length of a diagonal of a parallelogram with a side length of 5 ft and 8 ft if the length of another diagonal is 10 ft. Solution: Given: x $= 5$ ft, y $= 8$ ft & p $= 10$ ft As we know, the length of two sides and one diagonal is given for finding the length of another diagonal. We will use the formula of the relationship between the sides and diagonals of a parallelogram. By using the formula, $p^{2} + q^{2} = 2(x^{2} + y^{2})$ $\Rightarrow 10^{2} + q^{2} = 2(5^{2} + 8^{2})$ $\Rightarrow 100 + q^{2} = 2(25 + 64)$ $\Rightarrow 100 + q^{2} = 178$ $\Rightarrow q^{2} = 178\;-\;100$ $\Rightarrow q^{2} = 78$ By taking a square root, $\Rightarrow q = 8.83$ ft Attend this quiz & Test your knowledge.Correct answer is: 2From the 4 vertices of a parallelogram, two diagonals can be drawn connecting two opposite corners.Opposite sides are parallel.Opposite angles are equal.The length of the diagonal is equal.Correct answer is: The length of the diagonal is equal.The diagonals of the parallelogram are not equal. In the case of a rhombus, square, and rectangle, diagonals are equal.Correct answer is: KiteKite is not a parallelogram because opposite sides are not parallel and equal.Correct answer is: 8.96 inchesHere, x $= 3.5$ in , y $= 6$ in & $\angle\text{A} = 40^{\circ}$ $p = \sqrt{x^{2} + y^{2}\;-\;2xy\; cosA}$ $= \sqrt{3.5^{2} + 6^{2}\;-\;2(3.5)(6)\; cos40^{\circ}}$ $= 8.96$ inchesCorrect answer is: 11.02 ftAs we know, $p^{2} + q^{2} = 2(x^{2} + y^{2})$ $9^{2} + q^{2} = 2 (4.5^{2} + 9^{2})$ $81 + q^{2} = 202.5$ $q^{2} = 121.5$ $q=11.02$ ftin Are diagonals of a parallelogram equal? Diagonals of a parallelogram bisect each other, but they are not equal. Which parallelogram has equal diagonals? A rectangle has equal diagonals which bisect each other and are perpendicular. Are diagonals of parallelograms perpendicular? No, diagonals of a parallelogram bisect each other but not necessarily at 90°. What is parallelogram law? The parallelogram law states that the sum of the squares of the length of the four sides of a parallelogram is equal to the sum of the squares of the length of the two diagonals. What is the formula for calculating the number of diagonals of a quadrilateral? The number of diagonals of any quadrilateral can be calculated using the formula $\frac{n(n-3)}{2}$, where n is the number of sides of a given polygon. Diagonal in geometry, a line segment connecting two non-adjacent vertices of a polygon or polyhedron. The diagonal of a polygon is a line segment connecting its two vertices that do not lie on one side. Parallelogram — is a quadrangle in which the opposite sides are pairwise parallel, that is, they lie on parallel lines. Particular cases of a parallelogram are a rectangle, a square, and a rhombus. Are you struggling to find the diagonal of a parallelogram? Our Parallelogram Diagonal Calculator can help! This free tool can help you quickly and easily calculate the diagonal of a parallelogram. Parallelogram Diagonal Formulas According to the cosine theorem, the side of the triangle to the second degree is equal to the sum of the squares of its two other sides and their double product by the cosine of the angle between them. Since any diagonal of a parallelogram divides it into two congruent triangles, you can calculate the diagonal by knowing the sides of the parallelogram and the angle between them. Keep in mind that the angle and the diagonal must be in the same triangle, otherwise you need to calculate the necessary angle, taking away the known from 180 degrees by the principle of additional angles. To find the diagonal of a parallelogram, you can use either