MATHEMATICS · GRADES 10-12

The unit circle

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work with angles bigger than a right angle, like the position of a Ferris wheel cabin as it turns past the top, where a simple triangle is no longer enough. A right triangle can only hold angles up to ninety degrees, but a wheel keeps turning well past that. The unit circle carries the same ideas all the way around, so you can read off values for any angle, in any direction. That is how you track a cabin as it goes around, or work with any angle that goes beyond a single right triangle.



Rule

The unit circle: the unit circle is a circle of radius 1 centred at (0, 0).

The point at an angle is (cos, sin), so the x-coordinate is the cosine of the angle and the y-coordinate is the sine.

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Worked examples

EXAMPLE 1

Q Find the point on the unit circle at 90 degrees.

SOLUTION

Start at the +x-axis and turn counterclockwise 90 degrees.

You land on the positive y-axis.

The point is (0, 1), so cos 90 degrees = 0 and sin 90 degrees = 1

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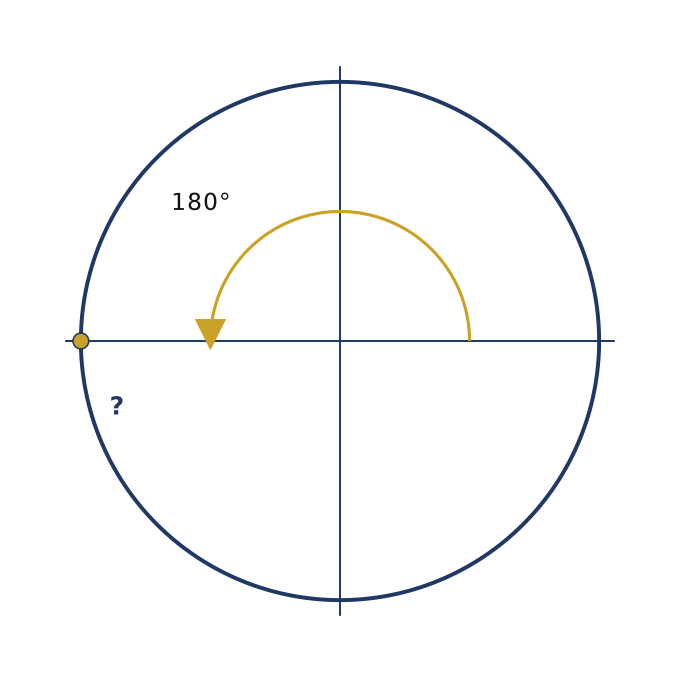
EXAMPLE 2

Q Find cos and sin at 180 degrees.



SOLUTION

Turn counterclockwise 180 degrees from the +x-axis.

You land on the -x-axis, at the point (-1, 0).

So cos 180 degrees = -1 and sin 180 degrees = 0

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Practice questions

1 A Ferris wheel cabin is at the top of the wheel, at the point (0, 1). What angle is the cabin at, in degrees?

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2 Start at the +x-axis and turn counterclockwise 0 degrees. What point are you at on the unit circle?

A (0, 1)

B (1, 0)

C (0, -1)

D (-1, 0)

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3 A Ferris wheel cabin is at the point (-1, 0) on the unit circle. What angle is the cabin at, in degrees?

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4 Start at the +x-axis and turn counterclockwise 270 degrees. What point are you at on the unit circle?

A (0, 1)

B (1, 0)

C (0, -1)

D (-1, 0)

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5 A Ferris wheel cabin is at 0 degrees. It turns 90 degrees, then another 90 degrees. What angle is it at now, in degrees?

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6 An angle of 200 degrees is in which quadrant?

A Quadrant 1

B Quadrant 2

C Quadrant 3

D Quadrant 4

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7 What is the angle, in degrees, halfway between 0 degrees and 90 degrees on the unit circle?

- A 30
- B 45
- C 60
- D 90

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8 A cabin starts at 0 degrees and turns counterclockwise to 270 degrees. How many degrees did it turn?

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9 How long is the radius of the unit circle?

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10

Where is the centre of the unit circle?

A (0, 0)

B (1, 0)

C (0, 1)

D (-1, 0)

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ANSWER KEY

1. 90

2. (1, 0)

3. 180

4. (0, -1)

5. 180

6. Quadrant 3

7. 45

8. 270

9. 1

10. (0, 0)

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