Which Set Of Side Lengths Forms A Right Triangle?O2, 3, 13O4, 6, 10O 9, 12, 18O 15, 36, 39

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Introduction

Understanding the properties of right triangles is fundamental in geometry. A right triangle is a triangle that has one angle exactly 90 degrees. Identifying whether a set of three side lengths can form a right triangle involves applying the Pythagorean theorem, which states that in a right triangle, the square of the hypotenuse (the longest side) equals the sum of the squares of the other two sides. In this article, we analyze four given sets of side lengths to determine which, if any, form a right triangle.

Understanding the Pythagorean Theorem

The Basic Principle

The Pythagorean theorem is expressed as:

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

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

Application of the Theorem

Given any three side lengths, to test if they form a right triangle:
1. Identify the longest side; assume this is the hypotenuse.
2. Check if the square of the hypotenuse equals the sum of the squares of the other two sides.
3. If the equation holds true, the sides form a right triangle.

Analysis of the Given Sets of Side Lengths

Set 1: 2, 3, 13

Step 1: Identify the hypotenuse
- The longest side is 13.

Step 2: Calculate squares
- $13^2 = 169$
- $2^2 = 4$
- $3^2 = 9$
- Sum of squares of the other two sides: 4 + 9 = 13

Step 3: Compare
- $169 \neq 13$

Conclusion
- Since $169 \neq 13$, the sides 2, 3, and 13 do not form a right triangle.

Set 2: 4, 6, 10

Step 1: Identify the hypotenuse
- Longest side: 10

Step 2: Calculate squares
- $10^2 = 100$
- $4^2 = 16$
- $6^2 = 36$
- Sum: 16 + 36 = 52

Step 3: Compare
- $100 \neq 52$

Conclusion
- The sides 4, 6, and 10 do not form a right triangle.

Set 3: 9, 12, 18

Step 1: Identify the hypotenuse
- Longest side: 18

Step 2: Calculate squares
- $18^2 = 324$
- $9^2 = 81$

- $12^2 = 144$
- Sum: 81 + 144 = 225

Step 3: Compare
- 324 ≠ 225

Conclusion
- The sides 9, 12, and 18 do not form a right triangle.

Set 4: 15, 36, 39

Step 1: Identify the hypotenuse
- Longest side: 39

Step 2: Calculate squares
- $39^2 = 1521$
- $15^2 = 225$
- $36^2 = 1296$
- Sum: 225 + 1296 = 1521

Step 3: Compare
- 1521 = 1521

Conclusion
- Since the square of the hypotenuse equals the sum of the squares of the other two sides, the sides 15, 36, and 39 do form a right triangle.

Summary of Findings

Based on the calculations:
- Set 1 (2, 3, 13): Does not form a right triangle.
- Set 2 (4, 6, 10): Does not form a right triangle.
- Set 3 (9, 12, 18): Does not form a right triangle.
- Set 4 (15, 36, 39): Forms a right triangle.

Therefore, the only set of side lengths among the four that forms a right triangle is 15, 36, and 39.

Additional Considerations

Are the side lengths plausible?

- All four sets consist of positive real numbers, satisfying the basic condition for side lengths of a triangle.
- For a set to be a right triangle, the Pythagorean theorem must hold precisely, which only applies to the last set.

Are these sets scaled versions of each other?

- No, the sets are distinct with no common ratios that produce the Pythagorean relationship except for the last set.

Implications for Geometry and Real-World Applications

- Recognizing right triangles is crucial in fields such as construction, navigation, and computer graphics.
- The Pythagorean theorem provides a quick method for validation without complex calculations.

Conclusion

By applying the Pythagorean theorem systematically to each set of side lengths, it is evident that only the set 15, 36, and 39 satisfies the criteria for forming a right triangle. This demonstrates the importance of the theorem as a reliable tool for geometric validation. Recognizing the properties of right triangles not only enhances mathematical understanding but also supports practical applications across various disciplines.

References

- Euclid's Elements, Book I, Proposition 47 (Pythagorean theorem)
- Basic Geometry textbooks
- Mathematical problem-solving resources

Frequently Asked Questions

Which set of side lengths forms a right triangle: 2, 3, 13?

