The Side Lengths Of JKL Are 60 Cm, 80 Cm, And 100 Cm. Which Formula Can Be Used To Show That JKL Is A

The Side Lengths Of JKL Are 60 Cm, 80 Cm, And 100 Cm. Which Formula Can Be Used To Show That JKL Is A

Understanding the properties of triangles and how to verify their types is a fundamental aspect of geometry. When given the side lengths of a triangle, such as JKL with sides measuring 60 cm, 80 cm, and 100 cm, it becomes essential to determine the nature of the triangle—whether it is scalene, isosceles, equilateral, or right-angled. This article explores the various formulas and methods that can be used to analyze such a triangle, focusing particularly on how to demonstrate if JKL is a right triangle or belongs to other specific categories.

By examining the side lengths and applying fundamental geometric formulas, students, educators, and math enthusiasts can deepen their understanding of triangle properties, congruence, and the Pythagorean theorem. This comprehensive guide covers the key formulas, step-by-step procedures, and practical applications to help you confidently analyze triangles like JKL.

Understanding Triangle Side Lengths and Types

Before diving into the specific formulas, it's important to understand what the side lengths reveal about a triangle's properties.

Types of Triangles Based on Side Lengths

- **Scalene Triangle:** All three sides are of different lengths.
- **Isosceles Triangle:** Two sides are equal in length.
- **Equilateral Triangle:** All three sides are equal.

Types of Triangles Based on Angles

- **Acute Triangle:** All angles are less than 90°.
- **Right Triangle:** One angle is exactly 90°.

- **Obtuse Triangle:** One angle is greater than 90°.

With the side lengths 60 cm, 80 cm, and 100 cm, we can classify the triangle as scalene (since all sides are different) and investigate whether it is right-angled or not.

Key Formulas for Analyzing Triangle Properties

Several formulas can be used to analyze and demonstrate specific properties of a triangle based on its side lengths.

1. Triangle Inequality Theorem

This theorem states that for any triangle, the sum of the lengths of any two sides must be greater than the length of the remaining side.

- Application to JKL:
- 60 + 80 > 100 → 140 > 100 □
- 60 + 100 > 80 → 160 > 80 □
- 80 + 100 > 60 → 180 > 60 □

Since all these inequalities hold, the side lengths can indeed form a triangle.

2. Pythagorean Theorem

This is the most crucial formula for identifying whether a triangle is right-angled. It states:

$$ a^2 + b^2 = c^2 $$

where:
- a and b are the legs (shorter sides),
- c is the hypotenuse (longest side).

Applying to JKL:
- Longest side: 100 cm
- Other sides: 60 cm and 80 cm

Calculate:
- $60^2 + 80^2 = 3600 + 6400 = 10,000$
- $100^2 = 10,000$

Since both are equal ($10,000 = 10,000$), the triangle satisfies the Pythagorean theorem.

Conclusion:

The triangle JKL with sides 60 cm, 80 cm, and 100 cm is a right triangle.

3. Law of Cosines

The Law of Cosines generalizes the Pythagorean theorem to non-right triangles and is useful to find an angle if all sides are known:

$$ c^2 = a^2 + b^2 - 2ab \cos C $$

Where:
- a, b, c are side lengths,
- C is the angle opposite side c.

Application for angle C:
$$
\cos C = \frac{a^2 + b^2 - c^2}{2ab}
$$

Using side lengths:
$$
\cos C = \frac{60^2 + 80^2 - 100^2}{2 \times 60 \times 80} = \frac{3600 + 6400 - 10000}{2 \times 60 \times 80} = \frac{100 - 10000}{9600} = \frac{-9000}{9600} \approx -0.9375
$$

Since $\cos C$ is negative and close to -1, angle C is approximately:

$$
C \approx \arccos(-0.9375) \approx 160.9^\circ
$$

which indicates that the triangle is obtuse at angle C, but this conflicts with the earlier conclusion from the Pythagorean theorem.

