Radians & Degrees and Co-Terminal Angles

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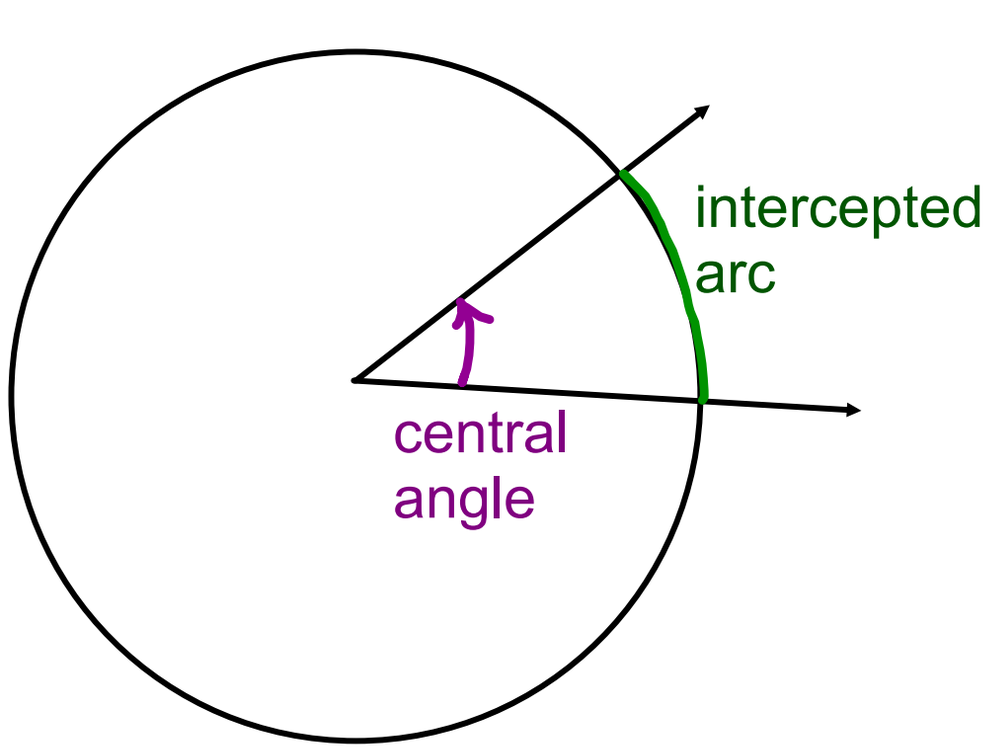
Definitions

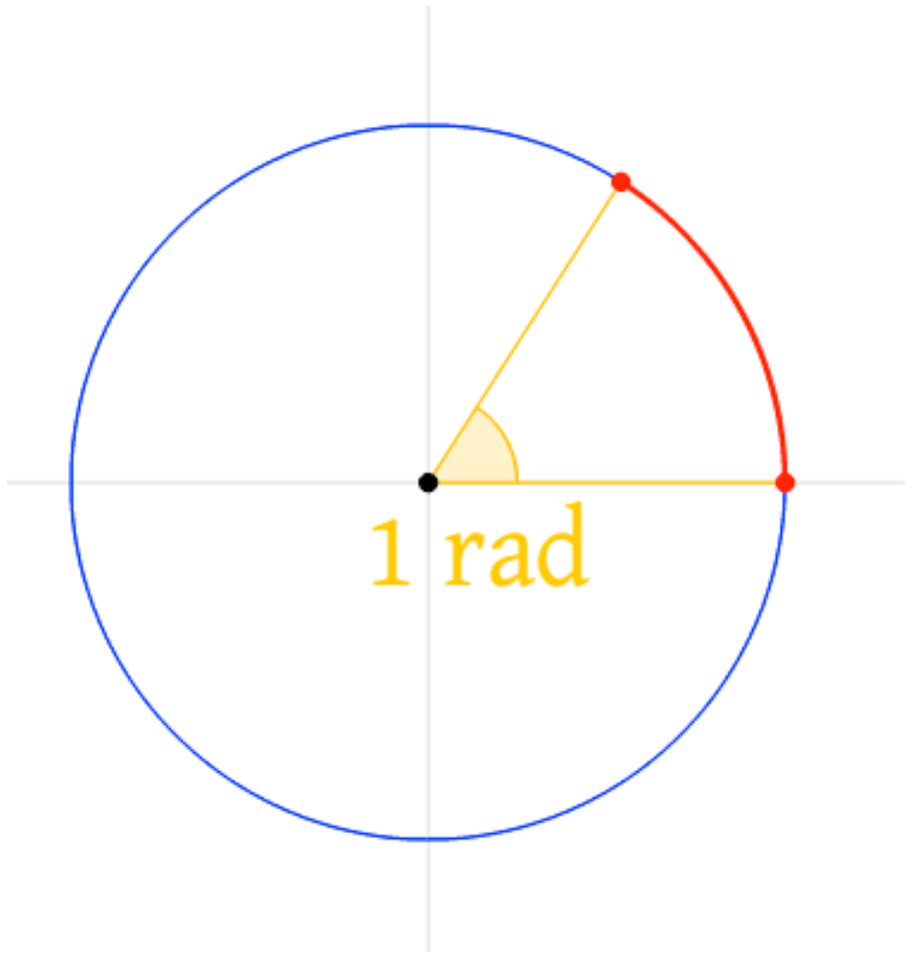
A **central angle** of a circle is an angle whose vertex is the center of the circle.

