

Find The Measure Of The Remote Exterior Angle. (Angles Above)

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Understanding geometric concepts such as angles is fundamental in both academic settings and real-world applications. One common problem involves calculating the measure of a remote exterior angle in various polygon configurations. In this article, we'll explore how to find the measure of the remote exterior angle, especially when angles above are involved, through detailed explanations, step-by-step methods, and practical examples.

Introduction to Remote Exterior Angles

Before diving into the specifics of calculating remote exterior angles, it's important to understand what they are and how they relate to other angles within polygons.

What Is a Remote Exterior Angle?

- A remote exterior angle is an exterior angle of a polygon that does not share a common side with a particular interior angle.
- In polygons, exterior angles are formed by extending one side of the polygon at each vertex.
- The remote angles are specifically those exterior angles that are not adjacent to a given interior angle.

Properties of Exterior and Remote Exterior Angles

- The sum of exterior angles in any polygon is always 360 degrees.
- Each exterior angle forms a linear pair with its adjacent interior angle (they are supplementary).
- In polygons with multiple sides, the remote exterior angles can be used to determine unknown angles using various geometric theorems.

Understanding Angles Above in Context

Angles above typically refer to angles positioned "above" or "opposite" in certain configurations, often in diagrams involving polygons. Recognizing these angles and their relationships is key to solving for unknown measures.

Angles Above in Polygon Configurations

- In some diagrams, angles above refer to angles that are located opposite or remote from given angles.
- These angles often help establish relationships via the exterior angle theorem or supplementary angles.

Significance of Angles Above in Calculations

- They often serve as the key to solving for unknown angles when other angles are given.
- Recognizing which angles are "above" helps identify the remote exterior angles needed for calculations.

Methods to Find the Measure of Remote Exterior Angles

There are several approaches for calculating remote exterior angles depending on the polygon type and the information provided.

Method 1: Using the Exterior Angle Theorem

The exterior angle theorem states:

- > The measure of an exterior angle of a triangle equals the sum of the measures of the two non-adjacent interior angles.

In polygons, particularly triangles and quadrilaterals, this can be extended to find remote exterior angles.

Steps:

1. Identify the exterior angle you need to find.
2. Determine the adjacent interior angle(s).
3. Use the fact that exterior and interior angles are supplementary (sum to 180°).
4. Subtract known interior angles from 180° to find the exterior angle, or use the theorem directly if applicable.

Method 2: Using Polygon Interior and Exterior Angle

Relationships

In convex polygons:

- The sum of all interior angles = $(n - 2) \times 180^\circ$, where n is the number of sides.
- The sum of all exterior angles = 360° , regardless of the number of sides.

Application:

- If you know some interior angles, subtract their sum from the total interior angle sum to find unknown angles.
- Use the exterior angles' sum property to find remaining exterior angles, including remote exterior angles.

Method 3: Applying Algebraic Equations in Complex Figures

For complex polygons with multiple angles:

1. Assign variables to unknown angles.
2. Set up equations based on known relationships (e.g., supplementary angles, angles above).
3. Solve the equations step-by-step to find the measure of remote exterior angles.

Step-by-Step Example: Finding a Remote Exterior Angle in a Triangle

Let's work through a specific example to illustrate the process.

Problem Statement:

In triangle ABC, angle A measures 50° , and angle B measures 60° . Find the measure of the remote exterior angle at vertex C.

Solution:

1. Identify the interior angles:

- Angle A = 50°
- Angle B = 60°
- Angle C = ? (unknown)

2. Calculate angle C:

- Sum of interior angles in a triangle = 180°

- So, Angle C = $180^\circ - (50^\circ + 60^\circ) = 70^\circ$

3. Find the exterior angle at vertex C:

- Extend side BC beyond C.

- The exterior angle at C is supplementary to interior angle C:

$$\text{Exterior angle at C} = 180^\circ - 70^\circ = 110^\circ$$

4. Identify the remote exterior angle:

- The remote exterior angles are the exterior angles at vertices A and B, not at C.

- For vertex A, the exterior angle is supplementary to interior angle A: $180^\circ - 50^\circ = 130^\circ$.