of the following formulas: Where: d is the diagonal length of the rhombus, a and b are the lengths of the adjacent sides of the parallelogram, and α is the angle between the adjacent sides (in degrees). Step-by-Step Process: How to Find Parallelogram Diagonal Our calculator makes it even easier to find the diagonal of a parallelogram. Simply enter the values of a, b, and α, and our calculator will give you the diagonal of the parallelogram in seconds.Whether you are a student, teacher, or professional, our free tool can save you time and effort. Try it out now! Written By Priya Wadhwa Last Modified 30-03-2023 Diagonal of Parallelogram Formula: The name parallelogram comes from the Greek word parallelogrammon, which means bounded by parallel lines. As a result, a parallelogram is a quadrilateral with parallel lines on opposite sides. The opposite sides of a parallelogram will be parallel and equal. The diagonals of a parallelogram are the line segments that connect the parallelogram's opposite vertices. We can calculate the lengths of the diagonals of a parallelogram if we know the measure of its adjacent sides and the adjacent angles. In this article, we will discuss the diagonal of the parallelogram formula in detail. A parallelogram is a type of quadrilateral formed by parallel lines. The opposite sides of the parallelogram are parallel and congruent. A parallelogram's angle between consecutive sides can vary, but the opposite angles are equal. Examine the diagram below, which represents the three kinds of parallelograms. These are special cases of parallelograms. A diagonal is a line segment that connects two corners of a polygon that is not an edge. As a result, we may make a diagonal by connecting any two corners (vertices) that are not previously connected by an edge. For an \(n\) -sided regular polygon, the number of diagonals can be obtained using the formula given below:Number of diagonals \(= \frac{{n\left({n - 3} \right)}}{2}\)For a parallelogram, \(n = 4\)Therefore, the number of diagonals in a parallelogram \(= \frac{{4\left({4 - 3} \right)}}{2} = 2.\) The diagonals of a parallelogram are the line segments joining the opposite vertices of the parallelogram.A parallelogram has two pairs of opposite vertices, and hence it has two diagonals. In the parallelogram \(ABCD,\,AC\) and \(BD\) are the diagonals. The diagonals of a parallelogram formula are used to determine the length of a parallelogram's diagonals. Using the lengths of the sides and the measure of the angles, we can calculate the diagonal lengths. For any parallelogram \(ABCD,\) let \(a\) and \(b\) be the length of sides of the parallelogram and \(p\) and \(q\) be the lengths of the diagonals then,Using the cosine rule on angle \(A\) and \(B,\) we get\(p = \sqrt {{a^2} + {b^2} + 2\,ab\,\cos \,\left(A \right)} = \sqrt {{a^2} + {b^2} – 2\,ab\,\cos \,\left(B \right)} \)\(q = \sqrt {{a^2} + {b^2} – 2\,ab\,\cos \,\left(A \right)} = \sqrt {{a^2} + {b^2} + 2\,ab\,\cos \,\left(B \right)} \) One more special formula related to the lengths of the diagonals and sides of the parallelogram is given by:\({p^2} + {q^2} = 2\left({{a^2} + {b^2}} \right)\)Where \(p\) and \(q\) are the lengths of the diagonals, respectively, and \(a\) and \(b\) are the sides of the parallelogram. A parallelogram may be classified into several kinds based on its various properties. It is mostly classified into three distinct categories:1. Rectangle2. Square3. Rhombus A rectangle is a parallelogram with four right angles and two sets of equal and parallel opposite sides. A rectangle's diagonal is a line segment connecting any two of its non-adjacent vertices. The diagonals of the following rectangle are \(AC\) and \(BD.