An **intercepted arc** is the part of the circle that includes the points of intersection with the central angle and all the points in the interior of the angle.



Radians and Degrees

One radian is the measure of a central angle that intercepts an arc whose length is equal to the radius of the circle.
There are 2 π, or a little more than 6, radians in a circle.



Click on the circle for an animated view of radians.

Converting from Degrees to Radians

There are 360º in a circle. Therefore

$$360º = 2\pi \text{ radians}$$

$$1º = \frac{2\pi}{360} = \frac{\pi}{180} \text{ radians}$$

Use this conversion factor to covert degrees to radians.

Example: Convert 50º and 90º to radians.

$$50º \cdot \frac{\pi}{180} = \frac{5\pi}{18} \text{ radians}$$

$$90º \cdot \frac{\pi}{180} = \frac{\pi}{2} \text{ radians}$$

Converting from Radians to Degrees

2π radians = 360º

$$1 \text{ radian} = \frac{360}{2\pi} = \frac{180}{\pi} \text{ degrees}$$

Use this conversion factor to covert radians to degrees.

Example: Convert $\frac{\pi}{4}$ and π to degrees.

$$\frac{\pi}{4} \cdot \frac{180}{\pi} = 45^\circ$$

$$\pi \cdot \frac{180}{\pi} = 180^\circ$$

Converting between Radians and Degrees

Convert degrees to radians

$60° =$

$110° =$

$240° =$

Answer

Converting between Radians and Degrees

Convert radians to degrees

$\frac{\pi}{4}$ radians $=$

Answer

$\frac{5\pi}{6}$ radians $=$

$\frac{10\pi}{4}$ radians $=$

1 Convert degrees to radians: $120°$

A $\frac{\pi}{3}$

B $\frac{2\pi}{3}$

C $\frac{4\pi}{3}$

D $\frac{5\pi}{3}$

Answer

2 Convert degrees to radians: $300°$

A $\frac{\pi}{3}$

B $\frac{2\pi}{3}$

C $\frac{4\pi}{3}$

D $\frac{5\pi}{3}$

Answer

3 Convert radians to degrees:

$$\frac{11}{5}\pi$$

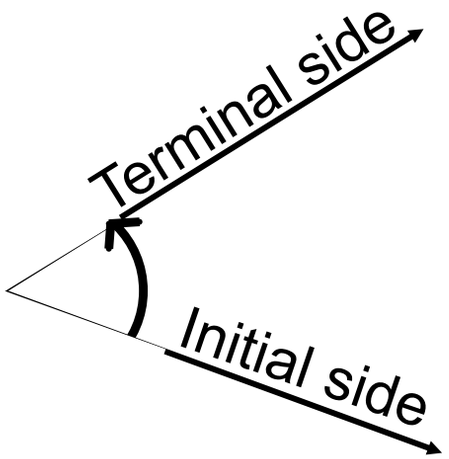
Answer

4 Convert radians to degrees:

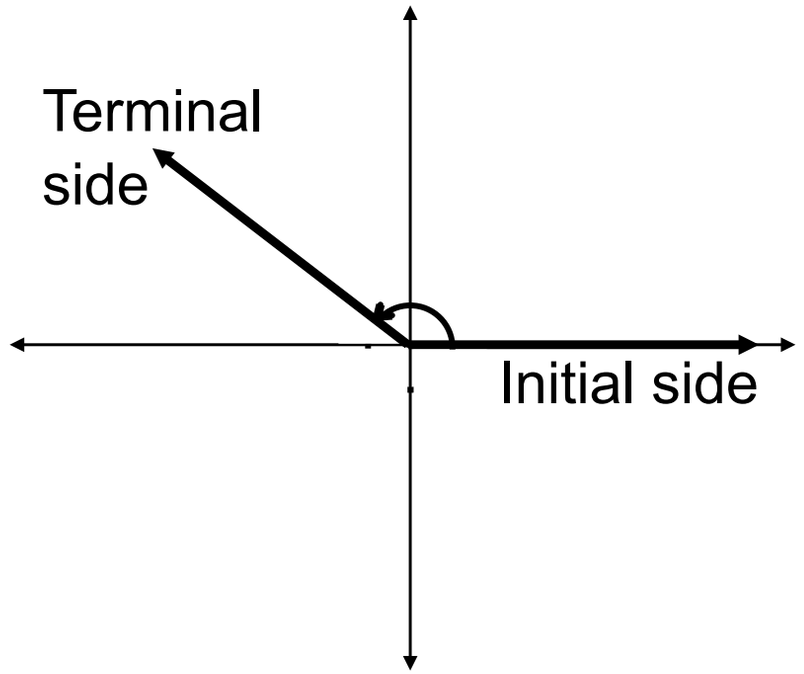
$$\frac{3}{8}\pi$$

Answer

Angles



Angle



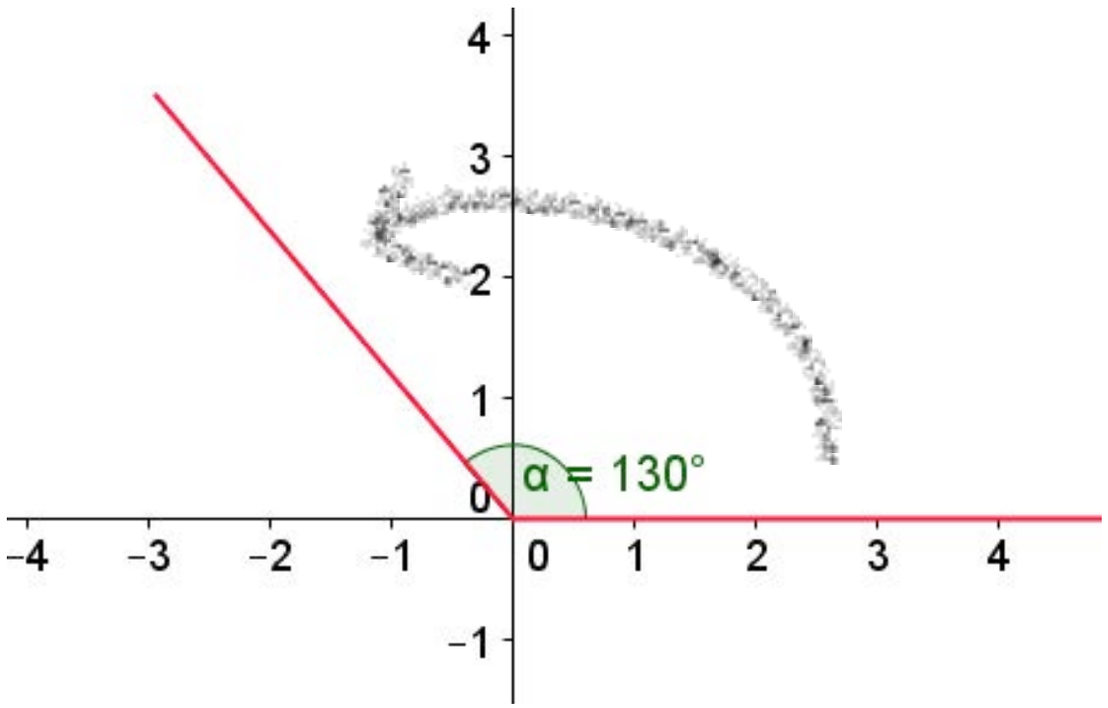
Angle in standard position

An angle is formed by rotating a ray about its endpoint. The starting position is the **initial side** and the ending position is the **terminal side**.