- For vertex B, the exterior angle is $180^\circ - 60^\circ = 120^\circ$.

5. Find the remote exterior angle at vertex C:

- Since the sum of all exterior angles is 360° , and the exterior angles at A and B are 130° and 120° , respectively:

$$\text{Sum of known exterior angles} = 130^\circ + 120^\circ = 250^\circ.$$

- Therefore, the remote exterior angle at C = $360^\circ - 250^\circ = 110^\circ$, which confirms our earlier calculation.

Result:

The measure of the remote exterior angle at vertex C is 110° .

Practice Problems for Finding Remote Exterior Angles

To reinforce understanding, here are some practice problems:

1. In a quadrilateral, three interior angles measure 85° , 95° , and 100° . Find the measure of the remote exterior angle at the fourth vertex.

2. In a regular hexagon, find the measure of a remote exterior angle given that one interior angle measures 120° .

3. Triangle DEF has angles of 45° and 75° . What is the measure of the remote exterior angle at vertex D?

Answers:

$$1. \text{ Sum of interior angles} = (4 - 2) \times 180^\circ = 360^\circ$$

$$\text{Sum of known angles} = 85^\circ + 95^\circ + 100^\circ = 280^\circ$$

Interior angle at the fourth vertex = $360^\circ - 280^\circ = 80^\circ$

Exterior angle at that vertex = $180^\circ - 80^\circ = 100^\circ$

Remote exterior angles are the ones at the other vertices, but since they are adjacent to the known interior angles, the remote exterior angle is the exterior angle at the vertex opposite the known interior angles.

— Alternatively, since the sum of all exterior angles is 360° , sum of known exterior angles = (At vertices with angles 85° , 95° , 100°): each exterior angle is $180^\circ - \text{interior angle}$, so:

- At vertex with 85° : 95°
- At vertex with 95° : 85°
- At vertex with 100° : 80°

Sum of these = $95 + 85 + 80 = 260^\circ$

Remote exterior angle = $360^\circ - 260^\circ = 100^\circ$

2. For a regular hexagon:

- Each interior angle = $[(6 - 2) \times 180^\circ] / 6 = 120^\circ$
- Exterior angle at each vertex = $180^\circ - 120^\circ = 60^\circ$
- Since the angles are equal, the remote exterior angles are also 60° .

3. For triangle DEF:

- Sum of interior angles = 180°
- Known angles: 45° , 75°
- Unknown angle at D = $180^\circ - (45^\circ + 75^\circ) = 60^\circ$
- Exterior angle at D (remote exterior angle) = $180^\circ - 60^\circ = 120^\circ$

Tips for Successfully Finding Remote Exterior Angles

- Always verify the polygon type and the sum of interior angles.
- Remember that the sum of all exterior angles in a convex polygon is 360° .
- Use supplementary angle relationships between interior and exterior angles.
- Assign variables to unknown angles for complex diagrams and set up algebraic equations.
- Draw clear diagrams to visualize angles and their relationships.

Conclusion

Finding the measure of remote exterior angles involves understanding key geometric principles, such as the exterior angle theorem, supplementary angles, and the sum of angles in polygons. By carefully analyzing the relationships between interior and exterior angles, and applying these principles systematically, you can accurately determine the measure of any remote exterior angle, even in complex figures involving angles above.

Practicing these methods with various polygons and configurations will enhance your problem-solving skills and deepen your understanding of geometric angles. Remember to leverage diagrams, organize your calculations, and double-check your work to ensure accuracy.

Whether you're preparing for exams or tackling real-world geometric problems, mastering the calculation of remote exterior angles is an essential step in your mathematical toolkit.

Frequently Asked Questions

What is the remote exterior angle in a triangle?

The remote exterior angle of a triangle is the exterior angle formed by extending one side of the triangle, which is not adjacent to the interior angle at the vertex. It is equal to the sum of the two non-adjacent interior angles.

How do you find the measure of a remote exterior angle?

To find the measure of a remote exterior angle, add the measures of the two non-adjacent interior angles of the triangle.

If two interior angles of a triangle are 50° and 60° , what is the measure of the remote exterior angle?

