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What is arc in math

In mathematics, an arc is defined as a portion of the boundary of a circle or a curve. It can also be referred to as an open curve. The boundary of a circle is the perimeter or the distance around a circle, also known as the circumference. So, the arc is the distance between any two points traced along its circumference. Let us understand this with the help of an example: In this figure, the distance between points A and B is an arc traced along the circumference of the circle. You can call it arc AB. An arc is denoted by the symbol ˆ. So, the arc AB can be written as ˆAB. The order of the points does not matter. Classify Shapes According to their Hierarchy Game Play More Games To make an arc, you either need a chord or a central angle. A chord is a line segment that joins any two points on a circle. A central angle is an angle between any two radii of the circle. For instance, the central angle in the diagram between the radii QA and QB, as shown below, is 60°. You must have noticed that an arc divides a circle into two parts. One has a shorter distance between the two endpoints (minor arc), while the other has a longer distance (major arc). Unless specified, an arc will always be considered a minor arc. To specify the major arc, you can take a third point on the arc of the circle and use three letters in the name. In the diagram above, ˆADB is the minor arc, and ˆADB is the major arc. A semicircle is an arc that has its endpoints on the diameter of a circle. You can calculate the length of an arc by using the formula given below. Arc length of a circle =

r
θ

{\frac{y}{360}}\times 2\pi r}

 Where r = the radius of the circle y = the angle (in degrees) subtended by an arc at the center of the circle 360 = the angle of one complete rotation. The value of π (pi) = 3.14 Example 1: Calculate the length of an arc that subtends an angle of 60 degrees at the center of a circle with a radius of 5 cm. Solution: We know the arc length formula is

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 In this example, y = 60 and r = 5 Substituting these values in the example, we get Arc length =

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{\frac{60}{360}}\times 2\pi \times 3.14 \times 5 = 5.23\text{ cm}

 Example 2: Calculate the length of the arc that subtends an angle of 40 degrees at the center of a circle with a radius of 6 cm. Solution: We know the arc length formula is

r
θ

{\frac{y}{360}}\times 2\pi r}

 In this example, y = 40 and r = 6 Substituting these values in the example, we get Arc length =

r
θ

{\frac{40}{360}}\times 2\pi \times 3.14 \times 6 = 4.186\text{ cm}

 Example 3: Identify the major arc in this circle. We know that a major arc is a long distance between two endpoints. So here, ˆADC is the major arc, and ˆABC is the minor arc. Attend this quiz & Test your knowledge. Correct answer is: 20.93 cm Arc length =

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 Substituting y = 120 and r = 10 cm, we get Arc length =

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{\frac{40}{360}}\times 2\pi \times 3.14 \times 10 = 20.93\text{ cm}

 Correct answer is: ˆADB ˆADB is the minor arc in this diagram. Correct answer is: 90° For an arc that spans a quarter of the circle, the radii drawn from its endpoints will be perpendicular to each other. Correct answer is: 99° The central angle is formed by joining the endpoints of the arc with the center of the circle. Hence, the greater the central angle, the greater will be the length of the arc formed. What is a semicircle arc? A semicircle is an arc that has its endpoints on the diameter of the circle. Here, both ˆAB and ˆACB are semicircle arcs. What is the central angle of an arc? A central angle is an angle that an arc subtends at the center. Can an arc be a straight line? No. An arc is always an open curve. In mathematics, an arc is defined as a portion of the boundary of a circle or a curve. It can also be referred to as an open curve. The boundary of a circle is the perimeter or the distance around a circle, also known as the circumference. So, the arc is the distance between any two points traced along its circumference. Let us understand this with the help of an example: In this figure, the distance between points A and B is an arc traced along the circumference of the circle. You can call it arc AB. An arc is denoted by the symbol ˆ. So, the arc AB can be written as ˆAB. You can also write it as ˆBA. The order of the points does not matter. Classify Shapes According to their Hierarchy Game Play More Games To make an arc, you either need a chord or a central angle. A chord is a line segment that joins any two points on a circle. A central angle is an angle between any two radii of the circle. For instance, the central angle in the diagram between the radii QA and QB, as shown below, is 60°. You must have noticed that an arc divides a circle into two parts. One has a shorter distance between the two endpoints (minor arc), while the other has a longer distance (major arc). Unless specified, an arc will always be considered a minor arc. To specify the major arc, you can take a third point on the arc of the circle and use three letters in the name. In the diagram above, ˆAB is the minor arc, and ˆADB is the major arc. A semicircle is an arc that has its endpoints on the diameter of a circle. You can calculate the length of an arc by using the formula given below. Arc length of a circle =