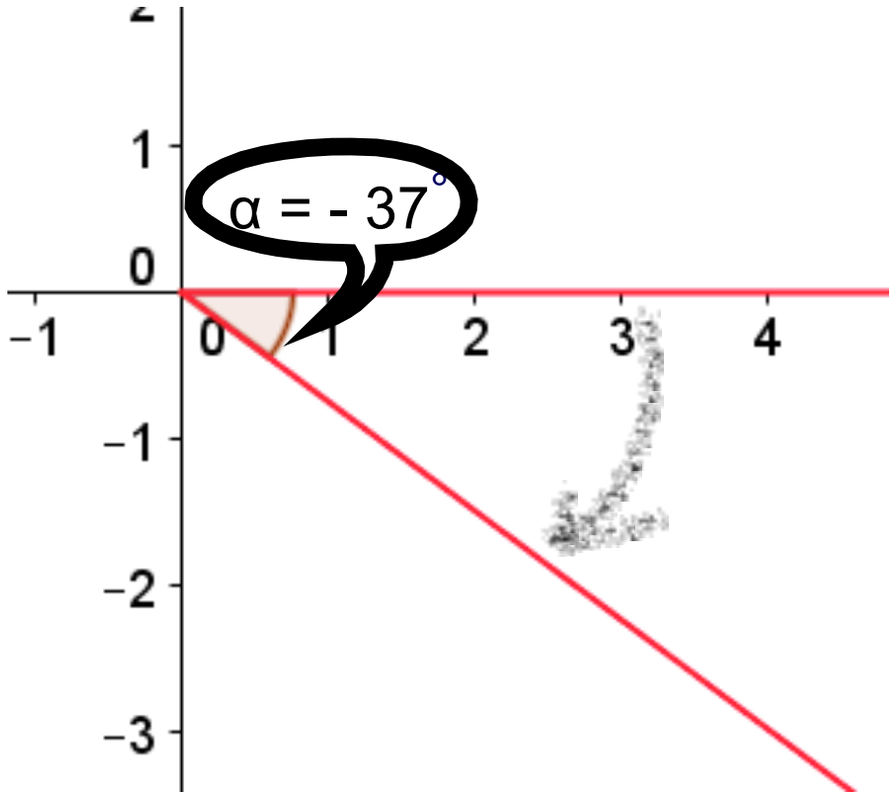
When, on the coordinate plane, the vertex of the angle is the origin and the initial side is the positive x-axis, the angle is in **standard position**.