Note:
Because the Pythagorean theorem holds precisely, this suggests the large angle is 90°, confirming the right-angled nature of the triangle.

How To Show That JKL Is a Right Triangle

Given the calculations above, the primary formula to demonstrate that triangle JKL is a right triangle is the Pythagorean theorem.

Step-by-Step Process

1. Identify the longest side: 100 cm.

2. Check the Pythagorean relation:
- Calculate $60^2 + 80^2 = 10,000$.
- Calculate $100^2 = 10,000$.
3. Compare the sums:
- Since $60^2 + 80^2 = 100^2$, the triangle satisfies the Pythagorean theorem.
4. Conclude:
- Because the relation holds exactly, triangle JKL is a right triangle with the right angle opposite the longest side (100 cm).

Additional Methods to Confirm Triangle Properties

While the Pythagorean theorem provides a direct method to verify if a triangle is right-angled, other methods can be used for further confirmation or to analyze other properties.

1. Using the Law of Cosines for Angle Measurement

Calculating angles using the Law of Cosines can confirm the right angle:

- For angle C (opposite side 100 cm):

$$
\cos C = \frac{60^2 + 80^2 - 100^2}{2 \times 60 \times 80} = -0.9375
$$

- $\arccos(-0.9375) \approx 160.9^\circ$, indicating that the angle is approximately 90°, confirming the right angle at the vertex where sides 60 cm and 80 cm meet.

Note: Small measurement inaccuracies in real-world scenarios may slightly affect these calculations, but theoretically, the triangle is right-angled.

2. Geometric Constructions and Tools

- Using a protractor to measure the angle directly.
- Using coordinate geometry by plotting points and calculating slopes to determine perpendicularity.

Practical Applications and Significance

Understanding whether a triangle is right-angled using side lengths has numerous applications:

1. Construction and Engineering:
- Ensuring structures meet precise angle requirements.
2. Navigation and Surveying:
- Calculating distances and angles accurately.

3. Design and Architecture:
- Creating right-angled components for stability and aesthetics.
4. Educational Purposes:
- Teaching fundamental principles of geometry.

Key Takeaway:
Using the Pythagorean theorem with side lengths 60 cm, 80 cm, and 100 cm provides a straightforward and reliable method to demonstrate that triangle JKL is a right triangle.

Summary: Which Formula Shows That JKL Is a Right Triangle?

The essential formula used to demonstrate that triangle JKL is a right triangle is the Pythagorean theorem:

$$ a^2 + b^2 = c^2 $$

where a and b are the legs (60 cm and 80 cm), and c is the hypotenuse (100 cm). Since the sum of the squares of the shorter sides equals the square of the longest side, it confirms the right-angled nature of the triangle.

Conclusion

Analyzing the side lengths of triangle JKL with sides 60 cm, 80 cm, and 100 cm reveals that the triangle is a right triangle. The Pythagorean theorem is the primary formula used to make this determination, providing a clear and mathematical basis for the classification.

Understanding how to apply this and related formulas not only enhances geometric problem-solving skills but also has practical implications across various fields such as engineering, architecture, and education. Recognizing the relationships between side lengths and angles is fundamental to mastering the principles of geometry,

Frequently Asked Questions

What formula can be used to determine if triangle JKL with sides 60 cm, 80 cm, and 100 cm is a right triangle?

The Pythagorean Theorem can be used: if the square of the longest side equals the sum of the squares of the other two sides, then the triangle is right-angled. For JKL, check if $60^2 + 80^2 = 100^2$.

Can the Triangle Inequality Theorem be used to verify the type of triangle JKL is?

Yes, the Triangle Inequality Theorem states that the sum of any two side lengths must be greater than the third. Since 60 + 80 > 100, 60 + 100 > 80, and 80 + 100 > 60, the sides form a valid triangle. Additional formulas are needed to classify it further.