No, because $2^2 + 3^2 = 4 + 9 = 13$, which equals 13. Wait, this suggests 2, 3, 13 might satisfy Pythagoras. But 13 is the largest side, so check if $2^2 + 3^2 = 13^2$: $4 + 9 = 13$, but $13^2 = 169$, so no. Since $4 + 9 \neq 169$, these do not form a right triangle.

Does the set 4, 6, 10 form a right triangle?

Check if $4^2 + 6^2 = 10^2$: 16 + 36 = 52, but $10^2 = 100$. Since $52 \neq 100$, these sides do not form a right triangle.

Is the set 9, 12, 18 a right triangle?

Check if $9^2 + 12^2 = 18^2$: 81 + 144 = 225, but $18^2 = 324$. Since $225 \neq 324$, these do not form a right triangle.

Does the set 15, 36, 39 form a right triangle?

Check if $15^2 + 36^2 = 39^2$: 225 + 1296 = 1521, and $39^2 = 1521$. Since both sides equal 1521, these sides form a right triangle.

Are the side lengths 2, 3, 13 suitable for forming a right triangle?

No, because the Pythagorean theorem does not hold for these lengths, as shown by the calculation.

Which of the given sets are Pythagorean triples?

Only the set 15, 36, 39 forms a Pythagorean triple, satisfying the Pythagoras theorem.

Can the set 4, 6, 10 be considered a right triangle?

No, because it does not satisfy the Pythagorean theorem; $16 + 36 \neq 100$.

What is the key check to determine if three sides form a right triangle?

Apply the Pythagorean theorem: the square of the longest side should equal the sum of the squares of the other two sides.

Is the set 9, 12, 18 a right triangle?

No, because $81 + 144 \neq 324$; thus, it does not satisfy the Pythagorean theorem.

Which side lengths from the list form a right triangle?

Only the set 15, 36, 39 forms a right triangle based on the Pythagorean theorem.

Additional Resources

Right Triangle Side Lengths: An Expert Exploration of Which Sets Form a Right Triangle

When exploring the fascinating realm of geometry, one of the most intriguing questions revolves around identifying which sets of side lengths can form a right triangle. This classic problem hinges on understanding the Pythagorean theorem, a fundamental principle that helps determine whether a given trio of lengths can constitute a right-angled triangle. In this article, we will analyze four different sets of side lengths—O2, 3, 13; O4, 6, 10; O9, 12, 18; and O15, 36, 39—assessing each to determine their compatibility with the properties of right triangles.

Throughout this comprehensive review, we aim to provide clarity, detail, and expert insights, ensuring that both students and enthusiasts can deepen their understanding of how side lengths relate to right triangles.

Understanding the Pythagorean Theorem and Its Significance

The Core Concept

At the heart of right triangle analysis lies the Pythagorean theorem, which states:

In a right-angled triangle, the square of the hypotenuse (the side opposite the right angle) equals the sum of the squares of the other two sides.

Mathematically, this can be expressed as:

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

where:

- $ c $ is the length of the hypotenuse,
- $ a $ and $ b $ are the lengths of the other two sides.

This theorem provides a straightforward test: if the sum of the squares of the two shorter sides equals the square of the longest side, then the triangle is right-angled.

Analyzing Each Set of Side Lengths

Let's evaluate each set methodically, verifying whether they satisfy the Pythagorean condition.

Set 1: O2, 3, 13

Step 1: Clarify the notation

The notation "O2" and "O13" appears to suggest the use of the letter 'O' possibly as a placeholder or a typo. Assuming that these are meant to be numerical side lengths, the most logical interpretation is:

- Set 1: 2, 3, 13

Step 2: Arrange sides for analysis

Identify the longest side:

- Longest: 13

Remaining sides: 2 and 3

Step 3: Apply Pythagorean theorem

Calculate:

- $2^2 + 3^2 = 4 + 9 = 13$
- $c^2 = 13^2 = 169$

Compare:

- Sum of squares of shorter sides: 13
- Square of hypotenuse: 169

Since $13 \neq 169$, the sides do not satisfy the Pythagorean theorem.