Positive and Negative Angles

Positive Angle - terminal side rotates in a counter-clockwise direction

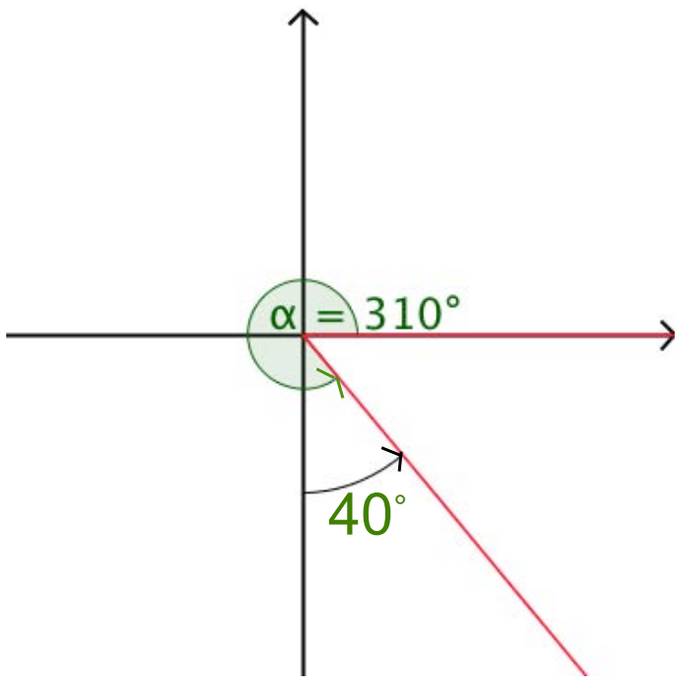


Negative Angle - terminal side rotates in a clockwise direction



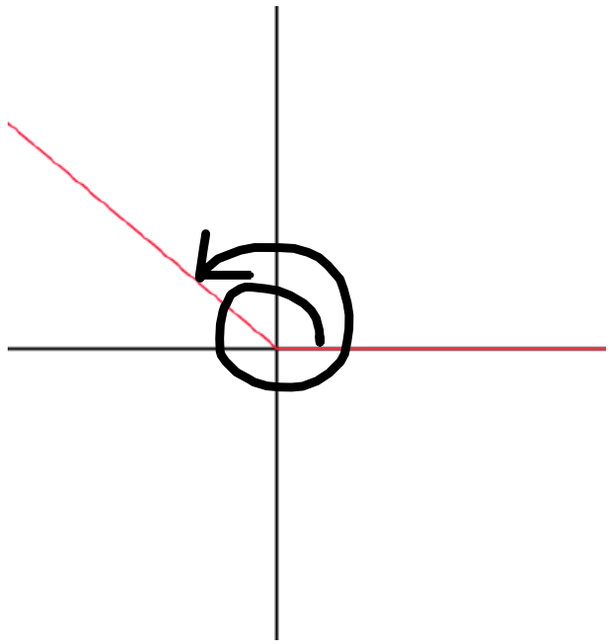
Drawing angles in standard position

310 °



Each quadrant is 90°, and 310° is 40° more than 270°, so the terminal side is 40° past the negative y-axis.

500°



500° is 140° more than 360°, so the angle makes a complete revolution counterclockwise and then another 140°.

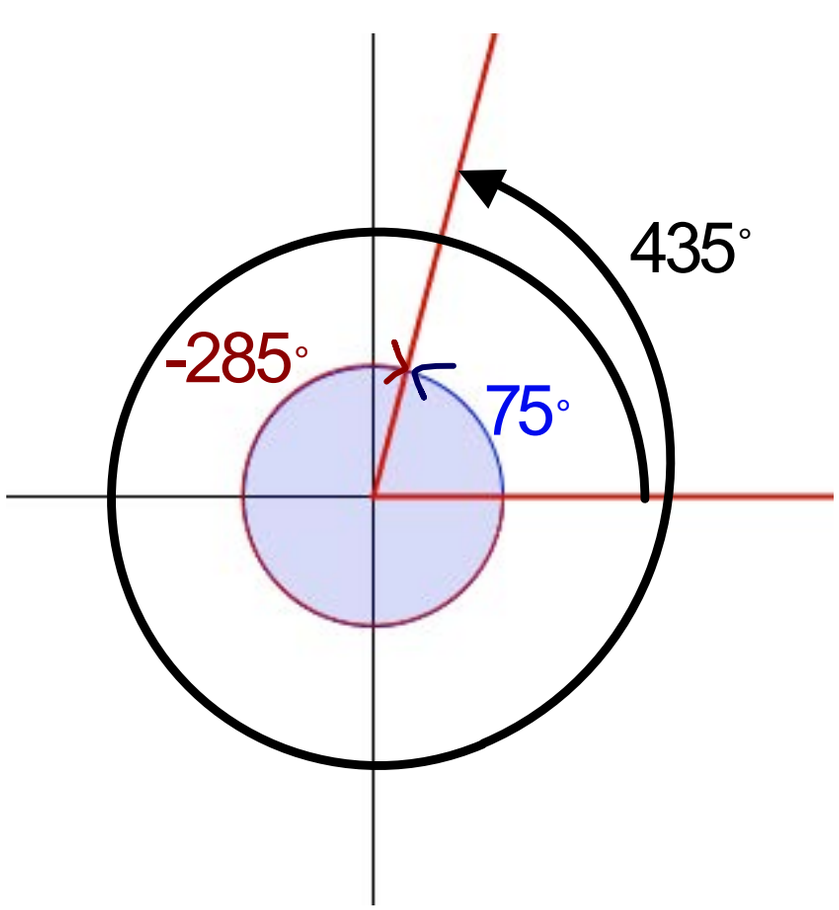
Coterminal Angles

Angles that have the same terminating side are coterminal. To find coterminal angles add or subtract multiples of 360° for degrees and 2π for radians.

Example: Find one positive and one negative angle that are terminal with 75°.