\) As you can see, the lengths of \(AC\) and \(BD\) are equal. A diagonal divides a rectangle into two right triangles, each having sides equal to the rectangle's sides and a hypotenuse which is the diagonal of the rectangle. The length of a diagonal \(d\) of a rectangle whose length is \(l\) units and breadth is \(b\) units is calculated by the Pythagoras theorem.Using Pythagoras theorem, we get:\({d^2} = {l^2} + {b^2}\)Therefore, length of diagonal of a rectangle \(= \sqrt {{l^2} + {b^2}} \,\) A parallelogram with four equal sides and four right angles is known as a square. A square's diagonal is a line segment connecting two of its opposite vertices. In the given square, the lengths of \(AC\) and \(BD\) are equal. Any square's diagonal divides it into two equal right triangles. The Pythagoras theorem is used to compute the length of a diagonal \(d\) of a square with side length \(a\) units. According to Pythagoras theorem,Length of diagonal of a square, \(d = \sqrt {{a^2} + {a^2}} = \sqrt {2{a^2}} = a\sqrt 2 \,\left({{\rm{units}}} \right)\) A rhombus is a parallelogram with four equal sides and equal opposite angles. The diagonals of a rhombus are perpendicular to each other and bisect each other at a \({90^ \circ }\) angle, ensuring that the two halves of each diagonal are the same length. A rhombus is a diamond-shaped quadrilateral with equal sides on all four sides. Unless the rhombus is a square, the diagonals of a rhombus will have distinct values.For a rhombus \(ABCD\)\(AB = BC = CD = AD = a\)\(AC = p,\,BD = q\)\(\angle at vertex \(A\) then,\(p = \sqrt {{a^2} + {a^2} + 2\,{a^2}\cos \theta } = \sqrt {2\,{a^2}(1 + \cos \theta)} = a\sqrt {2 + 2\,\cos \theta } \)\(q = \sqrt {{a^2} + {a^2} - 2\,{a^2}\cos \theta } = \sqrt {2\,{a^2}(1 - \cos \theta)} = a\sqrt {2 - 2\,\cos \theta } \) The properties of a parallelogram's diagonals are as follows:1. The diagonals of a parallelogram bisect each other. \(OB = OD\) and \(OA = OC\)2. Each diagonal divides the parallelogram into two congruent triangles.3. Parallelogram Law: The sum of the squares of the sides is equal to the sum of the squares of the diagonals. \(A{B^2} + B{C^2} + C{D^2} + A{D^2} = A{C^2} + B{D^2}\) Q.1. Explain how a square is:(i) a quadrilateral(ii) a parallelogram(iii) a rhombus(iv) a rectangleAns: (i) A square is a quadrilateral since it is a closed two-dimensional shape with four straight line segments.(ii) A square is a parallelogram since it has both pairs of opposite sides parallel and equal.(iii) A square is a rhombus since it has four equal sides and diagonals bisect each other at \({90^ \circ }.\)(iv) A square is a rectangle since it has each adjacent angle a right angle and opposite sides are equal. Q.2. Find the length of the diagonals of the rhombus of side length 4 cm, if the interior angles are \({120^{\rm{o}}}\) and \({60^{\rm{o}}}.\)Ans: Given, Interior \(\angle A = {120^{\rm{o}}}\) and \(\angle B = {60^{\rm{o}}}.\)\(a = 4\,{\rm{cm}}\)Using diagonal of rhombus formula, \(p = a\sqrt {2 + 2\,\cos \,A} \)\(q = a\sqrt {2 - 2\,\cos \,A} \)Putting the values in the formula for \(p:\)\(p = 4\sqrt {2 + 2\,\cos \,({120^{\rm{o}}})} \)\(p = 4\sqrt {2 + 2\left({ - \frac{1}{2}} \right)} \)\(p = 4\sqrt {2 - 1} = 4\,{\rm{cm}}\)Similarly, for\(q,\)\(q = 4\sqrt {2 - 2\,\cos \,({120^{\rm{o}}})} \)\(q = 4\sqrt {2 - 2\left({ - \frac{1}{2}} \right)} \)\(q = 4\sqrt {2 + 1} = 4 \times 1.732 = 6.928\,{\rm{cm}}\)Hence, the length of the diagonals is \(4\,{\rm{cm}}\) and \(6.928\,{\rm{cm}}.