Conclusion: Set 1 (2, 3, 13) does not form a right triangle.

Set 2: O4, 6, 10

Step 1: Interpret notation

Assuming "O4" is 4, the set becomes:

- 4, 6, 10

Step 2: Identify the hypotenuse

- Longest: 10

Remaining sides: 4 and 6

Step 3: Calculate

- $4^2 + 6^2 = 16 + 36 = 52$
- $10^2 = 100$

Since $52 \neq 100$, the set does not satisfy the Pythagorean theorem.

Conclusion: Set 2 (4, 6, 10) cannot form a right triangle.

Set 3: O9, 12, 18

Step 1: Interpret notation

Assuming "O9" is 9, so:

- 9, 12, 18

Step 2: Identify the hypotenuse

- Longest: 18

Remaining sides: 9 and 12

Step 3: Calculate

- $9^2 + 12^2 = 81 + 144 = 225$
- $18^2 = 324$

Since 225 ≠ 324, this set does not satisfy the Pythagorean condition.

Conclusion: Set 3 (9, 12, 18) does not form a right triangle.

Set 4: O15, 36, 39

Step 1: Interpret notation

Assuming "O15" is 15, so:

- 15, 36, 39

Step 2: Identify the hypotenuse

- Longest: 39

Remaining sides: 15 and 36

Step 3: Calculate

- $15^2 + 36^2 = 225 + 1296 = 1521$
- $39^2 = 1521$

Since:

$$1521 = 1521$$

The sums are equal!

Conclusion: Set 4 (15, 36, 39) satisfies the Pythagorean theorem and thus

forms a right triangle.

Summary of Findings

Set of Side Lengths	Longest Side	Pythagorean Check	Right Triangle?
2, 3, 13	13	4 + 9 ≠ 169	No
4, 6, 10	10	16 + 36 ≠ 100	No
9, 12, 18	18	81 + 144 ≠ 324	No
15, 36, 39	39	225 + 1296 = 1521, matches 1521	Yes

Therefore, the only set that forms a right triangle is the last one: (15, 36, 39).

Additional Insights and Practical Implications

Why Is Identifying Right Triangles Important?

Understanding which sets of lengths form right triangles has profound implications in various fields:

- Architecture and Construction: Ensuring structures are properly aligned using right angles.
- Navigation and Surveying: Calculating distances and angles accurately.
- Design and Engineering: Creating components with precise right angles for stability and aesthetics.
- Mathematics Education: Building foundational knowledge in geometry and trigonometry.

How to Use the Pythagorean Theorem Effectively

- Always identify the longest side as the potential hypotenuse.
- Square all sides and verify if the sum of the squares of the shorter sides equals the square of the hypotenuse.
- Remember that for non-integer lengths, rounding may introduce errors; use exact calculations wherever possible.

Extensions and Related Concepts

- Pythagorean Triples: Sets of three positive integers that satisfy $a^2 + b^2 = c^2$. For example, (3, 4, 5) and (5, 12, 13).
- Converse of Pythagoras: If $a^2 + b^2 = c^2$, then the triangle with sides a, b, c is right-angled.
- Pythagorean Theorem in Coordinate Geometry: Used to determine distances between points in a plane.

Final Verdict and Recommendations

In conclusion, among the provided sets, only (15, 36, 39) satisfies the Pythagorean theorem and therefore forms a right triangle. When analyzing side lengths to determine right-angled triangles, always:

- Verify the longest side.
- Apply the Pythagorean theorem precisely.
- Be cautious of notational ambiguities—clarify units and symbols before calculations.

For students, educators, and professionals alike, mastering these fundamental checks empowers accurate geometric assessments, essential in both theoretical mathematics and practical applications.

In the world of geometry, the elegance of right triangles continues to inspire curiosity and precision. Knowing exactly which lengths form such triangles is not just a mathematical exercise but a vital skill across countless disciplines.

Which Set Of Side Lengths Forms A Right Triangle O2 3 13o4 6 10o 9 12 18o 15 36 39

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