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 Example 2: Calculate the length of the arc that subtends an angle of 40 degrees at the center of a circle with a radius of 6 cm. Solution: We know the arc length formula is

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In Mathematics, it commonly refers to a portion of a circle, but it can also be parts of other shapes such as spheres, ellipses, and cylinders. In this article, we will discuss the introduction, definition, types, and application of an Arc and its meaning. We will also understand measures and formulae to calculate the Arc Length and Arc Angle in mathematics. We will also solve various examples and provide practice questions for a better understanding of the concept of this article. What is Arc in Math? From the perspective of mathematics, an Arc is a smooth curve connecting two distinct points at a certain distance. This curve can be a fragment of a circle, ellipse, or even a hyperbola. In special cases, it is defined as a segment of a circle, termed a circular arc. If we extend the ends of an arc, it will form a perfect circle. Arc is also referred to as an 'open curve'. The circle's perimeter, known as the circumference, defines the boundary. Thus, an arc measures the distance between two traced points along its circumference. For two arcs to be alike, their central angles must be equal. Definition of Arc An Arc is the part of a circle's circumference that lies between two radii. Arc represents a section of a curve, typically a circle, within a two-dimensional plane. Specifically, if the curve is a circle, we refer to it as a circular arc. In the strictest definition, an Arc is a segment of a curve located on a plane. Symbol of Arc The arc in geometry is typically represented by symbols ˆ or ˘ and is denoted as 'arc AB', pronounced as such. Hence, 'arc AB' can be expressed as AB or equivalently as BA. The sequence of the points does not affect its order. Arc of a Circle A Circle is defined as the set of all points in a two-dimensional plane that maintains a constant distance from a fixed point in the same plane, known as the Center. This fixed distance between any point on the circle's perimeter and the center is referred to as the radius. An Arc of a Circle represents a segment of its circumference. Consider two random points, P and Q, situated on the circle's surface. These points are connected to the Circle's center, forming an angle. This angle, known as the angle subtended by the Arc at the Circle's center, divides the circle into two distinct arcs: the Minor Arc PQ ('P to Q' in the counter-clockwise direction) and the Major Arc PQ ('P to Q' in the clockwise direction). The difference between these Arcs is reflected in their respective lengths and the angles they subtend at the circle's center. Types of Arcs An Arc in a circle divides the circle into two distinct parts: a shorter segment known as the Minor Arc and a longer segment known as the Major Arc. The Minor Arc refers to an arc that will be less than half of the entire circumference of a circle. In the given circle, ˘PQ represents a Minor Arc. This shorter Arc connects two endpoints on the circle and is characterized by an angle (central angle) equal to its arc measure, which is less than 180°. Major Arc A Major Arc covers more than half of the circle's circumference. In the given circle, ˘QP corresponds to the Major Arc. This longer Arc links two endpoints on the circle and has a measure exceeding 180°. The measure of a Major Arc is calculated as 360° minus the measure of the corresponding Minor Arc with the same endpoints. Semicircle An arc that measures exactly 180° is termed a Semicircle. A semicircle is basically half of a circle where a circle is bisected along its diameter. Applications of an Arc Arc has important roles in construction and other designs. Let's see some of the applications of Arc shape An arc is most widely used in the construction of bridges spanning streams and rivers of various sizes and designs. It is used in creating architectural elements such as arches over roofs and forming domes. Arcs in structures not only facilitate functionality but also enhance the overall visual of a building. The design of Arcs plays an important role in