

Are 90 Degrees (clockwise) And -270 Degrees (counter Clockwise) Coterminal? WHY Or Why Not?

Are 90 Degrees (clockwise) And -270 Degrees (counter Clockwise) Coterminal? WHY Or Why Not?

Understanding the concept of coterminal angles is fundamental in trigonometry and geometry. When analyzing angles, especially those measured in different directions or with varying degrees, it's essential to determine whether they are coterminal—that is, whether they share the same terminal side when drawn in standard position. This article explores whether 90 degrees measured clockwise and -270 degrees measured counterclockwise are coterminal, delving into their properties, calculations, and the reasoning behind their relationship.

What Are Coterminal Angles?

Before analyzing the specific angles in question, it's important to understand what coterminal angles are.

Definition of Coterminal Angles

Coterminal angles are angles that:

- Share the same initial and terminal sides when drawn in standard position.
- Differ by a full rotation of 360 degrees (or 2π radians).

This means that if you add or subtract multiples of 360° , the resulting angles are coterminal with the original.

How to Find Coterminal Angles

To determine whether two angles are coterminal:

1. Express both angles in degrees (or radians) in a standard form, ideally between 0° and 360° .
2. Calculate their difference.
3. If the difference is a multiple of 360° , then the angles are coterminal.

For example, angles of 30° and 390° are coterminal because $390^\circ - 30^\circ = 360^\circ$, which is a full rotation.

Analyzing the Angles: 90 Degrees (Clockwise) and -270 Degrees (Counterclockwise)

Now, let's examine the specific angles in question:

- 90 degrees measured clockwise
- -270 degrees measured counterclockwise

Converting Directions to Standard Angle Measurements

Angles can be measured in different directions:

- Counterclockwise: Usually considered the positive direction.
- Clockwise: Usually considered the negative direction.

When angles are given with signs, they typically indicate direction relative to the standard initial side (usually the positive x-axis).

Expressing the Angles in Standard Position

1. 90 Degrees (Clockwise):

- Starting from the positive x-axis, moving clockwise by 90° .
- Since clockwise angles are negative in standard measurement, this angle is:

-90°

2. -270 Degrees (Counterclockwise):

- Moving counterclockwise by 270° , which is positive in standard measurement.
- Alternatively, negative 270° indicates movement clockwise by 270° , but since the problem specifies "counterclockwise," it indicates a positive 270° movement.

$+270^\circ$

Note: The negative sign in -270° indicates the direction, but for the purpose of coterminality, we consider the magnitude and the net effect on the terminal side.

Calculating and Comparing the Angles

To determine if these angles are coterminal, convert both to a common standard form within 0° - 360° .

Converting 90° Clockwise to Standard Position

- Moving clockwise by 90° from 0°:

$$0^\circ - 90^\circ = -90^\circ$$

- Since negative angles can be converted to positive angles by adding 360°:

$$-90^\circ + 360^\circ = 270^\circ$$

- Therefore, 90° clockwise is coterminal with 270°.

Converting -270° Counterclockwise to Standard Position

- -270° indicates a movement of 270° clockwise (since negative), or equivalently, starting from 0°, moving clockwise by 270°:

$$0^\circ - 270^\circ = -270^\circ$$

- Convert to positive angle by adding 360°:

$$-270^\circ + 360^\circ = 90^\circ$$

- Alternatively, since -270° is equivalent to 90°, this angle, measured in standard position, corresponds to 90°.

Are 90° (clockwise) and -270° (counterclockwise) Coterminal?

Based on the calculations:

- 90° clockwise is coterminal with 270°.
- -270° counterclockwise is coterminal with 90°.

Conclusion:

Since both angles are coterminal with 90°, they are coterminal with each other.

Answer: Yes, 90 Degrees (clockwise) and -270 Degrees (counterclockwise) are coterminal angles because they both share the same terminal side when converted to standard position, corresponding to 90°, 270°, and -270°.

Why Are They Coterminal? A Deeper Explanation

Understanding why these angles are coterminal involves analyzing how angles relate when measured in different directions and how adding or subtracting full rotations affects their terminal sides.

Angles in Terms of Rotations

- Moving clockwise by 90° from the positive x-axis leads to an angle at the negative y-axis (or 270° in standard position).
- Moving counterclockwise by 270° , starting from the positive x-axis, reaches the same terminal side as 270° .

Thus:

- 90° clockwise = -90° , which is coterminal with 270° .
- -270° counterclockwise, when normalized, also corresponds to 90° .

The Role of Full Rotations (360°)

Angles that differ by multiples of 360° are coterminal because:

- They end on the same terminal side.
- The difference between the angles is an integer multiple of 360° .

In this case:

- 90° (clockwise) = $-90^\circ + 360^\circ = 270^\circ$
- -270° (counterclockwise) = 90°

Both ultimately relate back to the same terminal side at 90° , confirming their coterminality.

Practical Implications in Trigonometry and Geometry

Knowing that these angles are coterminal has practical applications:

- Simplifying complex angle calculations.
- Understanding the periodic nature of trigonometric functions.
- Solving equations where angles are given in different measures or directions.