\) Q.3. Find the length of diagonals of a rectangle whose length is 3 cm and breadth is 4 cm?Ans: Given, \(l = 3\,{\rm{cm}}\) and \(b = 4\,{\rm{cm}}\)Using diagonal of rectangle formula, \(d = \sqrt {{l^2} + {b^2}} \)\(d = \sqrt {{3^2} + {4^2}} \)\(d = \sqrt {9 + 16} = \sqrt {25} = 5\,{\rm{cm}}\)Hence, the length of the diagonal of the given rectangle is \(5\,{\rm{cm}}.\) Q.4. Name the quadrilaterals whose diagonals:(i) bisect each other(ii) are perpendicular bisectors of each other(iii) are equalAns: (i) The diagonals bisect each other in a rhombus, parallelogram, rectangle, or square.(ii) The quadrilaterals, which have diagonals as perpendicular bisectors, are rhombus and square.(iii) A square or rectangle is formed when the diagonals are equal. Q.5. Find the diagonal of a parallelogram with sides 2 cm, 6 cm, and angle \({45^ \circ }\)?Ans: Given \(a = 2\,{\rm{cm}},\,b = 6\,{\rm{cm}}\) and \(\angle A = {45^ \circ }\)The formula of diagonal is, \(p = \sqrt {{a^2} + {b^2} - 2\,ab\,\cos \,\left(A \right)} \)\(p = \sqrt {{2^2} + {6^2} - 2 \times 2 \times 6 \times \cos \,\left({{45^{\rm{o}}}} \right)} \)\(p = \sqrt {4 + 36 - 24 \times 0.707} \)\(p = \sqrt {40 - 16.968} \)\(p = \sqrt {23.032} \)\(p = 4.799\,{\rm{cm}}\)Hence, the diagonal of the parallelogram is \(4.799\,{\rm{cm}}.\) In this article, we discussed that a parallelogram is a polygon whose opposite sides are equal and parallel. In this article, we also learnt about the definition of a parallelogram, its diagonal, types of a parallelogram and their length of diagonals, properties of a parallelogram, formula to find the length of the diagonals of a parallelogram. We solved some examples concerning all these. Q.1. Is the diagonal of the parallelogram equal? Ans: No, the diagonals of a parallelogram are not equal. But, the diagonals divide the parallelogram into two pairs of congruent triangles. The diagonals will be equal if a parallelogram is a rectangle or square. Q.2. What is diagonals of parallelogram?Ans: The diagonals of a parallelogram are the line segments connecting the opposite vertices of the parallelogram. There are two diagonals in a parallelogram. Q.3. What is the length of a \(5\) inches square?Ans: We know that the length of diagonal of a square is \(a\sqrt 2 ,\) where \(a\) is the side of the square.Therefore, for a \(5\,{\rm{inches}}\) square, the length of the diagonal is \(5\sqrt 2 \,{\rm{inches}}{\rm{.}}\) Q.4. What is the formula of the diagonal of a parallelogram?Ans: The diagonals of a parallelogram formula is used to determine the length of a parallelogram's diagonals. Using the lengths of the sides and the measure of the angles, we can find the length of diagonals of a parallelogram.For any parallelogram, let \(a\) and \(b\) be the sides of the parallelogram and \(p\,\) and \(q\) be the lengths of the diagonals thenStep 1: Check for the given parameters, the values of the sides of the parallelograms, and the corresponding angles.Step 2: Put the values in the formula for \(a,\,b,\,A\) and \(B\) and solve to get the values of \(p\) and \(q\) which are the lengths of the diagonals of the parallelogram.\(p = \sqrt {{a^2} + {b^2} - 2\,ab\,\cos \,\left(A \right)} = \sqrt {{a^2} + {b^2} + 2\,ab\,\cos \,\left(B \right)} \)\(q = \sqrt {{a^2} + {b^2} + 2\,ab\,\cos \,\left(A \right)} = \sqrt {{a^2} + {b^2} - 2\,ab\,\cos \,\left(B \right)} \) Now you are provided with all the necessary information on the diagonal of a parallelogram formula and we hope this detailed article is helpful to you. If you have any queries regarding this article, please ping us through the comment section below and we will get back to you as soon as possible.