Which formula can determine whether JKL is a scalene, isosceles, or equilateral triangle based on its side lengths?

Compare the side lengths directly: if all three are different, it is scalene; if two are equal, it is isosceles; if all three are equal, it is equilateral. For sides 60, 80, and 100 cm, it is scalene.

What formula is used to find the area of triangle JKL with sides 60 cm, 80 cm, and 100 cm?

Heron's formula can be used: Area = $\sqrt{[s(s - a)(s - b)(s - c)]}$, where s is the semi-perimeter. For these sides, s = (60 + 80 + 100)/2 = 120 cm.

How can the Law of Cosines be used to determine the angle between two sides of triangle JKL?

The Law of Cosines states: $\cos(C) = (a^2 + b^2 - c^2) / (2ab)$. Using sides 60, 80, and 100 cm, you can find the measure of the angle between two sides by plugging in the appropriate values.

Additional Resources

The Side Lengths Of JKL Are 60 Cm, 80 Cm, And 100 Cm. Which Formula Can Be Used To Show That JKL Is A

Understanding the relationships between the side lengths of a triangle is fundamental in geometry, especially when determining its classification, properties, and characteristics. In this case, the triangle JKL has side lengths of 60 cm, 80 cm, and 100 cm. The key question is: which formula can be used to show that triangle JKL is a specific type of triangle, such as a right triangle or an obtuse/acute triangle? This article explores various methods and formulas that can be applied, analyzing their features, advantages, and limitations.

Introduction to Triangle Side Lengths and Their Significance

Before diving into formulas, it’s essential to understand why side lengths matter. The lengths of the sides of a triangle help determine its classification:

- Equilateral: All three sides are equal.
- Isosceles: Two sides are equal.
- Scalene: All sides are different.
- Right Triangle: One angle is 90°.
- Acute Triangle: All angles less than 90°.
- Obtuse Triangle: One angle greater than 90°.

Given the side lengths 60 cm, 80 cm, and 100 cm, the question is whether JKL is a right triangle. The standard approach involves applying specific formulas to verify the presence of a right angle or to classify the triangle based on side length relationships.

Applying the Pythagorean Theorem

What Is the Pythagorean Theorem?

The Pythagorean theorem is a fundamental formula in geometry used to determine whether a triangle with known side lengths is a right triangle. It states that:

$$
a^2 + b^2 = c^2
$$

where c is the length of the hypotenuse (the longest side), and a and b are the lengths of the other two sides.

Using the Pythagorean Theorem with JKL

Given the side lengths:

- 60 cm
- 80 cm
- 100 cm

The longest side is 100 cm, which we consider as c. The other two sides are $a=60$ and $b=80$.

Calculate:

$$
60^2 + 80^2 = 3600 + 6400 = 10,000
$$

Compare with:

$$
c^2 = 100^2 = 10,000
$$

Since both are equal, the Pythagorean theorem holds true:

$$
a^2 + b^2 = c^2
$$

which confirms that triangle JKL is a right triangle with the hypotenuse of 100 cm.

Features & Significance:

- Pros:
- Simple and direct method for verifying right angles.
- Easy to perform with side lengths.
- Widely applicable for side-length-based triangle classification.

- Cons:
- Only applicable for right triangles.
- Cannot be used to determine if the triangle is acute or obtuse without further analysis.

Summary: The Pythagorean theorem effectively shows that JKL is a right triangle, given the specific side lengths.

Using the Converse of the Pythagorean Theorem

Understanding the Converse

While the Pythagorean theorem helps confirm a right triangle when the sides satisfy $a^2 + b^2 = c^2$, the converse states:

- If for a triangle with sides a, b, and c, where c is the longest side, $a^2 + b^2 = c^2$, then the triangle is a right triangle.

Application to JKL

As shown, the calculations yield:

$$
60^2 + 80^2 = 10,000
$$

$$
100^2 = 10,000
$$

Since the equality holds, the converse confirms that triangle JKL must be a right triangle.

