# Is It Possible To Form A Triangle Whose Sides Are 3.5 Cm 4.5 Cm 7.5 Cm Long?

**Is It Possible To Form A Triangle Whose Sides Are 3.5 Cm 4.5 Cm 7.5 Cm Long?**

When exploring the fascinating world of geometry, one of the fundamental questions that often arises is whether a set of given lengths can form a triangle. Specifically, for the side lengths 3.5 centimeters, 4.5 centimeters, and 7.5 centimeters, it’s essential to analyze if these measurements satisfy the necessary conditions to create a valid triangle. This inquiry not only helps in understanding the properties and constraints of triangles but also enhances problem-solving skills in geometry. This article delves into the criteria for forming triangles, applies them to these specific lengths, and discusses the implications and related concepts.

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## Understanding the Triangle Inequality Theorem

One of the foundational principles in geometry related to the formation of triangles is the Triangle Inequality Theorem. This theorem states that for any three side lengths to form a triangle, the sum of the lengths of any two sides must be greater than the length of the remaining side.

### Statement of the Triangle Inequality Theorem

- For three sides $a$, $b$, and $c$ to form a triangle:

1. $a + b > c$
2. $a + c > b$
3. $b + c > a$

If all three inequalities are satisfied, then the three lengths can form a triangle. If any one of these inequalities fails, the lengths cannot form a triangle, and the shape will be degenerate (a straight line).

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## Applying the Triangle Inequality to 3.5 cm, 4.5 cm, and 7.5 cm

Let's analyze the given side lengths:

- $a = 3.5\, \text{cm}$
- $b = 4.5\, \text{cm}$
- $c = 7.5\, \text{cm}$

Now, check each of the three inequalities:

### 1. Sum of the two smaller sides > the largest side

- $a + b = 3.5 + 4.5 = 8.0\, \text{cm}$
- The largest side is $c = 7.5\, \text{cm}$

Check:

$$
a + b > c \quad \Rightarrow \quad 8.0 > 7.5 \quad \text{(True)}
$$

## 2. Sum of $a$ and $c$ > $b$

- $a + c = 3.5 + 7.5 = 11.0\, \text{cm}$
- $b = 4.5\, \text{cm}$

Check:

$$
a + c > b \quad \Rightarrow \quad 11.0 > 4.5 \quad \text{(True)}
$$

## 3. Sum of $b$ and $c$ > $a$

- $b + c = 4.5 + 7.5 = 12.0\, \text{cm}$
- $a = 3.5\, \text{cm}$

Check:

$$
b + c > a \quad \Rightarrow \quad 12.0 > 3.5 \quad \text{(True)}
$$

Since all three inequalities hold true, the given lengths can indeed form a triangle.

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# Conclusion: Can a Triangle Be Formed?

Based on the application of the Triangle Inequality Theorem, the side lengths 3.5 cm, 4.5 cm, and 7.5 cm satisfy all the necessary conditions. Therefore, it is possible to form a triangle with these side lengths.

This triangle would be a scalene triangle, as all sides are of different lengths, and it would have an area that can be calculated if needed.

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# Additional Considerations in Triangle Formation

While the basic Triangle Inequality Theorem confirms the possibility of forming a triangle, there are other factors and properties worth considering, especially in more complex scenarios.

## Types of Triangles Based on Side Lengths

- Equilateral Triangle: All three sides are equal.
- Isosceles Triangle: Two sides are equal.
- Scalene Triangle: All sides are unequal.

Given our side lengths, the triangle formed would be scalene.

## Types of Triangles Based on Angles

- Acute Triangle: All angles less than 90°.
- Right Triangle: One angle exactly 90°.
- Obtuse Triangle: One angle greater than 90°.

To determine the angles, the Law of Cosines can be employed, which is particularly useful for non-right triangles.

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# Calculating the Area of the Triangle

Once confirmed that the sides can form a triangle, calculating its area provides further insight into its size and properties.

## Using Heron's Formula

Heron's formula states that for a triangle with sides $a$, $b$, and $c$, the area $A$ is:

$$
A = \sqrt{s(s - a)(s - b)(s - c)}
$$

where $s$ is the semi-perimeter:

$$
s = \frac{a + b + c}{2}
$$

Calculations:

- $a = 3.5\, \text{cm}$
- $b = 4.5\, \text{cm}$
- $c = 7.5\, \text{cm}$

Semi-perimeter:

$$
s = \frac{3.5 + 4.5 + 7.5}{2} = \frac{15.5}{2} = 7.75\, \text{cm}
$$

Area:

$$
A = \sqrt{7.75(7.75 - 3.5)(7.75 - 4.5)(7.75 - 7.5)}
$$

$$
A = \sqrt{7.75 \times 4.25 \times 3.25 \times 0.25}
$$

Calculate step-by-step:

1. $7.75 \times 4.25 = 32.9375$
2. $32.9375 \times 3.25 = 107.234375$
3. $107.234375 \times 0.25 = 26.80859375$

Now, take the square root:

$$
A \approx \sqrt{26.8086} \approx 5.18\, \text{cm}^2
$$

Thus, the triangle’s area is approximately 5.18 square centimeters.

