MATHEMATICS · GRADES 10-12

Quadrants and reference angles

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out angles bigger than a right angle, like reading a compass bearing past 90 degrees or working out the angle of a turn that swings back on itself. A hiker following a bearing of 200 degrees needs to know where that points, and a pilot turning through a wide arc needs the same reading. A clock hand past the three and a door swinging back on its hinge both sweep through angles bigger than a right angle. Knowing which quarter of the circle an angle sits in tells you which way it really points.



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Rule

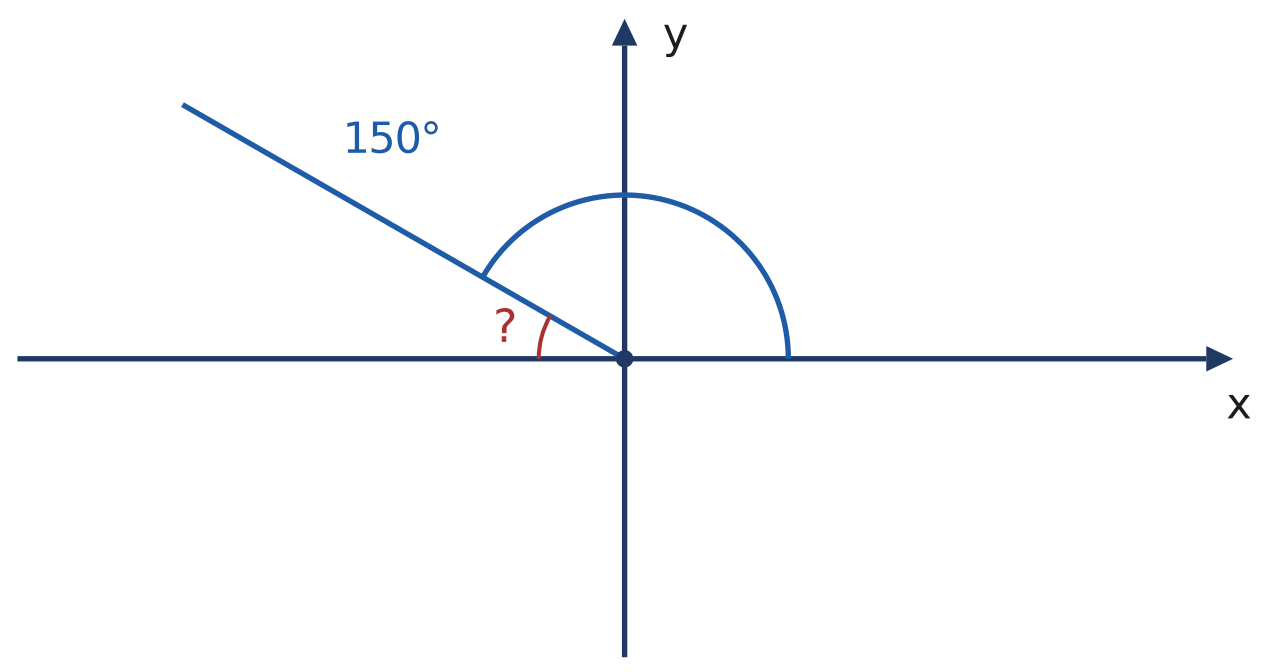
The reference angle is the acute angle between the terminal side and the x-axis.

In quadrant 1 it is the angle itself. In quadrant 2 it is 180 minus the angle. In quadrant 3 it is the angle minus 180. In quadrant 4 it is 360 minus the angle.

Worked examples

EXAMPLE 1

Q **Find the quadrant and reference angle of 150 degrees.**



SOLUTION

150 degrees is between 90 and 180, so it is in quadrant 2.