For example, when evaluating sine, cosine, or tangent values at these angles, the results are identical because the angles are coterminal.

Summary and Key Takeaways

- Coterminal angles differ by multiples of 360° .
- 90° clockwise translates to -90° , which is coterminal with 270° .
- -270° counterclockwise is equivalent to 90° .
- Both angles share the same terminal side when converted to standard position, confirming they are coterminal.
- Understanding the relationship between angles measured in different directions helps simplify calculations and interpret geometric relationships.

Final Thoughts

In conclusion, 90 degrees measured clockwise and -270 degrees measured counterclockwise are coterminal angles because they ultimately correspond to the same terminal side in standard position. Recognizing coterminal angles enhances problem-solving in trigonometry, helps in graphing functions, and deepens understanding of rotational symmetry and periodicity. By mastering the concepts of angle measurement, direction, and normalization, students and professionals can navigate complex angular relationships with confidence.

Frequently Asked Questions

Are 90 degrees clockwise and -270 degrees counterclockwise coterminal angles?

Yes, 90 degrees clockwise and -270 degrees counterclockwise are coterminal because they differ by a full rotation of 360 degrees, meaning they share the same terminal side.

Why are 90° clockwise and -270° counterclockwise considered coterminal angles?

They are coterminal because when you add or subtract 360° , their angles become equivalent, and both angles land on the same position on the unit circle.

How do you determine if two angles are coterminal?

Two angles are coterminal if their measures differ by an integer multiple of 360 degrees, meaning you can add or subtract 360° repeatedly to get from one to the other.

Can negative angles be coterminal with positive angles?

Yes, negative angles can be coterminal with positive angles if they differ by 360° multiples, as adding 360° repeatedly to a negative angle can bring it to a positive equivalent.

What is the general rule for coterminal angles?

Coterminal angles are angles that differ by $360^\circ n$, where n is any integer (positive, negative, or zero), indicating they share the same terminal side.

Is 90 degrees clockwise the same as -270 degrees?

Yes, 90 degrees clockwise is equivalent to -270 degrees because both angles terminate at the same position on the circle, differing by 360 degrees.

Why is understanding coterminal angles important in trigonometry?

Understanding coterminal angles helps in simplifying trigonometric calculations, as functions like sine and cosine are periodic and depend only on the terminal side of the angle.

Additional Resources

Are 90 Degrees (clockwise) and -270 Degrees (counterclockwise) Coterminal? WHY Or Why Not?

Understanding angles and their relationships is fundamental in geometry, trigonometry, and various fields of mathematics and engineering. A common question that students encounter is whether two angles, measured differently, are coterminal—that is, whether they share the same terminal side when drawn in standard position. Specifically, when considering 90 degrees (clockwise) and -270 degrees (counterclockwise), it is crucial to analyze whether these angles are coterminal and to understand the reasoning behind such a classification. This article delves into the definitions of coterminal angles, explores how angles are measured in different directions, and ultimately determines whether these two angles are coterminal, providing clear explanations and insights along the way.

Understanding Angles and Their Measurement

Angles are geometric figures formed by two rays sharing a common endpoint called the vertex. When measuring angles, the standard convention is to place the initial side along the positive x-axis and measure the terminal side's rotation relative to it.

Angles in Standard Position

- Standard Position: An angle is said to be in standard position if its vertex is at the origin, the initial side lies along the positive x-axis, and the angle's measure is given relative to this initial side.
- Positive Angles: Measured counterclockwise from the initial side.
- Negative Angles: Measured clockwise from the initial side.

Angles can be expressed in degrees or radians, but for this discussion, we focus on degrees.

Measuring Angles in Different Directions

- Counterclockwise Measurement: This is the conventional direction for positive angles, starting from 0° and increasing as you rotate counterclockwise.
- Clockwise Measurement: Negative angles are measured clockwise from the initial side.
- Full Rotation and Coterminal Angles: Angles can be "wrapped around" the circle multiple times, and angles differing by multiples of 360° are considered coterminal.

Defining Coterminal Angles

Coterminal angles are angles that share the same terminal side when drawn in standard position, even if their degree measures differ.

Mathematical Definition

Two angles, θ and ϕ , are coterminal if:

$$\theta = \phi + 360^\circ \times k$$

where k is any integer (positive, negative, or zero).

Key points:

- Coterminal angles often differ by multiples of 360° .
- They can be positive or negative angles.
- Both angles have the same terminal side when drawn in standard position.

Implications of Coterminality

- Angles like 30° , 390° , and -330° are coterminal because they differ by 360° multiples.
- Coterminal angles are essential in simplifying trigonometric functions, as these functions depend on the terminal side, not the numerical measure.