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## Implications for Geometry and Real-World Applications

Understanding whether specific side lengths can form a triangle is fundamental in many real-world applications, including engineering, architecture, and design.

Key implications include:

- Design and Construction: Ensuring structural components can assemble into valid triangles for stability.
- Navigation and Surveying: Using triangles in triangulation methods to measure distances accurately.
- Computer Graphics: Modeling shapes and ensuring polygons are valid for rendering.

The ability to verify the possibility of forming a triangle with given lengths simplifies many practical tasks.

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## Summary of Key Points

- The Triangle Inequality Theorem is essential for determining if a set of lengths can form a triangle.
- For lengths 3.5 cm, 4.5 cm, and 7.5 cm, all inequalities are satisfied.
- Therefore, these lengths can form a valid, scalene triangle.
- The area of this triangle can be calculated using Heron's formula, yielding approximately 5.18 $cm^2$.
- Recognizing triangle properties is vital in various scientific and engineering fields.

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## Final Thoughts

In conclusion, based on the mathematical analysis, it is indeed possible to form a triangle with side lengths of 3.5 centimeters, 4.5 centimeters, and 7.5 centimeters. This example underscores the importance of the Triangle Inequality Theorem in geometry, providing a straightforward yet powerful method to assess the feasibility of triangle formation. Whether for academic purposes or practical applications, understanding these principles enhances problem-solving skills and supports effective design and analysis in numerous disciplines.

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Keywords: triangle formation, triangle inequality theorem, side lengths, 3.5 cm, 4.5 cm, 7.5 cm, Heron's formula, geometry, scalene triangle, area calculation, triangle properties

## Frequently Asked Questions

### Can a triangle be formed with sides measuring 3.5 cm, 4.5 cm, and 7.5 cm?

No, these sides cannot form a triangle because they do not satisfy the triangle inequality theorem, as the sum of the two smaller sides (3.5 cm + 4.5 cm = 8 cm) is greater than the largest side (7.5 cm). However, since 3.5 + 4.5 = 8 cm > 7.5 cm, it actually satisfies the inequality. Therefore, yes, a triangle can be formed with these side lengths.

## What is the triangle inequality theorem, and how does it apply here?

The triangle inequality theorem states that the sum of the lengths of any two sides of a triangle must be greater than the length of the remaining side. In this case, $3.5 + 4.5 = 8 > 7.5$, so the sides satisfy the theorem, and a triangle can be formed.

## Are the side lengths 3.5 cm, 4.5 cm, and 7.5 cm valid for constructing a triangle?

Yes, because the sum of the two smaller sides ($3.5 + 4.5 = 8$) is greater than the largest side (7.5), fulfilling the necessary condition for triangle formation.

## What type of triangle would these side lengths form?

Since the sides are of different lengths, the triangle would be scalene, with no sides equal.

## Can these side lengths form a right-angled triangle?

To determine if it's right-angled, check if the Pythagorean theorem holds: $3.5^2 + 4.5^2 = 7.5^2$. Calculating: $12.25 + 20.25 = 32.5$, while $7.5^2 = 56.25$. Since $32.5 \neq 56.25$, it is not a right-angled triangle.

## What is the importance of the side lengths in triangle formation?

Side lengths determine whether a set of segments can form a triangle based on the triangle inequality theorem. They also influence the type of triangle (acute, obtuse, or right-angled) and its properties.

# Additional Resources

Is It Possible To Form A Triangle Whose Sides Are 3.5 Cm, 4.5 Cm, 7.5 Cm Long?

When exploring the fascinating world of geometry, one of the fundamental questions often posed is whether a set of three lengths can form a triangle. This query becomes particularly intriguing when the lengths are non-integer and seemingly close to each other but vary significantly. Today, we delve into the specific case of whether a triangle can be formed with side lengths of 3.5 centimeters, 4.5 centimeters, and 7.5 centimeters. Understanding this involves revisiting the core principles of triangle formation and applying them to these particular measurements.

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The Triangle Inequality Theorem: The Cornerstone of Triangle Formation

At the heart of determining whether three lengths can constitute a triangle is the Triangle Inequality Theorem. This fundamental principle states:

For any three line segments to form a triangle, the sum of the lengths of any two sides must be strictly greater than the length of the remaining side.

In more concrete terms, if the sides are labeled a, b, and c, then the following must hold true:

- $a + b > c$
- $a + c > b$
- $b + c > a$

If all three conditions are satisfied, then the three lengths can indeed form a triangle. Conversely, if any one of these inequalities fails, forming a triangle is impossible with those measurements.

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Applying the Triangle Inequality to 3.5 cm, 4.5 cm, and 7.5 cm

Let's assign the side lengths as follows:

- a = 3.5 cm
- b = 4.5 cm
- c = 7.5 cm

Now, applying the Triangle Inequality Theorem:

1. Check if a + b > c

3.5 + 4.5 = 8.0

Is 8.0 > 7.5? Yes, this condition is satisfied.

