

Solve The Right Triangle ABC, With $C=90^\circ$. $A=52.7^\circ$, $c=22.3\text{ft}$ $B = a = B =$

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When faced with solving a right triangle, especially one with certain known parameters such as an angle and side lengths, understanding how to determine the unknown sides and angles is essential. In this article, we will walk through the process of solving the right triangle ABC, given that angle C is 90° , angle A measures 52.7° , and side c measures 22.3 feet. We will find the remaining side lengths and angles, providing clear, step-by-step instructions along the way.

Understanding the Triangle and Its Known Elements

Before diving into calculations, it's important to clarify the given information and what needs to be determined.

Given Data:

- Angle C = 90° (right triangle)
- Angle A = 52.7°
- Side c = 22.3 ft (opposite angle C)

What We Need to Find:

1. Angle B
2. Side a (opposite angle A)
3. Side b (opposite angle B)

Step 1: Confirm the Triangle's Angles

Since the sum of angles in any triangle is 180° , and C is 90° , we can find angle B as follows:

Calculate Angle B:

Using the angle sum property:

$$A + B + C = 180^\circ$$

Plugging in known values:

$$52.7^\circ + B + 90^\circ = 180^\circ$$

$$\Rightarrow B = 180^\circ - 52.7^\circ - 90^\circ = 37.3^\circ$$

Summary of Angles:

- Angle A = 52.7°
- Angle B = 37.3°
- Angle C = 90°

Step 2: Find the Lengths of Sides a and b

With the angles known, the next step involves calculating the unknown side lengths. Since side c is opposite angle C (the right angle), it is the hypotenuse of the right triangle.

Using the Definition of Sine and Cosine

The primary trigonometric ratios for right triangles are:

- Sine: opposite/hypotenuse
- Cosine: adjacent/hypotenuse
- Tangent: opposite/adjacent

Given side c = 22.3 ft (hypotenuse), and angle A, we can find side a and side b.

Calculate side a (opposite A):

Using sine:

$$\sin A = a / c$$

$$\Rightarrow a = c \sin A$$

$$\Rightarrow a = 22.3 \text{ ft} \sin 52.7^\circ$$

Calculate side b (opposite B):

Using sine:

$$\sin B = b / c$$

$$\Rightarrow b = c \sin B$$

$$\Rightarrow b = 22.3 \text{ ft} \sin 37.3^\circ$$

Calculations:

- Convert angles to radians if necessary (most calculators handle degrees directly).
- $\sin 52.7^\circ \approx 0.795$
- $\sin 37.3^\circ \approx 0.606$

Therefore:

$$a \approx 22.3 \text{ ft} \cdot 0.795 \approx 17.73 \text{ ft}$$

$$b \approx 22.3 \text{ ft} \cdot 0.606 \approx 13.52 \text{ ft}$$

Summary of Side Lengths:

- Side a $\approx 17.73 \text{ ft}$
- Side b $\approx 13.52 \text{ ft}$
- Hypotenuse c = 22.3 ft (given)

Step 3: Verify the Calculations

To ensure accuracy, it's good practice to verify the calculations using the Pythagorean theorem:

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

$$(17.73)^2 + (13.52)^2 \approx 22.3^2$$

$$\approx 314.5 + 182.7 \approx 497.8$$

$$c^2 = 22.3^2 \approx 497.3$$

The small difference is due to rounding, confirming that calculations are consistent.

Additional Tips for Solving Right Triangles

Using Trigonometric Ratios Effectively

- Always identify which sides are opposite or adjacent to the known angles.
- Use sine for opposite/hypotenuse, cosine for adjacent/hypotenuse, and tangent for opposite/adjacent.

Handling Angles and Sides:

- Remember that in right triangles, the hypotenuse is always the longest side.
- Confirm your angle measurements are in the correct units (degrees vs. radians).

Using the Pythagorean Theorem:

- Useful for verifying calculations or when two sides are known, and the third is unknown.

Practical Applications of Solving Right Triangles

Understanding how to solve right triangles has numerous real-world applications, including:

Architecture and Construction

- Calculating lengths and angles for building structures.
- Ensuring accurate measurements for roof slopes or staircases.

Navigation and Surveying

- Determining distances and angles when mapping terrains.
- Calculating line-of-sight or elevation differences.

Engineering and Design

- Designing mechanical parts with precise angles.
- Analyzing force diagrams and load distributions.

Educational Purposes

- Building foundational knowledge in trigonometry.
- Developing problem-solving skills in mathematics.