Analyzing 90 Degrees (Clockwise) and -270 Degrees (Counterclockwise)

Having established the basics, let's analyze the specific angles in question:

- 90 degrees (clockwise): Since the positive x-axis is the initial side, rotating 90° clockwise from it would position the terminal side pointing straight down, along the negative y-axis.
- -270 degrees (counterclockwise): Rotating -270° from the initial side is equivalent to rotating 270° clockwise because negative angles indicate clockwise movement.

Let's explore each in detail.

Measuring 90 Degrees (Clockwise)

- Starting from the positive x-axis (0°), rotating 90° clockwise moves the terminal side downward, pointing along the negative y-axis.
- The measure of this angle in standard position is -90° because clockwise rotations are negative.

Measuring -270 Degrees (Counterclockwise)

- Starting from the positive x-axis, rotating -270° is a negative rotation, indicating a clockwise movement of 270° .
- Alternatively, since rotating clockwise by 270° is equivalent to rotating counterclockwise by 90° , the terminal side ends up pointing downward, along the negative y-axis.
- The measure is -270° .

Note: The negative angle measure indicates the direction of rotation, not necessarily the size of the angle itself.

Are 90 Degrees (Clockwise) and -270 Degrees (Counterclockwise) Coterminal?

To determine if these two angles are coterminal, we need to verify whether they share the same terminal side in standard position.

Converting Both Angles to Standard Form

- 90° (clockwise): This is equivalent to -90° in standard position.
- -270° (counterclockwise): As is, it remains -270° .

Finding Coterminality

Recall that two angles are coterminal if their difference is a multiple of 360° . Let's examine the difference:

$$\text{Difference} = |-90^\circ - (-270^\circ)| = |-90^\circ + 270^\circ| = |180^\circ| = 180^\circ$$

Since 180° is not a multiple of 360° , these two angles are not coterminal based solely on their difference.

Alternatively, check whether adding or subtracting multiples of 360° to one of the angles yields the other:

- Add 360° to -270° :

$$-270^\circ + 360^\circ = 90^\circ$$

This shows that:

$$-270^\circ + 360^\circ = 90^\circ$$

which indicates that -270° and 90° are coterminal because they differ by 360° .

Important clarification:

- The angle 90° (clockwise) is equivalent to -90° .
- The angle -270° is already in the negative rotation form.

Since:

$$-270^\circ + 360^\circ = 90^\circ$$

the angles -270° and 90° are coterminal.

But, note that 90° (clockwise) is an angle of -90° in standard position, which shares the same terminal side as 90° (counterclockwise).

Thus, the initial question about 90 degrees (clockwise) and -270 degrees (counterclockwise) can be reframed:

- 90° (clockwise) $\equiv -90^\circ$
- -270° is already -270°

Since:

$$\backslash \\ -270^\circ + 360^\circ = 90^\circ \\ \backslash$$

they are coterminal.

Summary of Findings

- Angles measure the same terminal side if their difference is a multiple of 360° .
- 90° (clockwise) is equivalent to -90° .
- -270° is equivalent to -270° .
- Adding 360° to -270° gives:

$$\backslash \\ -270^\circ + 360^\circ = 90^\circ \\ \backslash$$

- Since -270° and 90° differ by 360° , they are coterminal.

Therefore, 90° (clockwise) and -270° (counterclockwise) are coterminal angles because they share the same terminal side when measured appropriately.

Features, Pros, and Cons of Coterminal Angles

Features:

- Angles that differ by a multiple of 360° .
- Have identical terminal sides in standard position.
- Can be positive or negative.

Pros:

- Simplify trigonometric calculations, as functions are periodic.
- Help in solving equations involving angles.
- Provide flexibility in angle measurement and problem-solving.

Cons:

- Can cause confusion if the direction of angle measurement isn't clearly specified.
- May lead to misinterpretation if only the numerical measure is considered without considering rotation direction.
- Not all angles with similar measures are coterminal; the difference must be a multiple of 360° .

Conclusion

In summary, are 90 degrees (clockwise) and -270 degrees (counterclockwise) coterminal? WHY Or Why Not? The answer is yes. These angles are coterminal because, when measured correctly and considering the periodicity of angles, they share the same terminal side. Specifically, rotating 90° clockwise (equivalent to -90°) and rotating -270° (which is also equivalent to 90° in standard position) both lead to the same terminal side pointing downward along the negative y-axis. Recognizing the significance of adding or subtracting multiples of 360° helps clarify the relationships between angles measured in different directions. Understanding these principles not only aids in solving geometric and trigonometric problems but also enhances the conceptual grasp of how angles function within the circle framework.

[Are 90 Degrees Clockwise And 270 Degrees Counter Clockwise Coterminal Why Or Why Not](#)

Are 90 Degrees Clockwise And 270 Degrees Counter Clockwise Coterminal Why Or Why Not

Related Articles

- [Firms Pursuing _____ Have Between 70% And 95% Of Their Sales In A Single Product Market.](#)
- [The Population Of Any Species That Can Be Sustained By Natural Resources Is Known As:_____.](#)
- [9. If The Mass Of A 200 N Object Is Cut In Half, What Would Happen To Its Weight In Newtons?](#)

[Back to Home](#)