efficiently transmitting TV and radio signals via high-speed cables. The traditional bow used by archers showcases a prominent arc or curved shape, fundamental to its design and function. Whenever an object like a coin or stone is tossed into the air, the resulting path will follow a curved arc. Central Angle or Angle of Arc The Central Angle or Angle of the Arc is simply the angle that is formed at the center of the circle by the two radii that connect to the endpoints of the arc. A central angle is nothing but the angle that is subtended by the Major or Minor Arc at the center of any circle. How to Make an Arc To form an Arc, you have two options: Use chord and a definite central angle. A chord is a straight line segment that connects two points anywhere on the circle's circumference. Alternatively, a Central Angle is the angle created by two radii of the circle, taken from the center We can also make an Arc of a circle using three point method. Let's learn step of making arc of a circle using three point method. Step 1: Assume three random points which are non collinear Step 2: Draw two lines connecting these two points Step 3: Draw Perpendicular bisectors of the two lines and extend them such that they intersect each other Step 4: Assume the point of Intersection of Perpendicular Bisectors as Centre and extend the pencil to one the three points assuming the distance as radius Step 5: Now draw the arc passing through the three Points Measures of an Arc There are two methods to measure an arc. Arc Angle: Measuring the angle formed by the Arc. Arc Length: Measuring the distance along the Arc. Arc Length Length of Arc is calculated in distance units like centimeters. To signify this measurement, we use the lowercase letter L (representing 'length') preceding the Arc. Arc Length (L) = θ × r (when θ is in Radians) Arc Length (L) = θ × (π/180) × r (when θ is in degrees) Angle of Arc The Angle formed by an Arc at the center of the circle is the Angle of Arc. With the help of the Arc length formula, we can find the measure of Arc Angle. θ = L/r ⇒ L = (L × 180°)/π × r Arc Formula In the preceding sections, we discussed the definition of an Arc and its categorization into Major and Minor Arcs. Now, let's see various formulas associated with Arcs. Formula for Arc Length The Arc Length of a circle represents the distance between two endpoints along the Arc of a circle. The Arc Length is always greater than the straight-line distance between these endpoints. When the Arc's ends are extended to the circle's center through straight lines, an angle is formed. This angle is linked to the Arc Length (L). Furthermore, the straight lines connecting the Arc's endpoints to the circle's center are the radii of the circle. The Arc Length can be expressed in terms of the circle's radius and the angle subtended by the Arc at the circle's center. Arc length is always measured in units of distance or length, such as millimeters (mm), centimeters (cm), meters (m), and so on. When the Central Angle (θ) is measured in radians, the formula for Arc Length is given by: L = θ × r Where, L is the Arc's Length θ is the Central Angle of the Arc in radians. r is the radius of the circle. Arc Length Formula for the angle in degrees: Arc Length = θ × (180°/π) × r OR Arc Length = (360°/θ) × 2 × π × r OR Arc Length = (360°/θ) × π × d Where, r is the radius of the circle. θ is the Central Angle of the arc in degrees. d is the diameter of the circle. Note: 180°/π is the conversion factor from degrees to radians. Arc Angle Formula In the preceding section, we discussed the formulas for calculating Arc Length given the angle in either degrees or radians. Now, let's focus on the formula for the angle subtended by the Arc at the center of a circle. Arc Length = (360°/θ) × 2 × π × r OR Arc Length = (360°/θ) × C Where C is the circumference of the circle, given by 2πr. Hence, Arc Angle Formula θ = (Arc Length × 360°)/C Where, C is the circumference of the Circle Note: This formula calculates the angle in degrees. To obtain the angle in radians, you can multiply the angle measure in degrees by π/180°. Radius of a Circle from Width and Height of Arc If we are given the width and height of arc then we can calculate the Radius of a Circle using