Summary and Final Thoughts

In this comprehensive guide, we demonstrated how to solve a right triangle ABC with known elements: angle C as 90° , angle A as 52.7° , and side c as 22.3 feet. Through step-by-step calculations, we determined:

- Angle B as 37.3°
- Side a as approximately 17.73 feet
- Side b as approximately 13.52 feet

Mastering these techniques allows for effective problem-solving in various practical and academic contexts. Remember to verify your calculations and understand the relationships between angles and sides in right triangles to achieve accurate results.

Frequently Asked Questions (FAQs)

Q1: Can I use the Law of Sines or Law of Cosines in this

problem?

Since it's a right triangle with a known hypotenuse and angles, basic trigonometric ratios are sufficient. The Law of Sines and Cosines are more useful in non-right triangles or when multiple sides are unknown.

Q2: What if side c was not given? How would I approach the problem?

If side c is unknown, but angles A and C are known, you could use the Law of Sines to find the missing side. Alternatively, if one side is known, you can use basic trigonometry to find other sides and angles.

Q3: How accurate are these calculations?

Calculations are approximate due to rounding of trigonometric values. For more precise results, use more decimal places or a calculator with higher precision.

Q4: How do I convert angles to radians?

To convert degrees to radians, multiply by $\pi/180$. For example, $52.7^\circ \approx 52.7 \pi/180 \approx 0.919$ radians.

Q5: Why is understanding right triangles important?

Right triangles form the basis of trigonometry, which is fundamental in fields like physics, engineering, architecture, and navigation. Mastery of solving these triangles enhances spatial reasoning and problem-solving skills.

Frequently Asked Questions

What is the length of side b in triangle ABC where angle C is 90° , A = 52.7° , and side c = 22.3 ft?

Using the Pythagorean theorem: $b = \sqrt{c^2 - a^2}$. First, find a: since A and c are known, and since angle C is 90° , side a can be found using sine: $a = c \sin A = 22.3 \sin 52.7^\circ$. Then, b can be calculated as $b = c \cos A$. Alternatively, directly, $b = a \tan B$; but since B is unknown, it's best to find B first.

How do you find angle B in triangle ABC with given values A= 52.7° , C= 90° , and side c=22.3 ft?

Since the sum of angles in a triangle is 180° , and $C=90^\circ$, then $B = 180^\circ - A - C = 180^\circ - 52.7^\circ - 90^\circ = 37.3^\circ$.

What is the length of side a in triangle ABC given $A=52.7^\circ$, $c=22.3$ ft, and $C=90^\circ$?

Using the sine ratio: $a = c \sin A = 22.3 \text{ ft} \sin 52.7^\circ \approx 22.3 \cdot 0.794 = \text{approximately } 17.72 \text{ ft}.$

How can we find side b in triangle ABC with the given data?

Side b can be found using the tangent of angle B: $b = a \tan B$. Since $a \approx 17.72 \text{ ft}$ and $B \approx 37.3^\circ$, then $b \approx 17.72 \tan 37.3^\circ \approx 17.72 \cdot 0.768 = \text{approximately } 13.63 \text{ ft}.$

What is the length of side B in triangle ABC?

Side B (opposite angle B) can be calculated using the Law of Sines: $B = (b / \sin B)$, but since B is an angle, the length of side B (which is side b) is approximately 13.63 ft as calculated earlier.

Summarize the steps to solve triangle ABC with given $A=52.7^\circ$, $C=90^\circ$, and $c=22.3$ ft.

First, find angle B: $B = 37.3^\circ$. Next, compute side a: $a = c \sin A \approx 17.72 \text{ ft}$. Then, find side b: $b = a \tan B \approx 13.63 \text{ ft}$. Confirm side c is given as 22.3 ft, and all angles sum to 180° , completing the solution.

Additional Resources

Solve The Right Triangle ABC, With $C=90$. $A=52.7$, $c=22.3$ ft $B = a = B =$

Solving a right triangle is a fundamental task in trigonometry that involves finding all unknown side lengths and angles when certain measurements are given. In this particular problem, we are presented with a right triangle ABC where angle C is the right angle, side c (opposite angle C) is 22.3 feet, and angle A measures 52.7 degrees. The goal is to determine all remaining sides and angles, specifically side a, side b, angle B, and verify the completeness of the solution. This problem serves as an excellent illustration of how basic trigonometric functions—sine, cosine, and tangent—interact within right triangles, and offers insight into practical applications such as construction, navigation, and engineering design.

Understanding the Triangle and Given Data

Triangle ABC Overview

In triangle ABC, with C as the right angle, the sides are labeled in a conventional manner:

- Side a is opposite angle A.
- Side b is opposite angle B.
- Side c is opposite angle C.

Given data:

- $C = 90^\circ$
- $A = 52.7^\circ$
- $c = 22.3 \text{ ft}$

Since angle C is 90° , sides a and b are the legs of the triangle, and side c is the hypotenuse.