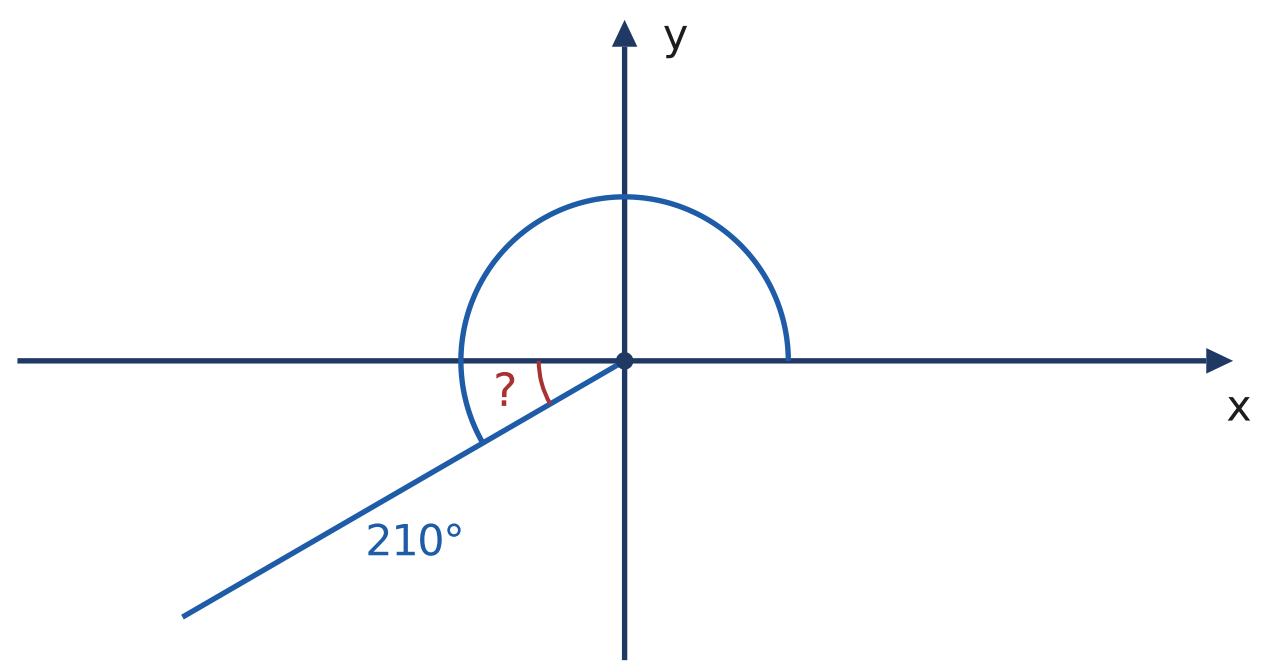
In quadrant 2, take the angle away from 180 to get the reference angle.

Reference angle = 180 - 150 = 30 degrees

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EXAMPLE 2

Q Find the quadrant and reference angle of 210 degrees.



SOLUTION

210 degrees is between 180 and 270, so it is in quadrant 3.

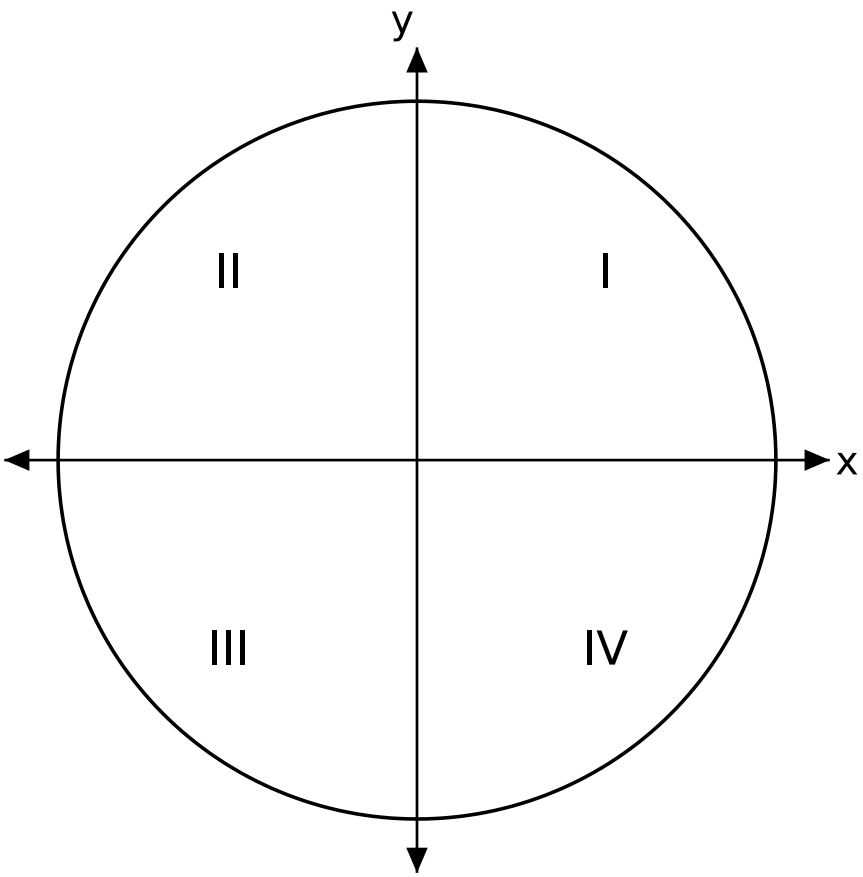
In quadrant 3, the reference angle is what is left after taking 180 away from the angle.

