Coterminal Angles And Reference Angles Answer Key

7) −510°

8) $-\dfrac{19\pi}{18}$

9) $-\dfrac{13\pi}{12}$

10) −250°

State if the given angles are coterminal.

11) 185°, −545°

12) $\dfrac{17\pi}{36}$, $\dfrac{161\pi}{36}$

Find a coterminal angle between 0° and 360°.

13) −330°

14) −435°

15) 640°

16) −442°

Find a coterminal angle between 0 and 2π for each given angle.

17)

18)

19)

20)

Find a positive and a negative coterminal angle for each given angle.

21)

22)

Coterminal angles are an essential concept in trigonometry that often perplexes students encountering this topic for the first time. Understanding coterminal angles is crucial for solving problems related to angles in the coordinate plane, as well as for applications involving trigonometric functions. This article will delve into the definitions, properties, and methods for finding coterminal angles and reference angles, providing a comprehensive answer key to aid in understanding.

Understanding Coterminal Angles

Coterminal angles are angles that share the same terminal side when drawn in standard position.

This means that if you were to take one angle and rotate it around the circle, you could land on another angle that has the same position. The concept of coterminal angles is vital in trigonometry since many problems involve circular motion or periodic functions.

Definition of Coterminal Angles

An angle θ is coterminal with another angle ϕ if:

$$
\phi = \theta + 360n
$$

where n is any integer. This equation indicates that you can obtain coterminal angles by adding or subtracting multiples of 360° (or 2π radians) to the original angle.

Examples of Coterminal Angles

To better illustrate this concept, consider the following examples:

1. Positive Angles:
- For 45°:
- $45^\circ + 360^\circ = 405^\circ$
- $45^\circ + 720^\circ = 765^\circ$
- Coterminal angles of 45° include 405° and 765°.

2. Negative Angles:
- For -30°:
- $-30^\circ + 360^\circ = 330^\circ$
- $-30^\circ + 720^\circ = 690^\circ$
- The coterminal angles of -30° include 330° and 690°.

Finding Coterminal Angles

To find coterminal angles, you can follow these steps:

1. Identify the given angle (in degrees or radians).

2. Add or subtract 360° (or 2π radians) to the angle to find multiple coterminal angles.

3. Repeat the process for different values of n (positive and negative integers) to generate more angles.

Examples of Finding Coterminal Angles

1. Finding Coterminal Angles for 150°:
- Adding 360°:
- $150^\circ + 360^\circ = 510^\circ$
- Subtracting 360°:
- $150^\circ - 360^\circ = -210^\circ$
- Coterminal angles for 150° include 510° and -210°.

2. Finding Coterminal Angles for $\frac{5\pi}{4}$ Radians:
- Adding 2π:
- $\frac{5\pi}{4} + 2\pi = \frac{5\pi}{4} + \frac{8\pi}{4} = \frac{13\pi}{4}$
- Subtracting 2π:
- $\frac{5\pi}{4} - 2\pi = \frac{5\pi}{4} - \frac{8\pi}{4} = -\frac{3\pi}{4}$
- Coterminal angles for $\frac{5\pi}{4}$ include $\frac{13\pi}{4}$ and $-\frac{3\pi}{4}$.

Understanding Reference Angles

Reference angles are another critical concept in trigonometry. A reference angle is the acute angle formed by the terminal side of a given angle and the x-axis. Reference angles are always positive and are measured in degrees or radians, typically falling between 0° and 90° (or 0 and $\frac{\pi}{2}$ radians).

Finding Reference Angles

To find the reference angle for any angle θ, follow these steps:

1. Identify the quadrant in which the angle lies.

2. Use the appropriate formula based on the quadrant:

- Quadrant I: Reference angle $= \theta$

- Quadrant II: Reference angle $= 180^\circ - \theta$ (or $\pi - \theta$)

- Quadrant III: Reference angle $= \theta - 180^\circ$ (or $\theta - \pi$)

- Quadrant IV: Reference angle $= 360^\circ - \theta$ (or $2\pi - \theta$)

Examples of Finding Reference Angles

1. Finding Reference Angle for 210°:
- 210° is in Quadrant III.
- Reference angle $= 210^\circ - 180^\circ = 30^\circ$.

2. Finding Reference Angle for 330°:
- 330° is in Quadrant IV.
- Reference angle $= 360^\circ - 330^\circ = 30^\circ$.

3. Finding Reference Angle for 120°:
- 120° is in Quadrant II.
- Reference angle $= 180^\circ - 120^\circ = 60^\circ$.

Conclusion

In summary, understanding coterminal angles and reference angles is fundamental in the study of trigonometry. Coterminal angles enable us to express the same geometric position using different numerical values, while reference angles allow us to simplify trigonometric calculations by focusing on the acute angle formed with the x-axis.

By mastering these concepts, students can enhance their problem-solving skills in trigonometry and develop a deeper understanding of angular relationships in geometry. Remember to practice finding coterminal and reference angles regularly, as familiarity with these concepts will greatly enhance your mathematical proficiency.

Frequently Asked Questions

What are coterminal angles?

Coterminal angles are angles that share the same terminal side when drawn in standard position, differing by whole multiples of 360 degrees or 2π radians.

How do you find coterminal angles for a given angle?

To find coterminal angles, you can add or subtract multiples of 360 degrees (or 2π radians) from the given angle.

What is the reference angle for an angle of 150 degrees?

The reference angle for 150 degrees is 180 degrees - 150 degrees = 30 degrees.

Can you provide an example of coterminal angles for 45

degrees?

Examples of coterminal angles for 45 degrees include 45 degrees, 405 degrees (45 + 360), and -315 degrees (45 - 360).

What is the formula to calculate the reference angle in radians?

The reference angle in radians can be calculated as follows: for angles in the second quadrant, reference angle = π - θ; in the third quadrant, reference angle = θ - π; and in the fourth quadrant, reference angle = 2π - θ.

What is the reference angle for -90 degrees?

The reference angle for -90 degrees is 90 degrees, as it corresponds to the positive angle of 270 degrees, which is in the third quadrant.

Are coterminal angles always positive?

No, coterminal angles can be positive or negative; they are defined by being a whole number multiple of 360 degrees away from the original angle.

What is the reference angle for an angle of 270 degrees?

The reference angle for 270 degrees is 270 degrees - 180 degrees = 90 degrees.

How do reference angles help in trigonometry?

Reference angles help simplify calculations in trigonometry by providing a way to relate angles in different quadrants to their corresponding acute angles.

What is the coterminal angle of 750 degrees?

The coterminal angle of 750 degrees can be found by subtracting 360 degrees twice, resulting in 750 - 720 = 30 degrees.

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