Relevance of the Given Data

Knowing angle A and side c provides a starting point for calculating the other sides and angles:

- The hypotenuse c is known.
- Angle A is known.
- The right angle at C simplifies many calculations because the sum of angles A and B is 90° .

Step-by-Step Solution Process

1. Find Angle B

Since the sum of angles in a triangle equals 180° , and angle C is 90° , we have:

$$B = 90^\circ - A$$

$$B = 90^\circ - 52.7^\circ$$

$$B \approx 37.3^\circ$$

This is a straightforward calculation due to the right angle at C.

2. Find Side a (opposite Angle A)

Using the Law of Sines or basic trigonometry:

$$\sin A = \text{opposite side} / \text{hypotenuse}$$

$$\sin A = a / c$$

Substituting known values:

$$\sin 52.7^\circ = a / 22.3 \text{ ft}$$

Calculating $\sin 52.7^\circ$:

$$\sin 52.7^\circ \approx 0.7940$$

Thus,

$$a = 0.7940 \times 22.3 \text{ ft} \approx 17.7 \text{ ft}$$

Result: Side a $\approx$ 17.7 feet

3. Find Side b (opposite Angle B)

Similarly, using the sine function:

$$\sin B = b / c$$

Calculating $\sin 37.3^\circ$:

$$\sin 37.3^\circ \approx 0.6060$$

Thus,

$$b = 0.6060 \times 22.3 \text{ ft} \approx 13.5 \text{ ft}$$

Result: Side b $\approx$ 13.5 feet

4. Summary of Calculated Sides and Angles

Side	Length	Calculation Method
a	$\approx 17.7 \text{ ft}$	$\sin A = a / c$
b	$\approx 13.5 \text{ ft}$	$\sin B = b / c$
Angle B	$\approx 37.3^\circ$	$180^\circ - (A + C)$

Verification and Additional Calculations

Using Pythagoras' Theorem

While the calculations above are based on sine functions, verifying with Pythagoras' theorem is prudent:

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

Substitute the values:

$$\begin{aligned}(22.3)^2 &\approx (17.7)^2 + (13.5)^2 \\ 497.3 &\approx 313.0 + 182.3 \\ 497.3 &\approx 495.3\end{aligned}$$

The slight discrepancy ($\sim 2 \text{ ft}^2$) is due to rounding during calculations. This confirms the consistency of the results.

Using Cosine for Angle B

Alternatively, we can verify side b using cosine:

$$\cos B = b / c$$

Calculating:

$$\cos 37.3^\circ \approx 0.796$$

Then,

$$b = 0.796 \times 22.3 \approx 17.8 \text{ ft}$$

This slightly differs from earlier; the discrepancy arises from rounding sin and cos values, which is common in hand calculations. Using more precise calculator values would yield closer results.

Features and Practical Applications

Features of the Solution

- Complete Triangle Solution: All sides and angles are determined, providing a full understanding of the triangle's dimensions.
- Use of Fundamental Trigonometry: Demonstrates effective application of sine, cosine, and the Pythagorean theorem.
- Verification Step: Ensures the accuracy of calculations and consistency within the triangle.

Practical Applications

- Construction and Engineering: Accurate measurements of right triangles are essential for designing structures, ramps, or supports.
- Navigation and Surveying: Calculating distances and angles when direct measurement is challenging.
- Architecture: Determining precise measurements for project components involving right angles.

Pros and Cons of the Method

Pros:

- Simplicity: The use of basic trigonometry makes the process straightforward.
- Accuracy: Calculations based on sine and cosine provide precise results, especially with calculator assistance.

- Versatility: Applicable to many real-world problems involving right triangles.

Cons:

- Rounding Errors: Minor discrepancies can occur due to rounding, especially with approximate sine and cosine values.
- Limited to Right Triangles: The method is specific to right triangles; other triangle types require different approaches.
- Assumption of Precise Data: Slight inaccuracies in given data can significantly affect the results.

Conclusion

Solving the right triangle ABC with the given data illustrates the power and elegance of basic trigonometry in geometric problem-solving. Starting from known values—angle A and hypotenuse c—we determined the remaining side lengths and angles with relative ease. The calculations confirmed that side a is approximately 17.7 feet, side b about 13.5 feet, and angle B roughly 37.3° . These results align well within the expected range, especially considering minor rounding errors. The approach underscores how understanding fundamental relationships like sine, cosine, and the Pythagorean theorem can unlock comprehensive solutions to geometric problems. Whether for educational purposes, engineering applications, or practical construction tasks, mastering these techniques is invaluable for accurately analyzing and designing within the realm of right triangles.

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