the formula given below: Radius = (height²+(width/2)²)/2 × height Summary All the formulas discussed in the article are summarized in the following table: Concept Formula Description Arc Length (radians) L = θ × r Arc Length (L) when the central angle (θ) is in radians. Arc Length (degrees) L = θ × (180°/π) × r Arc Length (L) when the central angle (θ) is in degrees. Arc Angle (radians) θ = r × L Central angle (θ) in radians, given arc length (L) and radius (r). Arc Angle (degrees) θ = π × L (180°/π) Central angle (θ) in degrees, given arc length (L) and radius (r). Arc Length using Circumference L = (360°/θ) × 2 × π × r Arc length (L) when the central angle (θ) is in degrees using a different approach. Radius from Width and Height of Arc Radius = (height²+(width/2)²)/2 × height Radius of a circle given the width (w) and height (h) of the arc. Also, Check Sector of Circle Segment of a Circle Area of Circle Solved Examples on Arc Example 1: Find the length of the Arc if the radius of the circle is equal to 4cm and the angle formed by the Arc is equal to π/16 radians. Solution: Given: Radius of the circle = 4cm Arc Angle = π/16 radians Since the Arc Angle is in radians, we can utilize the Arc Length formula, i.e., L = θ × r ⇒ L = (π/16) × 4 ⇒ L = π/4 cm. Example 2: Determine the length of the Arc if the Central Angle is equal to 65 degrees with a radius of 12 cm Solution: Given: Radius of the circle = 12 cm Arc Angle = 65 degrees Using the Arc Length (L) formula for the measure of the angle given in degrees. L = θ × (π/180°) × r = 65° × (π/180°) × 12 = L = 39π/9 cm. Example 3: If the diameter of a circle is 10 cm and the measure of the angle is 105°, find the length of the Arc? Solution: Given: Diameter of the circle = 10 cm Arc Angle = 105 degrees Using the diameter formula for Arc Length calculation, Arc Length (L) = (θ/360°) × π × d = L = (105°/360°) × π × 10 = L = 105π/36 cm. Example 4: The door width is 1500mm, the side height is 1950mm and total height at center is 2200mm. Find the radius of Arc. Solution: The Arc width is 1500mm The Arc height is 2200 – 1950 = 250mm Radius of Arc can be calculated as: Radius = (250² + (1500/2)²)/2 × 250 = Radius = 312.5cm Practice Questions on Arc Q1. If the angle formed by an Arc is π/32 in a circle with radius equal to 3 unit. What will be the length of Arc? Q2. The radius of the circle is 10 cm and the Arc formed 75° at the center. What is the length of the Arc? Q3. What is the length of an Arc if the angle formed by the circle is 75 degrees with a radius of 10 cm? Q4. Determine the length of an Arc if the arc formed by it is π/64 in a circle, given the side height is equal to 32 units. Q5. The door width is 2500mm, the side height is 2950mm and total height at center is 3200mm. Find the radius of Arc. In mathematics, an arc is defined as a portion of the boundary of a circle or a curve. It can also be referred to as an open curve. The boundary of a circle is the perimeter or the distance around a circle, also known as the circumference. So, the arc is the distance between any two points traced along its circumference. Let us understand this with the help of an example: In this figure, the distance between points A and B is an arc traced along the circumference of the circle. You can call it arc AB. An arc is denoted by the symbol ˆ. So, the arc AB can be written as ˆAB. You can also write it as ˆBA. The order of the points does not matter. Classify Shapes According to their Hierarchy Game Play More Games To make an arc, you either need a chord or a central angle. A chord is a line segment that joins any two points on a circle. A central angle is an angle between any two radii of the circle. For instance, the central angle in the diagram between the radii QA and QB, as shown below, is 60°. You must have noticed that an arc divides a circle into two parts. One has a shorter distance between the two endpoints (minor arc), while the other has a longer distance (major arc). Unless specified, an arc will always be considered a minor arc. 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 Example 2: Calculate the length of the arc that subtends an angle of 40 degrees at the center of a circle with a radius of 6 cm. Solution: We know the arc length formula is