The remote exterior angle is $50^\circ + 60^\circ = 110^\circ$.

Can the measure of a remote exterior angle be greater than 180° ?

No, the measure of any exterior angle, including remote exterior angles, in a triangle is always less than 180° because the sum of interior angles in a triangle is 180° .

What is the relationship between a remote exterior angle and the interior angles of the triangle?

A remote exterior angle is supplementary to its adjacent interior angle and equal in measure to the sum of the two non-adjacent interior angles.

Is the measure of a remote exterior angle always equal to the

sum of two interior angles?

Yes, in a triangle, the measure of a remote exterior angle is always equal to the sum of the two non-adjacent interior angles.

How can you verify the measure of a remote exterior angle in a diagram?

You can verify it by measuring the exterior angle directly and comparing it to the sum of the two non-adjacent interior angles, which should be equal.

What is the importance of understanding remote exterior angles in geometry problems?

Understanding remote exterior angles helps solve for unknown angles in a triangle and proves important in geometric proofs and problem-solving involving angles.

If one interior angle of a triangle is 40° , and another is 70° , what is the measure of the remote exterior angle at the third vertex?

The remote exterior angle at the third vertex is $40^\circ + 70^\circ = 110^\circ$.

Are remote exterior angles applicable only in triangles or in other polygons as well?

The concept of remote exterior angles is primarily used in triangles, but similar principles apply in other polygons where exterior angles relate to interior angles, following the exterior angle theorem.

Additional Resources

Find The Measure Of The Remote Exterior Angle. (Angles Above)

Understanding how to find the measure of a remote exterior angle is a fundamental skill in geometry that builds on core concepts like supplementary angles, exterior angles, and angle relationships within polygons. When faced with a problem involving angles above or outside a shape, mastering the method to determine the measure of remote exterior angles can significantly improve your problem-solving efficiency. This guide aims to break down the process step-by-step, offering clarity and confidence whether you're a student preparing for a test or a teacher seeking a comprehensive resource.

What Is a Remote Exterior Angle?

Before diving into the methods for finding the measure of a remote exterior angle, it's essential to

understand what this term means in the context of geometry.

Definition:

A remote exterior angle is an exterior angle of a polygon that does not share a common vertex with the given interior angle. In simpler terms, if you extend a side of a polygon, the resulting exterior angle is formed outside the polygon, and the remote angles are those outside the angles not directly adjacent to the side you extend.

Visualizing the Concept:

Imagine a triangle or a polygon. When you extend one side beyond a vertex, the exterior angle formed at that vertex is called an exterior angle. The remote exterior angles are the two exterior angles that are not adjacent to the particular interior angle you're examining. They are "remote" because they are located away from the vertex of the interior angle in question.

Fundamental Angle Relationships in Polygons

To find a remote exterior angle, it's vital to understand the basic relationships between interior and exterior angles within polygons.

Key Principles:

- Exterior and Interior Angles Are Supplementary:

For any polygon, each exterior angle and its adjacent interior angle are supplementary, meaning they add up to 180° .

$$\text{Exterior angle} + \text{Interior angle} = 180^\circ$$

- Sum of Exterior Angles in a Polygon:

The sum of all exterior angles in any convex polygon is always 360° , regardless of the number of sides.

- Remote Interior Angles and Exterior Angles:

The sum of the measures of the remote interior angles and the exterior angle at a vertex is related through the polygon's interior angles and exterior angles.

Step-by-Step Guide to Find the Measure of a Remote Exterior Angle

Step 1: Identify the Polygon and Known Angles

Begin by carefully examining the problem:

- Determine the type of polygon (triangle, quadrilateral, pentagon, etc.).
- Note any given angles, whether interior, exterior, or both.
- Recognize which angles are marked as "above" or "outside" the polygon.

Example: You might be given an interior angle at a vertex and the measure of some exterior or remote angles.

Step 2: Understand the Relationships Between the Angles

Use the basic principles:

- Interior and exterior angles at a vertex are supplementary:

$$\text{Interior angle} + \text{Exterior angle} = 180^\circ$$

- For polygons with multiple sides, the sum of all exterior angles is 360° .