Reference angle = 210 - 180 = 30 degrees

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Practice questions

1 An angle measures 160 degrees. In which quadrant is it, and what is its reference angle?



A. Quadrant 2, reference angle 20 degrees

B. Quadrant 2, reference angle 30 degrees

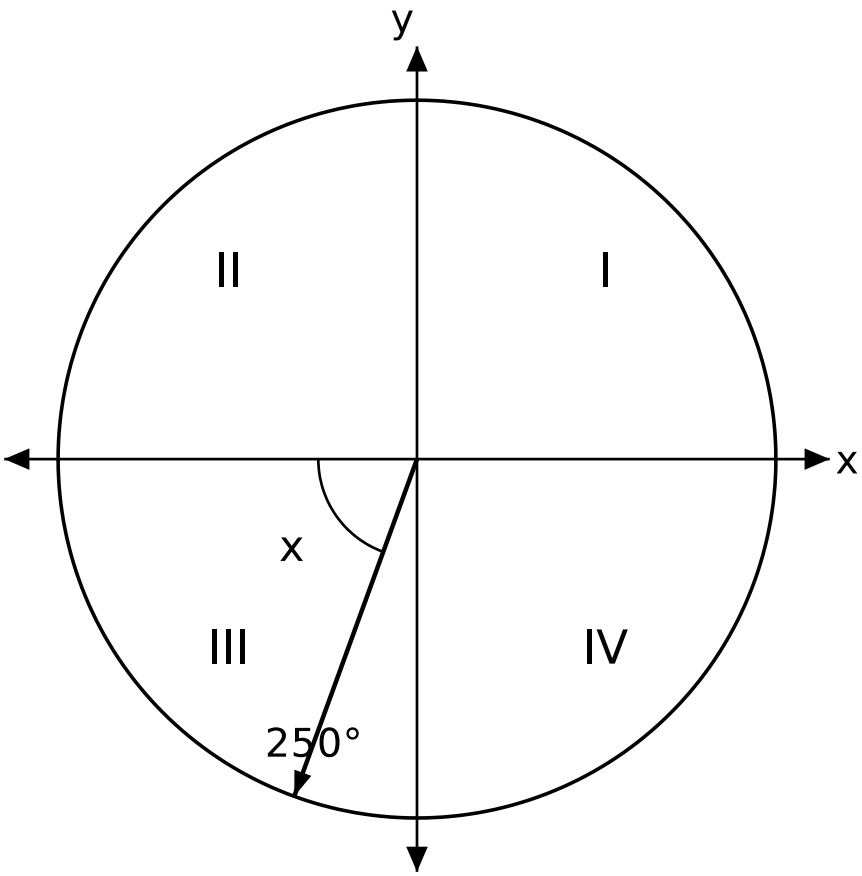
C. Quadrant 1, reference angle 20 degrees

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D Quadrant 3, reference angle 20 degrees

