Trigonometry and the Unit Circle

Use this key to check answers and read the explanations.

1. A triangle has vertices A, B and C. Its only right angle is at B. Which label belongs on the hypotenuse?

A. AC, the side opposite B
B. AB, the side from A to B
C. BC, the side from B to C
D. AB and BC together

Correct answer: A. AC, the side opposite B
The hypotenuse is directly across from the right angle. Sides AB and BC meet at the right angle, so both are legs.

2. Relative to an acute angle in a right triangle, which two side lengths form its sine?

A. Opposite divided by adjacent
B. Adjacent divided by hypotenuse
C. Opposite divided by hypotenuse
D. Hypotenuse divided by opposite

Correct answer: C. Opposite divided by hypotenuse
Sine compares the length of the leg across from the angle with the length of the hypotenuse.

3. For an acute angle in a right triangle, the adjacent leg is 20 units, the opposite leg is 21 units and the hypotenuse is 29 units. What is the cosine of the angle?

A. 21/29
B. 20/29
C. 20/21
D. 29/20

Correct answer: B. 20/29
Cosine is adjacent divided by hypotenuse. The two relevant lengths are 20 and 29.

4. Starting at the positive horizontal axis, go counterclockwise 30 degrees around the unit circle. What is the exact vertical coordinate?

A. 1
B. Square root of 3 divided by 2
C. Square root of 2 divided by 2
D. 1/2

Correct answer: D. 1/2
The vertical coordinate is the sine of 30 degrees. In the corresponding 30-60-90 triangle with hypotenuse 1, the side opposite 30 degrees has length 1/2.

5. On the unit circle, turn 180 degrees counterclockwise from the rightmost point. What is the horizontal coordinate of the ending point?

A. Positive 1
B. Negative 1
C. Zero
D. Negative 1/2

Correct answer: B. Negative 1
A half-turn lands at the leftmost point of the circle. It is one unit left of the center, so its horizontal coordinate is negative 1.

6. For an acute angle in a right triangle, the opposite leg is 9 and the adjacent leg is 12. What is the tangent in lowest terms?

A. 3/4
B. 4/3
C. 3/5
D. 4/5

Correct answer: A. 3/4
Tangent is opposite divided by adjacent. The ratio 9/12 reduces to 3/4.

7. The point on the unit circle at 45 degrees lies equally far to the right and above the center. What is its exact horizontal coordinate?

A. 1
B. Square root of 3 divided by 2
C. 1/2
D. Square root of 2 divided by 2

Correct answer: D. Square root of 2 divided by 2
The two positive coordinates are equal and their squares add to 1. Each squared coordinate is 1/2, so each coordinate is the square root of 2 divided by 2.

8. The reference angle for 150 degrees is 30 degrees. What is the exact sine of 150 degrees?

A. Positive square root of 3 divided by 2
B. Negative 1/2
C. Positive 1/2
D. Negative square root of 3 divided by 2

Correct answer: C. Positive 1/2
The point at 150 degrees is above the horizontal axis. Its vertical coordinate has the same magnitude as sine of 30 degrees, so it is positive 1/2.

9. A ramp measures 12 meters along its sloping surface and makes an angle of 30 degrees with level ground. How far does the top rise vertically above the bottom?

A. 6 meters
B. 3 meters
C. 12 meters
D. 6 times the square root of 3 meters

Correct answer: A. 6 meters
The ramp is the hypotenuse, and the rise is opposite the 30-degree angle. The rise is 12 times the sine of 30 degrees, which equals 6 meters.

10. An angle of 240 degrees ends in Quadrant III of the unit circle. What are the signs of its cosine and sine, in that order?

A. Positive, positive
B. Negative, positive
C. Positive, negative
D. Negative, negative

Correct answer: D. Negative, negative
Cosine gives the horizontal coordinate, and sine gives the vertical coordinate. A Quadrant III point lies to the left of and below the center.

11. The point for 225 degrees has horizontal and vertical coordinates of equal magnitude. What is the exact tangent of 225 degrees?

A. Zero
B. Negative 1
C. Positive 1
D. Undefined

Correct answer: C. Positive 1
The point is in Quadrant III, so both coordinates are negative. Tangent divides the vertical coordinate by the horizontal coordinate. Dividing equal negative values gives positive 1.

12. A and B are the two acute angles in a right triangle. The sine of A is 7/25. What is the exact tangent of B?

A. 7/24
B. 24/7
C. 7/25
D. 24/25

Correct answer: B. 24/7
Use 7 and 25 for the leg opposite A and the hypotenuse. The other leg is 24 because 25 squared minus 7 squared is 576. Relative to B, 24 is opposite and 7 is adjacent.

13. What is the exact cosine of 510 degrees?

A. Positive 1/2
B. Positive square root of 3 divided by 2
C. Negative 1/2
D. Negative square root of 3 divided by 2

Correct answer: D. Negative square root of 3 divided by 2
Subtract a full turn of 360 degrees to get 150 degrees. Its reference angle is 30 degrees, and its horizontal coordinate is negative in Quadrant II.

14. An observer's eye is 1.5 meters above level ground. A flagpole base is 18 meters away horizontally, and the angle of elevation to the top is 45 degrees. How tall is the pole?

A. 19.5 meters
B. 18 meters
C. 16.5 meters
D. 36 meters

Correct answer: A. 19.5 meters
At 45 degrees the tangent is 1, so the top is 18 meters above eye level. Add the 1.5 meters from the ground to eye level.

15. An angle ends in Quadrant III of the unit circle. Its cosine is negative 5/13. What is its exact tangent?

A. Positive 5/12
B. Negative 12/5
C. Positive 12/5
D. Negative 5/12

Correct answer: C. Positive 12/5
The squares of the unit-circle coordinates add to 1. If the horizontal coordinate is negative 5/13, the vertical coordinate is negative 12/13 in Quadrant III. Dividing the vertical coordinate by the horizontal one gives positive 12/5.