$75 + 360 = 435^\circ$

$75 - 360 = -285^\circ$



5 Which angles are coterminal with 40°? Select all that are correct.

A 320°

B -320°

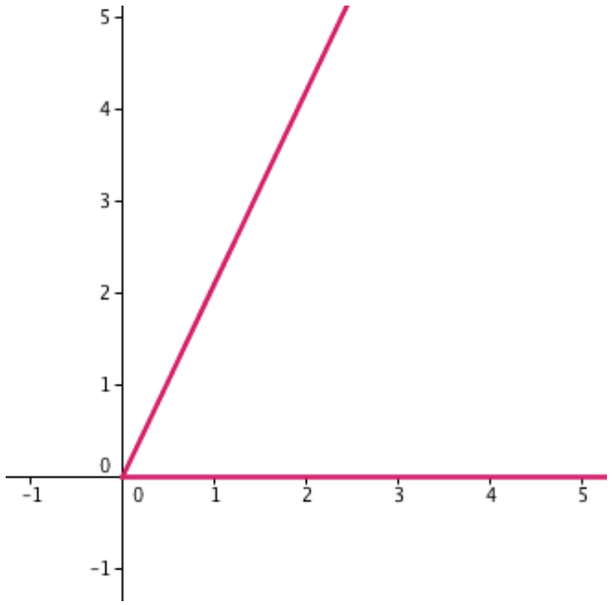
C 400°

D -400°

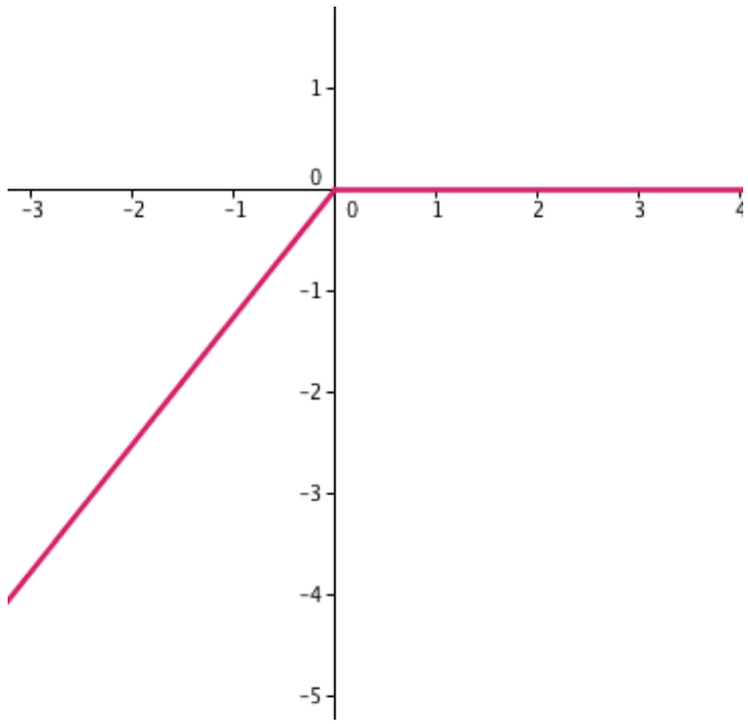
Answer

6 Which graph represents 425° ?

A