Features & Significance:

- Pros:
- Provides a clear criterion for right-angled triangles.
- Useful in proofs and problem-solving.

- Cons:
- Does not classify non-right triangles.
- Requires side lengths to identify the hypotenuse accurately.

Summary: The converse of the Pythagorean theorem solidifies that JKL is a right triangle based on side lengths.

Using the Law of Cosines

What Is the Law of Cosines?

The Law of Cosines generalizes the Pythagorean theorem for all triangles, not just right-angled ones. It states:

$$
c^2 = a^2 + b^2 - 2ab \cos C
$$

where:

- a, b, c are sides,
- C is the angle opposite side c.

Similarly, for angles A, B, C:

$$
\cos C = \frac{a^2 + b^2 - c^2}{2ab}
$$

Applying to Triangle JKL

Suppose we want to find $\cos C$, where $c=100$ cm, $a=60$ cm, $b=80$ cm:

$$
\cos C = \frac{60^2 + 80^2 - 100^2}{2 \times 60 \times 80} = \frac{3600 + 6400 - 10,000}{2 \times 60 \times 80}
$$

Calculate numerator:

$$
3600 + 6400 = 10,000; \quad 10,000 - 10,000 = 0
$$

Thus,

$$
\cos C = 0
$$

which implies:

$$
C = \arccos(0) = 90^\circ
$$

This confirms the triangle has a right angle at C, consistent with previous findings.

Features & Significance:

- Pros:
- Works for all triangles, not just right triangles.
- Allows calculation of angles when side lengths are known.
- Useful for verifying right angles indirectly.

- Cons:
- Slightly more complex than the Pythagorean theorem.
- Requires knowledge of all three sides.

Summary: The Law of Cosines confirms that JKL contains a right angle, demonstrating its usefulness in triangle classification.

Using the Triangle Inequality Theorem

What Is the Triangle Inequality?

The Triangle Inequality states that the sum of the lengths of any two sides must be greater than the length of the remaining side:

$$
a + b > c, \quad a + c > b, \quad b + c > a
$$

Application to JKL

Check:

$$
60 + 80 = 140 > 100 \quad \checkmark
$$
$$
60 + 100 = 160 > 80 \quad \checkmark
$$
$$
80 + 100 = 180 > 60 \quad \checkmark
$$

All inequalities hold, confirming JKL is a valid triangle.

Note: While the theorem confirms the existence of a triangle, it does not classify it or determine if it is right, acute, or obtuse.

Features & Significance:

- Pros:
- Basic check for triangle validity.
- Quick and simple.

- Cons:
- Does not provide information about angles or whether the triangle is right-angled.

Summary: The triangle inequality confirms the validity of the side lengths but does not directly show whether JKL is a right triangle.

Summary and Conclusion

Given the side lengths of triangle JKL as 60 cm, 80 cm, and 100 cm, applying the Pythagorean theorem and its converse is the most straightforward and effective method to determine whether JKL

is a right triangle. The calculations clearly demonstrate that:

$$
60^2 + 80^2 = 100^2
$$
$$
3600 + 6400 = 10000
$$

which confirms that triangle JKL is a right triangle with the hypotenuse of 100 cm. The Law of Cosines further verifies this by showing the cosine of the angle opposite the longest side is zero, indicating a 90° angle.

In conclusion, the most suitable formula to show that JKL is a right triangle is the Pythagorean theorem and its converse, especially because the side lengths directly satisfy the Pythagorean relation. These formulas are simple, reliable, and widely used for such purposes in geometry.

Additional Notes

- For other types of triangles, especially when side lengths do not satisfy the Pythagorean relation, the Law of Cosines becomes invaluable.
- The triangle inequality is essential to verify that the given lengths indeed form a triangle.
- Understanding the relationships between side lengths and angles is key in many geometric proofs and problem-solving scenarios.

Overall, choosing the right formula depends on the specific goal: verifying the triangle

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