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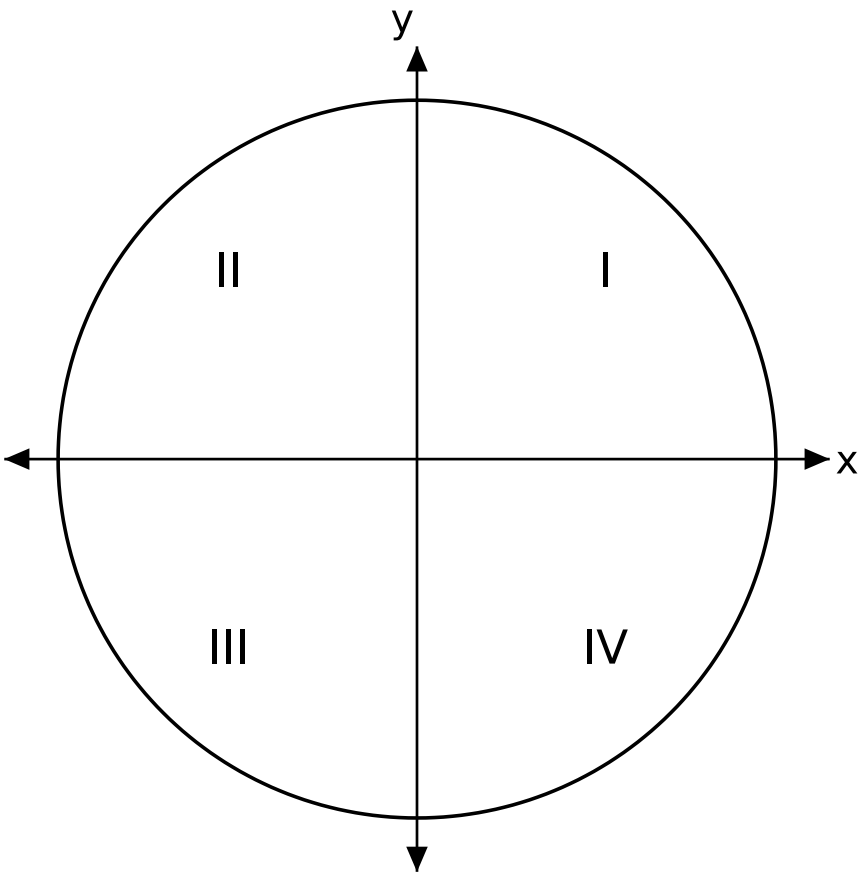
2 What is the reference angle of 250 degrees?



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3 An angle measures 120 degrees. Which quadrant is it in?



A Quadrant 1

B Quadrant 2

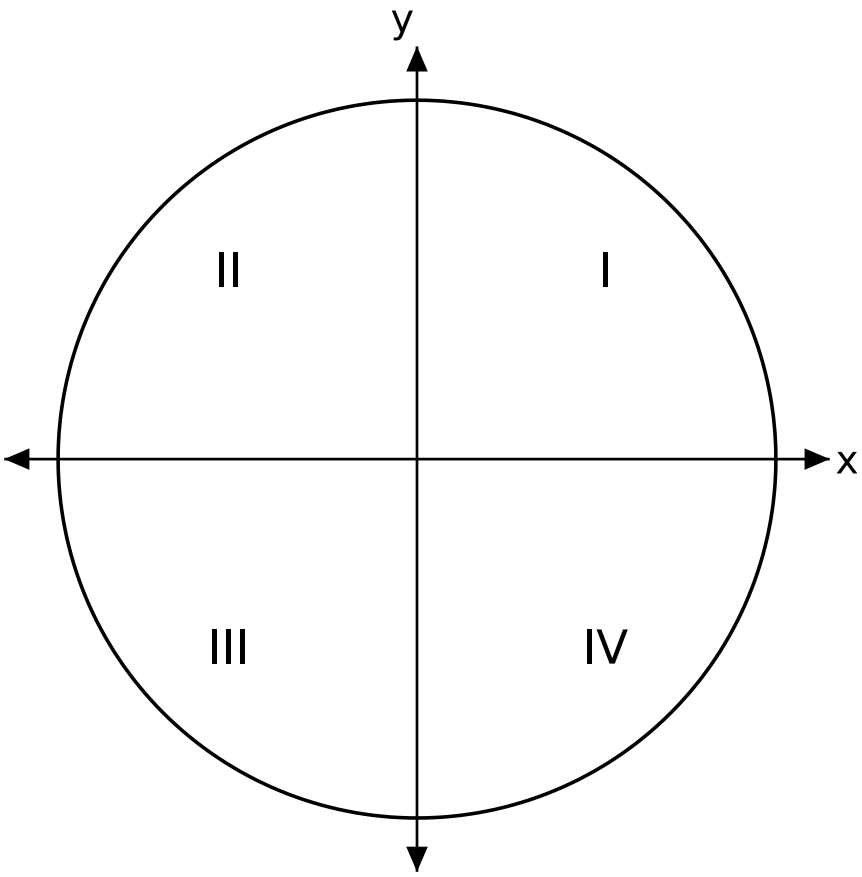
C Quadrant 3

D Quadrant 4

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4 **An angle measures 200 degrees. In which quadrant is it, and what is its reference angle?**



