

Oklahoma Math Day

November 7, 2019

Trigonometry

INSTRUCTIONS:

1. Do not begin the test until told to do so.
2. Calculators are not permitted.
3. Be sure to enter your name and high school code on the answer sheet.
4. Use a number 2 pencil to fill out your answer sheet.
5. Please remain in your seat until the time is called.

OU Math Day 2019
Trigonometry Test

1. Find the exact value of $\sin(2019\pi) + \cos(2019\pi) + \tan(2019\pi)$.

- (A) 0 (B) 1 (C) -1 (D) 2 (E) None of the above
-

2. A right triangle has sides of length 5, 12 and 13. What is the tangent of the angle opposite the side of length 5?

- (A) 0 (B) $\frac{5}{12}$ (C) $\frac{5}{13}$ (D) $\frac{12}{13}$ (E) None of the above
-

3. A right triangle has sides of length 5, 12 and 13. What is the cosine of the angle opposite the hypotenuse?

- (A) 0 (B) $\frac{5}{12}$ (C) $\frac{5}{13}$ (D) $\frac{12}{13}$ (E) None of the above
-

4. Which quadrant contains the terminal side of the angle -2019° ?

- (A) *I* (B) *II* (C) *III* (D) *IV* (E) None of the above
-

5. With respect to radian measure, the expression $\sin\left(\frac{\pi}{2} + \theta\right) + \cos(\theta + \pi)$ simplifies to

- (A) $2\cos(\theta)$ (B) $-2\cos(\theta)$ (C) $\cos(\theta) + \sin(\theta)$ (D) 0 (E) None of the above
-

6. How many solutions for x does the equation $\sin(x) + \sin(-x) = 0$ have if $0 \leq x \leq 2\pi$?
(Radian measure is assumed in this problem.)

- (A) infinitely many (B) 1 (C) 2 (D) 3 (E) None of the above
-

7. The addition formula for sine states, for all angles α and β , that $\sin(\alpha + \beta)$ equals

- (A) $\cos(\alpha) \cos(\beta) + \sin(\alpha) \sin(\beta)$
(B) $\cos(\alpha) \cos(\beta) - \sin(\alpha) \sin(\beta)$
(C) $\cos(\alpha) \sin(\beta) - \sin(\alpha) \cos(\beta)$
(D) $\cos(\alpha) \sin(\beta) + \sin(\alpha) \cos(\beta)$
(E) None of the above
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8. If $\theta = \arctan(3/10)$ then find the value of $\sin(2\theta)$.

- (A) $60/109$ (B) $6/\sqrt{109}$ (C) $169/\sqrt{109}$ (D) $13/\sqrt{109}$ (E) None of the above
-

9. If θ is an acute angle and $\cos(\theta) \sec(\theta) = 1/2$ then what does θ equal?

- (A) 0 (B) 30° (C) 45° (D) 60° (E) None of the above
-

10. Determine the value of $\cos(x) \sin^3(-x) + \cos^3(-x) \sin(x)$ given that x is an acute angle with $\cos(x) = 1/3$.

- (A) $\frac{2\sqrt{2}}{9}$ (B) 0 (C) $-\frac{14\sqrt{2}}{81}$ (D) $-\frac{2\sqrt{2}}{9}$ (E) None of the above
-

11. How many radians are in 630 degrees?

- (A) $7/4$ (B) $7\pi/4$ (C) 7π (D) $7\pi/2$ (E) None of the above
-

12. Let θ be an angle whose radian measure is between 0 and π . If $\sin(\theta) + \cos(\theta) = 1/5$ then determine the value of $\cot(\theta)$.

- (A) $3/4$ (B) $5/3$ (C) $4/5$ (D) $3/5$ (E) None of the above
-

13. Which of the numbers is strictly larger than the other three?

$$\theta_1 = \arcsin(0) + \arccos(0)$$

$$\theta_2 = \arcsin(\sqrt{3}/2) + \arccos(\sqrt{3}/2)$$

$$\theta_3 = \arcsin(1/2) + \arccos(1/2)$$

$$\theta_4 = \arcsin(-1/\sqrt{2}) + \arccos(-1/\sqrt{2})$$

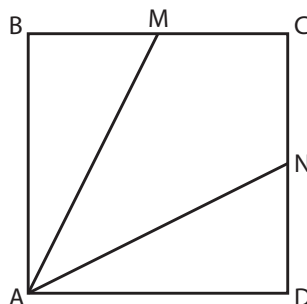
- (A) θ_1 (B) θ_2 (C) θ_3 (D) θ_4 (E) None of the above
-

14. If $\cos(2\theta) = 1/3$, find $\sin^4(\theta) + \cos^4(\theta)$.

- (A) $1/2$ (B) $3/2$ (C) 0 (D) $5/9$ (E) None of the above
-

15. Let $ABCD$ be a square and M and N be the midpoints of the sides BC and CD as shown below. Find $\sin(\alpha)$ where α is the angle $\angle MAN$.

- (A) $1/2$ (B) $3/5$ (C) $\sqrt{2}/2$ (D) $\sqrt{3}/2$ (E) None of the above



16. How many solutions does the equation $\tan(x) = 3x$ have if $0 \leq x \leq 4\pi$? (Radian measure is assumed for x .)

- (A) infinitely many (B) 0 (C) 4 (D) 2 (E) None of the above
-

17. Let

$$\cos(4x) = A \cos^4(x) + B \cos^3(x) + C \cos^2(x) + D \cos(x) + E.$$

Determine the value of $A + B + C + D + E$.

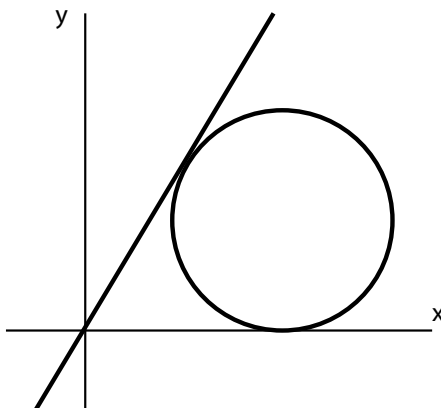
- (A) -1 (B) 0 (C) 1 (D) 2 (E) None of the above
-

18. A triangle ΔPQR has side lengths $PQ = 4$ and $QR = 5$, and the angle at Q is 60° . Find the side length PR .

- (A) $2\sqrt{3}$ (B) $\sqrt{15}$ (C) $3\sqrt{2}$ (D) $\sqrt{21}$ (E) None of the above
-

19. As shown below, a circle of radius 1 is placed in the first quadrant so that it is tangent to the line that passes through the origin and forms an angle of $\pi/3$ with the positive x -axis. What is the x -coordinate of the point of tangency between the circle and the x -axis?

- (A) $1/2$ (B) $1/\sqrt{3}$ (C) $\sqrt{2}/2$ (D) $\sqrt{3}$ (E) None of the above



Answers for the 2019 Trigonometry Test:

1-5: CBABD

6-10: ADAEC

11-15: DAEDB

16-19: ECDD