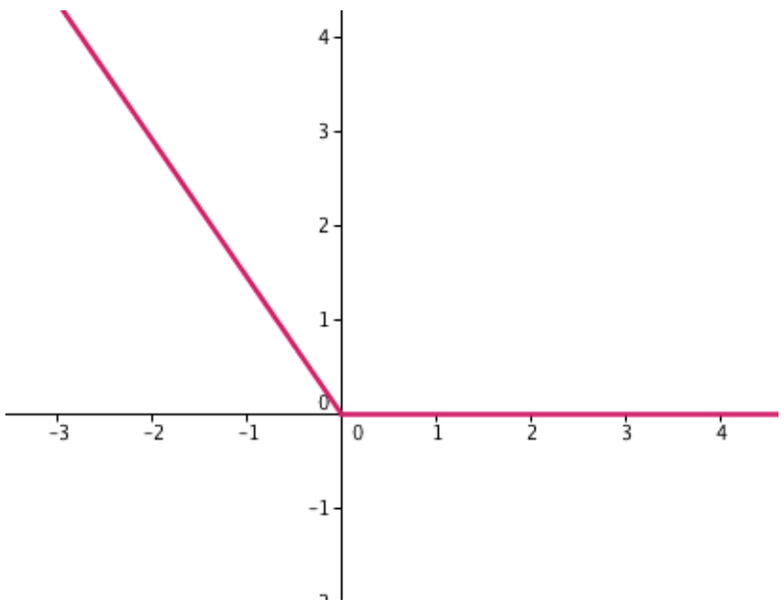


B

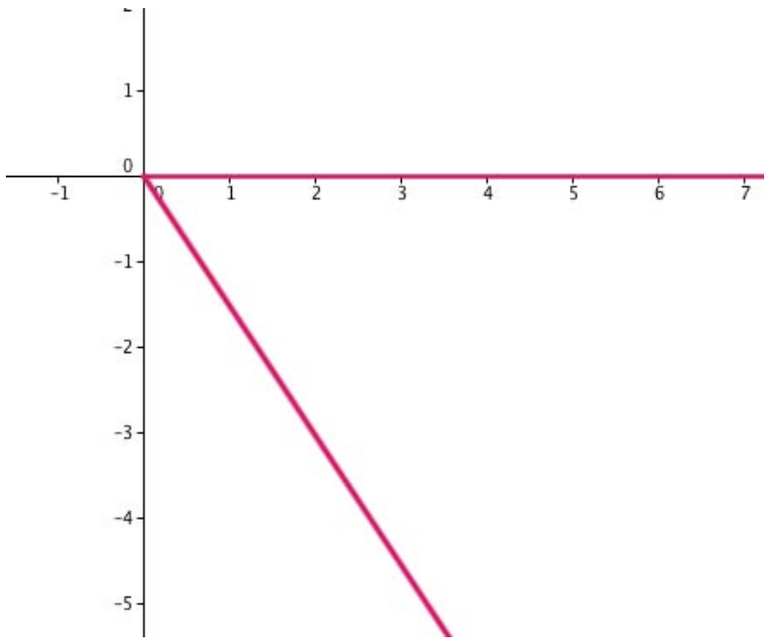


Answer

C

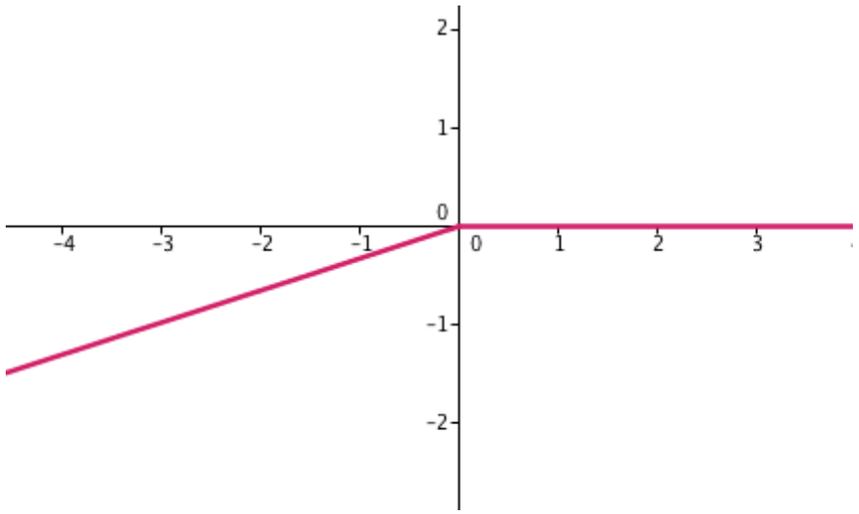


D

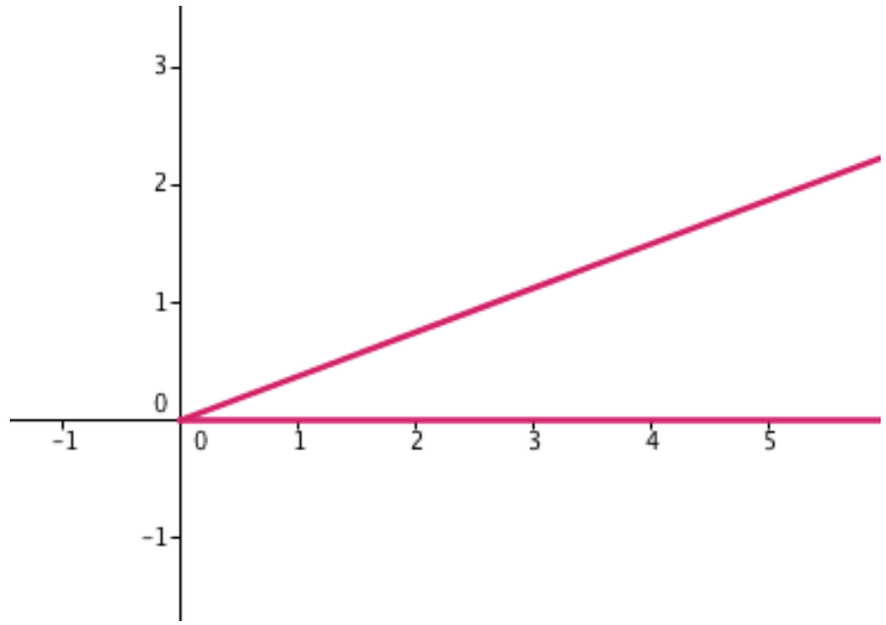


7 Which graph represents $-\frac{9\pi}{8}$?

A



B



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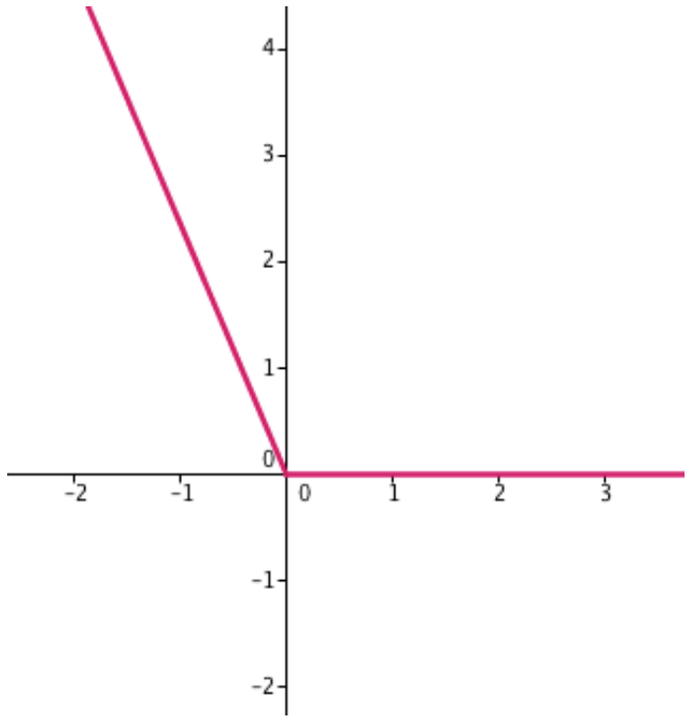