A Quadrant 3, reference angle 20 degrees

B Quadrant 3, reference angle 30 degrees

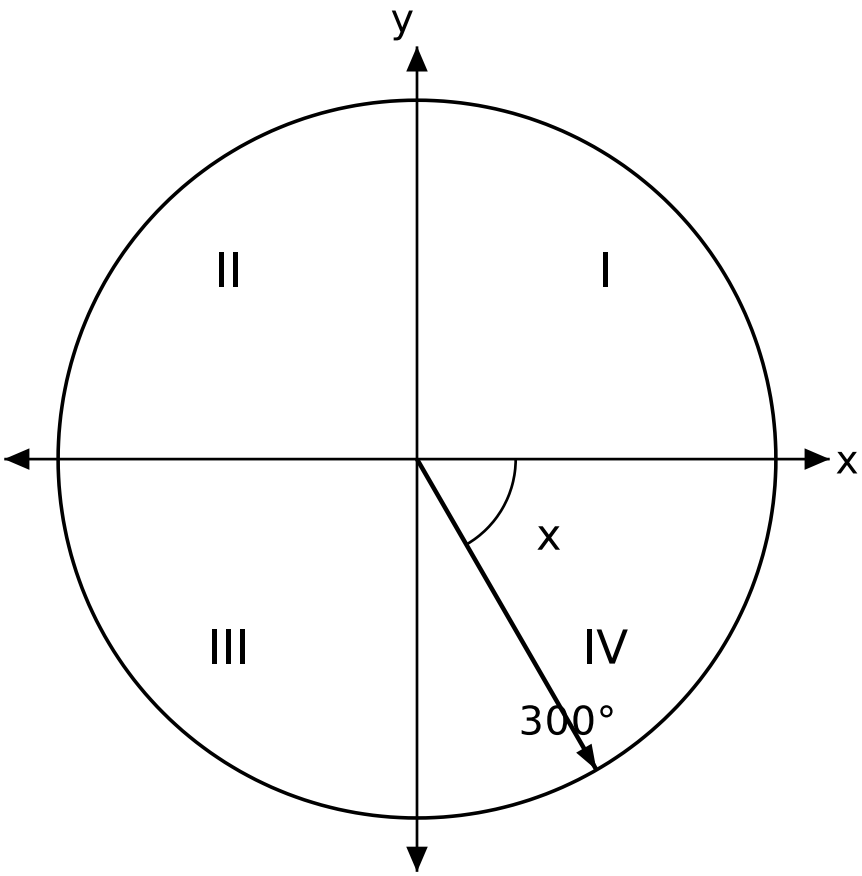
C Quadrant 2, reference angle 20 degrees

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D Quadrant 4, reference angle 20 degrees