- When given an interior angle and the exterior angle at a specific vertex, you can find the missing angle using the supplementary relationship.

Step 3: Recognize Which Angles Are Remote

Distinguish between adjacent exterior angles and remote exterior angles:

- The adjacent exterior angle shares a vertex with the interior angle.
- The remote exterior angles are the other exterior angles not directly adjacent.

In problems involving "angles above," the focus typically lies in identifying the remote exterior angles relative to a particular interior angle.

Step 4: Use the Exterior Angle Theorem

The Exterior Angle Theorem is crucial:

> The measure of an exterior angle of a triangle (or polygon) equals the sum of the measures of the two remote interior angles.

While this directly applies to triangles, similar principles can be extended to polygons:

- For polygons, each exterior angle can be related to the interior angles through supplementary angles.
- In polygons with known interior angles, the exterior angles can be found, and then the remote exterior angles can be deduced.

Step 5: Apply the Relationships to Find the Remote Exterior Angle

Example Process:

Suppose you have a convex polygon with a known interior angle at a vertex and the measures of some exterior angles elsewhere.

- Step 1: Find the exterior angle at the vertex with the known interior angle:

$$\text{Exterior angle} = 180^\circ - \text{interior angle}$$

- Step 2: Use the sum of all exterior angles (360°) to find the measure of the remaining exterior angles:

$$\text{Sum of all exterior angles} = 360^\circ$$

- Subtract the known exterior angles from 360° to find the sum of the remote exterior angles.

- Step 3: Distribute the remaining sum among the remote exterior angles based on the problem specifics, or use additional given angles to identify individual measures.

Worked Example

Let's walk through a specific problem to illustrate the process:

Problem:

In a convex pentagon, one interior angle measures 110° . The exterior angle adjacent to this interior angle is unknown, but the remote exterior angles (the two outside the adjacent angles) are 70° and 80° . Find the measure of the remote exterior angle "above" the known interior angle.

Step 1: Find the exterior angle adjacent to the 110° interior angle:

$$\text{Exterior angle} = 180^\circ - 110^\circ = 70^\circ$$

Step 2: Recognize the remote exterior angles:

- The remote exterior angles are given as 70° and 80° , and these are not adjacent to the 110° interior angle.

Step 3: Sum of all exterior angles:

In a pentagon, total exterior angles = 360° .

Sum of known exterior angles:

$$70^\circ (\text{adjacent}) + 70^\circ + 80^\circ = 220^\circ$$

Remaining exterior angles sum to:

$$360^\circ - 220^\circ = 140^\circ$$

Assuming the "angle above" is one of these remaining exterior angles, its measure is 140° .

Tips for Solving Remote Exterior Angle Problems

- Always verify if the polygon is convex or concave.

The relationships differ; mainly, the exterior angles sum up to 360° in convex polygons.

- Pay attention to markings and labels.

They often indicate which angles are known and which need to be found.

- Use supplementary angles where applicable.

Remember that interior and exterior angles at a vertex are supplementary.

- Apply the Exterior Angle Theorem cautiously.

While directly applicable to triangles, extend the logic carefully to polygons.

- Check your work by verifying the sum of all exterior angles equals 360° .

Common Mistakes to Avoid

- Confusing adjacent and remote exterior angles:

Remember, remote exterior angles are those not sharing a vertex with the interior angle in question.

- Forgetting the sum of exterior angles in polygons:

Always ensure the total sum is 360° in convex polygons.

- Misapplying the Exterior Angle Theorem:

It applies primarily to triangles; for polygons, rely on supplementary angles and the sum of exterior angles.

Summary

Finding the measure of a remote exterior angle involves understanding the fundamental relationships between interior and exterior angles, recognizing which angles are remote, and applying the sum of exterior angles in polygons. By systematically identifying known angles, applying the exterior angle theorem, and using supplementary relationships, you can confidently determine the measure of any remote exterior angle.

Remember, practice with various polygon types and angle configurations enhances your problem-solving skills, making you adept at handling angles above or outside shapes with ease. Whether you're tackling a homework problem or preparing for an exam, mastering these concepts will solidify your understanding of geometric angle relationships.

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