2. Check if a + c > b

3.5 + 7.5 = 11.0

Is 11.0 > 4.5? Yes, this condition is satisfied.

3. Check if b + c > a

4.5 + 7.5 = 12.0

Is 12.0 > 3.5? Yes, this condition is satisfied.

Since all three inequalities hold true, the side lengths 3.5 cm, 4.5 cm, and 7.5 cm satisfy the Triangle Inequality Theorem.

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Is the Triangle Scalene, Isosceles, or Equilateral?

Having established that these side lengths can form a triangle, it's interesting to classify the type:

- Scalene Triangle: All sides are of different lengths.

In this case: 3.5 cm, 4.5 cm, and 7.5 cm are all distinct, so the triangle would be scalene.

- Isosceles Triangle: Exactly two sides are equal.

Not applicable here, as all sides are different.

- Equilateral Triangle: All sides are equal.

Also not applicable here.

Therefore, the triangle formed with these dimensions is a scalene triangle.

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Visualizing the Triangle and Practical Considerations

While mathematically these lengths can form a triangle, visualizing or physically constructing one involves some practical considerations:

- Scale and Construction:

Building the triangle with these specific measurements requires precise tools such as a ruler or calipers.

- Material Flexibility:

If attempting to form a triangle using flexible materials, the side lengths can be maintained accurately. For rigid materials, precise measurement and cutting are essential.

- Angles and Area:

With side lengths known, the angles can be calculated using the Law of Cosines, providing further insight into the shape of the triangle.

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Calculating the Triangle's Angles

Knowing side lengths allows us to compute the internal angles:

Law of Cosines Formula:

For angle A opposite side a:

$A = \arccos[(b^2 + c^2 - a^2) / (2bc)]$

Similarly for angles B and C.

Let's compute angle A, opposite side a = 3.5 cm:

$A = \arccos[(b^2 + c^2 - a^2) / (2bc)]$

Plugging in the values:

b = 4.5 cm

c = 7.5 cm

Calculate numerator:

$b^2 + c^2 - a^2 = (4.5)^2 + (7.5)^2 - (3.5)^2$

$= 20.25 + 56.25 - 12.25$

$= 64.25$

Calculate denominator:

2 b c = 2 4.5 7.5 = 2 33.75 = 67.5

Now, compute:

$A = \arccos(64.25 / 67.5) \approx \arccos(0.952) \approx 17.3°$

Similarly, for angle B:

$B = \arccos[(a^2 + c^2 - b^2) / (2ac)]$

Compute numerator:

$(3.5)^2 + (7.5)^2 - (4.5)^2 = 12.25 + 56.25 - 20.25 = 48.25$

Compute denominator:

2 3.5 7.5 = 2 26.25 = 52.5

Thus:

$B \approx \arccos(48.25 / 52.5) \approx \arccos(0.918) \approx 24.2°$

And for angle C:

$C = \arccos[(a^2 + b^2 - c^2) / (2ab)]$

Numerator:

$12.25 + 20.25 - 56.25 = -23.75$

Denominator:

2 3.5 4.5 = 2 15.75 = 31.5

Calculate:

C □ arccos(-23.75 / 31.5) □ arccos(-0.754) □ 138.7°

Note: The sum of angles:

17.3° + 24.2° + 138.7° □ 180°, confirming the calculations.

This analysis underscores that the triangle would be quite obtuse, with a large angle approximately 138.7°, consistent with the side length ratios.

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Broader Implications and Real-World Applications

Understanding whether specific lengths can form a triangle isn’t just an academic exercise; it has practical relevance in various fields:

- Engineering and Construction:
Ensuring that parts or supports can fit together to form stable structures.

- Navigation and Cartography:
Triangular measurements are foundational in triangulation for mapping.

- Computer Graphics:
Rendering and modeling often involve forming triangles from vertices.

- Educational Contexts:
Demonstrating fundamental geometric principles to students.

In everyday life, being able to quickly verify whether three lengths can form a triangle can aid in problem-solving, design, and creative projects.

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Conclusion: The Short Answer and Key Takeaways

Based on the application of the Triangle Inequality Theorem, the answer is clear: Yes, it is possible to form a triangle with side lengths of 3.5 cm, 4.5 cm, and 7.5 cm. All the necessary inequalities are satisfied, and the sides can indeed come together to create a valid triangle.

However, this conclusion also exemplifies a broader lesson in geometry: the importance of fundamental principles. The Triangle Inequality Theorem provides a simple yet powerful tool for assessing the feasibility of triangle formation. Whether dealing with everyday objects or complex engineering structures, understanding these core concepts ensures accurate analysis and innovative problem-solving.

So, next time you encounter three lengths and wonder if they can form a triangle, remember to check those inequalities—your mathematical intuition will thank you!

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