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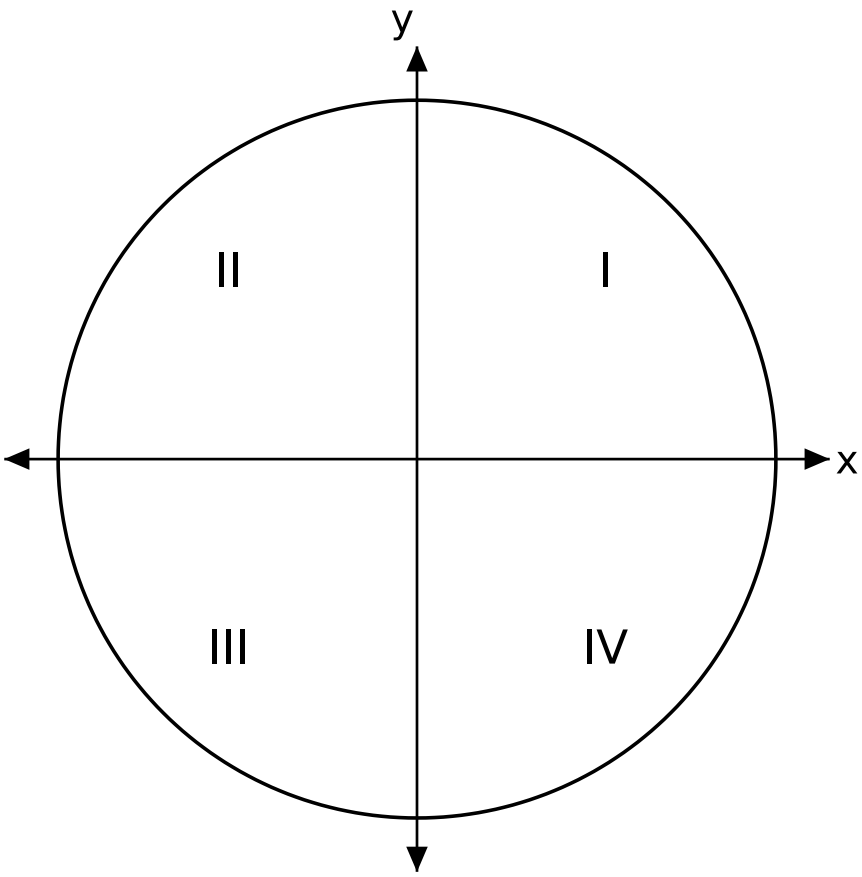
5 **What is the reference angle of 300 degrees?**



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6 **An angle measures 330 degrees. In which quadrant is it, and what is its reference angle?**



A Quadrant 3, reference angle 30 degrees

B Quadrant 4, reference angle 30 degrees

C Quadrant 4, reference angle 60 degrees

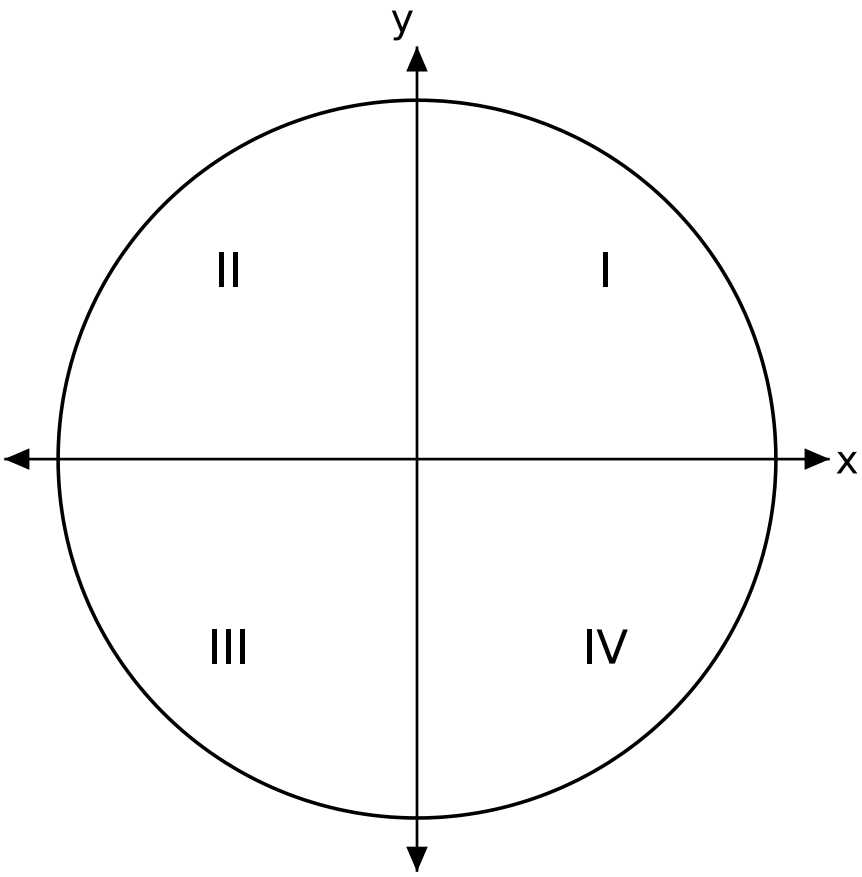
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D Quadrant 1, reference angle 30 degrees

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7 **An angle in quadrant 2 has reference angle 45 degrees. What is the angle?**