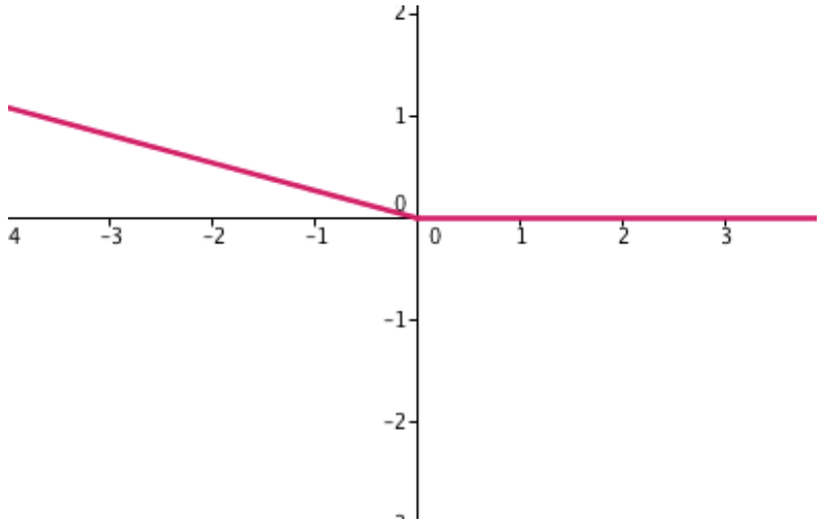


D



Answer

8 Which angle is NOT coterminal with -55°?

A 305°

B 665°

C -415°

D -305°

Answer

9 Which angle is coterminal with $\frac{5\pi}{3}$?

A $-\frac{7\pi}{3}$

B $-\frac{\pi}{3}$

C $\frac{9\pi}{3}$

D $-\frac{2\pi}{3}$

Answer