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Today, we're going to explore a wonderful concept in the world of geometry – the Arc. Just as every great adventure begins with a single step, every circle starts with an arc. If you've ever drawn a circle and stopped halfway, you've drawn an arc. As simple as it may seem, the arc is a foundational idea in geometry, with numerous practical applications in the world around us. By the end of this exploration, you and your child will have a complete understanding of what an arc is, its characteristics, and how to work with it in mathematical calculations. So, buckle up, and let's delve into the exciting world of arcs! What is Arc in Math? Picture a circle. You got it? Now imagine cutting out a slice of it like a piece of a delicious pie. That slice, or the curve along the edge of your circle "piece," is what we call an Arc. In mathematical terms, an arc is a portion of the circumference of a circle. It's like a bridge connecting two points on the circle's boundary. This might seem simple, but the concept of an arc is used in many complex calculations, which we will explore. Arc Length Formula The Arc Length Formula is a tool that helps us figure out how "long" an arc is. In other words, it tells us the distance along the curve of the arc. In simple terms, if you were to walk along the path of the arc, the arc length is the distance you would travel. The formula to calculate the arc length (L) is: L = θr where: θ is the central angle (in degrees) r is the radius of the circle Arc Length Formula in Radians Hold up! We've got another way to measure the central angle, and it's called Radians. When the angle is measured in radians, the formula to calculate the arc length (L) becomes: L = θr where: θ is the central angle (in radians) r is the radius of the circle See? The formula stays the same. The only thing that changes is how we measure the angle. Don't worry; we'll get into more details about degrees and radians later on. How to Find Arc Length of a Curve? Finding the arc length of a curve might seem like a daunting task. But don't worry, it's not that difficult! The arc length of a curve in a plane from a point A(x1, y1) to a point B(x2, y2) can be calculated using calculus and is often denoted as S. The formula for arc length of a curve is: S = ∫√(1 + (dy/dx)²) dx from x1 to x2 Remember, this formula requires some understanding of calculus, so make sure to study that first! How to Find Arc Length With the Radius and Central Angle? To find the arc length with the radius and the central angle, you use the formula L = θr, as we mentioned before. You need to be cautious about whether your angle θ is in degrees or radians, as this will affect your calculations. How to Find Arc Length Without the Radius? If we want to find the arc length but don't know the radius, we need to use other information. For example, if we know the diameter (d), we can divide it by 2 to get the radius (r = d/2), then plug this into our formula. In some cases, we might need to use trigonometry to solve the problem. How to Find Arc Length Without the Central Angle? Finding the arc length without the central angle requires some geometry and trigonometry. If you know the radius and the length of the chord, you can use the Pythagorean theorem to find the central angle. Once you have the angle, you can use the arc length formula L = θr. Arc of a Circle The Arc of a Circle is just the term used to refer to any arc that is a part of a circle. It could be a small part of the edge or half the circle or even the entire circle itself! Symbol of Arc The symbol of arc in geometry is a small arc drawn over two points which indicate the ends of the arc. This symbol (⌢) is used in geometry to represent an arc. Measures of an Arc There are two main Measures of an Arc: The length of the arc (which we've been discussing all along). The measure of the arc's central angle. Both of these measures can be important depending on what we're trying to calculate. Angle of the Arc The Angle of the Arc is simply the angle that is formed at the center of the circle by the two radii that connect to the endpoints of the arc. Arc Length Formula We have mentioned the Arc Length Formula earlier, but just to reiterate, the formula is L = θr, where θ is the angle (in degrees or radians) and r is the radius. When the angle is in radians As mentioned before, when the angle is in radians, the arc length formula doesn't change. It's still L = θr. The only thing that changes is how we measure the angle. Solved Examples on Arc Length Let's dive into some Solved Examples on Arc Length: If we have a circle with a radius of 5 cm and the central angle of 60 degrees, the arc length would be: L = θr = (60/360) * 2π * 5 = π/3 cm. If the central angle is 1 radian and the radius is 2 cm, the arc length would be: L = θr = 1 * 2 = 2 cm. Practice Problems on Arc Length It's time to put your knowledge into practice with some Practice Problems on Arc Length: Find the arc length of a circle with a radius of 3 cm and a central angle of 90 degrees. Find the arc length of a circle with a radius of 7 cm and a central angle of 2 radians. Remember, practice makes perfect! Conclusion What an incredible journey we've been on together! We hope this comprehensive guide has helped to illuminate the concept of arcs for you and your child. Here at Brighterly, we believe that understanding complex ideas starts with grasping the basic concepts, and we're confident that we've achieved that today with our deep dive into arcs. The knowledge of what an arc is, how to measure its length, and how to work with it in mathematical calculations will set the stage for your child to comprehend more advanced topics in geometry. As they continue to explore the amazing world of math, remember that each new concept is like an arc in their growing circle of understanding. Keep practicing, keep asking questions, and keep discovering, because every bright idea brings your child one step closer to their next great discovery! Frequently Asked Questions on Arc Length Can the arc length be greater than the circumference of the circle? No, the arc length can never be greater than the circumference of the circle. The longest possible arc of a circle is the circumference itself, which happens when the arc spans the entire circle. How is the arc length formula derived? The arc length formula is derived from the proportion between the angle subtended by the arc at the center of the circle and the total angle at the center of the circle, which is 360 degrees or 2π radians. So, if the angle subtended by the arc is θ degrees or radians, the length of the arc (L) is a fraction of the total circumference, given by L = θ/360 * 2πr (in degrees) or L = θ * r (in radians). What is the difference between arc length and chord length? The arc length and chord length are both distances, but they measure different things. The arc length is the distance along the curve of the arc from one endpoint to the other, while the chord length is the straight-line distance between the two endpoints of the arc. For a given arc, the arc length is always equal to or greater than the chord length. Information sources: Poor Level Weak math proficiency can lead to academic struggles, limited college, and career options, and diminished self-confidence. Mediocre Level Weak math proficiency can lead to academic struggles, limited college, and career options, and diminished self-confidence. Needs Improvement Start practicing math regularly to avoid your child's math scores dropping to C or even D. High Potential It's important to continue building math proficiency to make sure your child outperforms peers at school. Jo-ann Caballes 13 articles