A 315 degrees

B 135 degrees

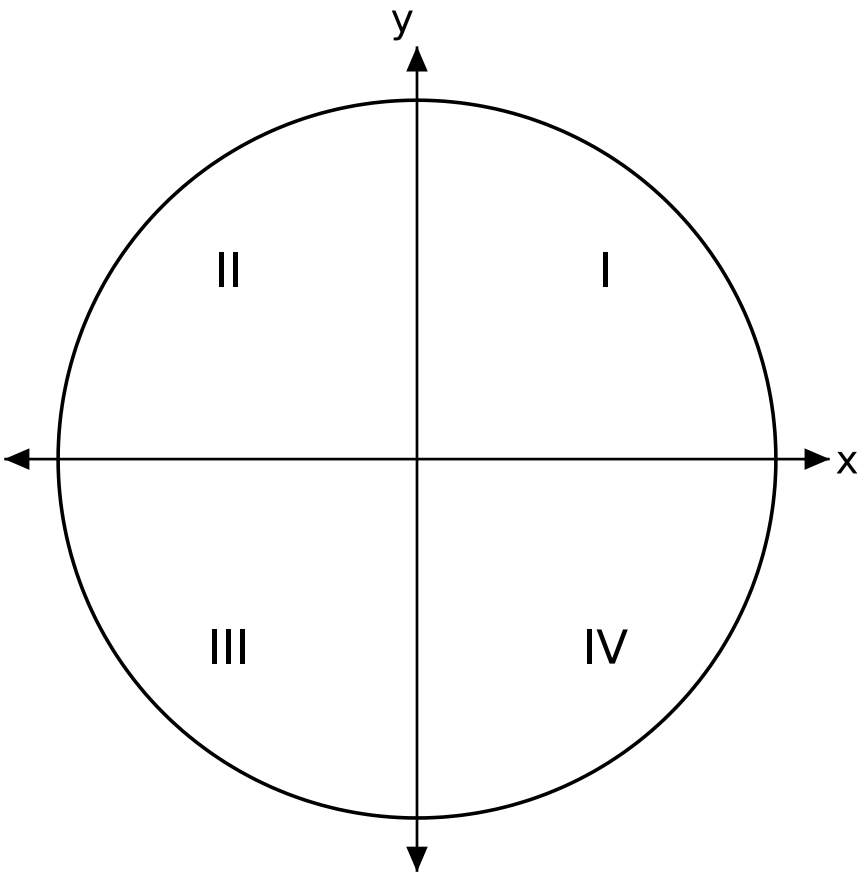
C 45 degrees

D 225 degrees

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8 **An angle in quadrant 3 has reference angle 45 degrees. What is the angle?**



