coterminal angles worksheet with answers

Coterminal angles worksheet with answers is an essential resource for students learning about angles in mathematics. Coterminal angles are angles that share the same terminal side when drawn in standard position, which means they differ by a full rotation of 360 degrees (or 2π radians). Understanding coterminal angles is crucial for grasping concepts in trigonometry, geometry, and calculus. This article will explore the concept of coterminal angles, provide examples, outline a worksheet, and offer answers to help learners solidify their understanding.

Understanding Coterminal Angles

Coterminal angles can be easily identified through a straightforward mathematical approach. Here's how they work:

1. Definition: Two angles are coterminal if they differ by a multiple of 360 degrees (or 2π radians). For instance, if you have an angle of 30 degrees, you can find coterminal angles by adding or subtracting multiples of 360 degrees:
- $30^\circ + 360^\circ = 390^\circ$
- $30^\circ - 360^\circ = -330^\circ$

2. Formula: The general formula for finding coterminal angles is given by:
- $\theta + 360n$ (degrees)
- $\theta + 2\pi n$ (radians)
Where n is an integer (positive, negative, or zero).

3. Visual Representation: When graphed, coterminal angles overlap on the unit circle. This visual aspect is important to understand, as it shows that angles can be expressed in multiple ways while still representing the same orientation.

Examples of Coterminal Angles

To illustrate the concept of coterminal angles, let's look at a few examples:

Example 1: Finding Coterminal Angles

Find two positive and two negative coterminal angles for 45°:

- Positive coterminal angles:
- $45^\circ + 360^\circ \cdot 1 = 405^\circ$
- $45^\circ + 360^\circ \cdot 2 = 765^\circ$

- Negative coterminal angles:
- $45^\circ - 360^\circ \cdot 1 = -315^\circ$

- $45^\circ - 360^\circ \cdot 2 = -675^\circ$

Thus, the coterminal angles for 45° include 405°, 765°, -315°, and -675°.

Example 2: Coterminal Angles in Radians

Find two positive and two negative coterminal angles for $\frac{\pi}{4}$:

- Positive coterminal angles:
- $\frac{\pi}{4} + 2\pi \cdot 1 = \frac{\pi}{4} + \frac{8\pi}{4} = \frac{9\pi}{4}$
- $\frac{\pi}{4} + 2\pi \cdot 2 = \frac{\pi}{4} + \frac{16\pi}{4} = \frac{17\pi}{4}$

- Negative coterminal angles:
- $\frac{\pi}{4} - 2\pi \cdot 1 = \frac{\pi}{4} - \frac{8\pi}{4} = -\frac{7\pi}{4}$
- $\frac{\pi}{4} - 2\pi \cdot 2 = \frac{\pi}{4} - \frac{16\pi}{4} = -\frac{15\pi}{4}$

From the above, the coterminal angles for $\frac{\pi}{4}$ are $\frac{9\pi}{4}$, $\frac{17\pi}{4}$, $-\frac{7\pi}{4}$, and $-\frac{15\pi}{4}$.

Creating a Coterminal Angles Worksheet

A coterminal angles worksheet can be a valuable tool for practicing the concepts discussed. Below is a sample worksheet that can be used in a classroom setting or for self-study.

Worksheet: Coterminal Angles

Instructions: For each angle given below, find two positive and two negative coterminal angles. Show all your calculations.

1. 60°
2. -120°
3. 270°
4. $\frac{5\pi}{6}$
5. $-\frac{\pi}{3}$

Additional Questions:

6. Determine if 150° and -210° are coterminal.
7. Find the smallest positive coterminal angle for -450°.

Answers to the Coterminal Angles Worksheet

Here are the answers and explanations for the worksheet provided above.

Answer Key

1. For 60°:
- Positive:
- $60^\circ + 360^\circ = 420^\circ$
- $60^\circ + 720^\circ = 780^\circ$
- Negative:
- $60^\circ - 360^\circ = -300^\circ$
- $60^\circ - 720^\circ = -660^\circ$

2. For -120°:
- Positive:
- $-120^\circ + 360^\circ = 240^\circ$
- $-120^\circ + 720^\circ = 600^\circ$
- Negative:
- $-120^\circ - 360^\circ = -480^\circ$
- $-120^\circ - 720^\circ = -840^\circ$

3. For 270°:
- Positive:
- $270^\circ + 360^\circ = 630^\circ$
- $270^\circ + 720^\circ = 990^\circ$
- Negative:
- $270^\circ - 360^\circ = -90^\circ$
- $270^\circ - 720^\circ = -450^\circ$

4. For $\frac{5\pi}{6}$:
- Positive:
- $\frac{5\pi}{6} + 2\pi = \frac{5\pi}{6} + \frac{12\pi}{6} = \frac{17\pi}{6}$
- $\frac{5\pi}{6} + 4\pi = \frac{5\pi}{6} + \frac{24\pi}{6} = \frac{29\pi}{6}$
- Negative:
- $\frac{5\pi}{6} - 2\pi = \frac{5\pi}{6} - \frac{12\pi}{6} = -\frac{7\pi}{6}$
- $\frac{5\pi}{6} - 4\pi = \frac{5\pi}{6} - \frac{24\pi}{6} = -\frac{19\pi}{6}$

5. For $-\frac{\pi}{3}$:
- Positive:
- $-\frac{\pi}{3} + 2\pi = -\frac{\pi}{3} + \frac{6\pi}{3} = \frac{5\pi}{3}$
- $-\frac{\pi}{3} + 4\pi = -\frac{\pi}{3} + \frac{12\pi}{3} = \frac{11\pi}{3}$
- Negative:
- $-\frac{\pi}{3} - 2\pi = -\frac{\pi}{3} - \frac{6\pi}{3} = -\frac{7\pi}{3}$
- $-\frac{\pi}{3} - 4\pi = -\frac{\pi}{3} - \frac{12\pi}{3} = -\frac{13\pi}{3}$

6. Are 150° and -210° coterminal?
- $150^\circ + 360^\circ = 510^\circ$

- $-210^\circ + 360^\circ = 150^\circ$
- Yes, they are coterminal.

7. Smallest positive coterminal angle for -450°:
- $-450^\circ + 360^\circ = -90^\circ$
- $-90^\circ + 360^\circ = 270^\circ$
- The smallest positive coterminal angle is 270°.

Conclusion

A worksheet on coterminal angles is a practical tool for reinforcing the understanding of this important mathematical concept. By practicing with examples,

Frequently Asked Questions

What are coterminal angles?

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

How can I find coterminal angles?

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

If I have an angle of 45 degrees, what is one positive coterminal angle?

One positive coterminal angle for 45 degrees is 405 degrees (45 + 360).

What is the formula for finding coterminal angles in radians?

The formula is: angle ± 2πn, where n is any integer.

Can you give an example of finding a negative coterminal angle for 150 degrees?

A negative coterminal angle for 150 degrees is -210 degrees (150 - 360).

Why are coterminal angles important in trigonometry?

Coterminal angles are important because trigonometric functions are periodic, meaning they have the same values for coterminal angles.

What is a worksheet on coterminal angles typically used for?

A worksheet on coterminal angles is typically used for practice in finding and understanding the concept of coterminal angles in geometry and trigonometry.

How do I check if two angles are coterminal?

To check if two angles are coterminal, verify if their difference is a multiple of 360 degrees (or 2π radians).

Coterminal Angles Worksheet With Answers

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