A 315 degrees

B 45 degrees

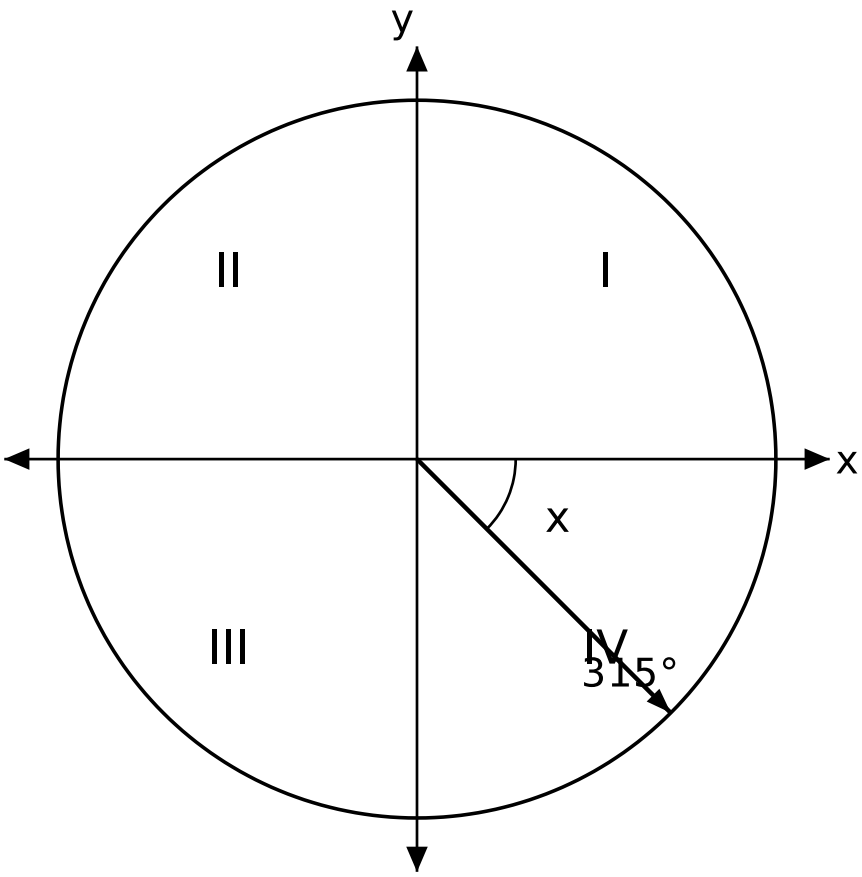
C 225 degrees

D 135 degrees

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9 An angle measures 315 degrees. Which quadrant is it in?



A Quadrant 1

B Quadrant 2

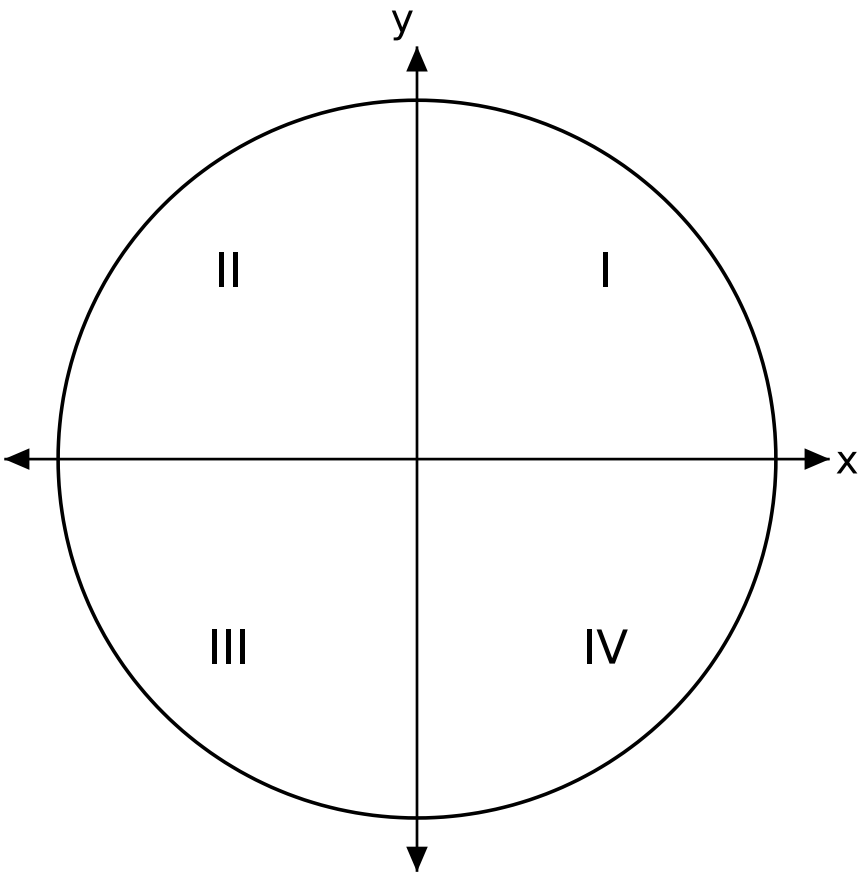
C Quadrant 3

D Quadrant 4

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10 **An angle measures 45 degrees. In which quadrant is it, and what is its reference angle?**



A Quadrant 1, reference angle 45 degrees

B Quadrant 2, reference angle 45 degrees

C Quadrant 1, reference angle 30 degrees

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D Quadrant 4, reference angle 45 degrees

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ANSWER KEY

1. Quadrant 2, reference angle 20 degrees

2. 70 degrees

3. Quadrant 2

4. Quadrant 3, reference angle 20 degrees

5. 60 degrees

6. Quadrant 4, reference angle 30 degrees

7. 135 degrees

8. 225 degrees

9. Quadrant 4

10. Quadrant 1, reference angle 45 degrees

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