OU Math Day 2003

TRIGONOMETRY TEST

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1. If θ is an acute angle with $\tan\theta = 3/4$ what is $\sin\theta$?

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

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2. If $\sin\theta$ is negative and $\cot\theta$ is positive, which quadrant does θ lie in?

   (A) quadrant I (B) quadrant II (C) quadrant III (D) quadrant IV (E) None of the above.

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3. Determine the value of $\sin(-y) + \cos(-x) + \sin^2(-x)\cos^2(y)$ if you are given the information that $\cos(x) = 1/5$ and $\sin(y) = 1/3$.

   (A) 8/25 (B) 104/75 (C) $-74/75$ (D) 18/25 (E) None of the above.

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4. An observer standing at the same level 200 feet from the base of a building measures an angle of 30° between the horizontal and the line of sight of the top of the building. How tall is the building?

   (A) 50 ft (B) 100 ft (C) $100\sqrt{3}$ ft (D) 200 ft (E) None of the above.

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5. The three sides of a triangle have length 15, 20, and 25. What is the tangent of the smallest angle in the triangle?

   (A) $\sqrt{3}/2$ (B) 1/2 (C) 1 (D) 3/4 (E) None of the above.

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6. The expression $\dfrac{\tan(x)}{1-\sec(x)} + \dfrac{1+\sec(x)}{\tan(x)}$, when defined, is equivalent to which of the following?

   (A) $2\csc(x)$ (B) $2\tan(x)$ (C) 0 (D) $2\sin(x)$ (E) None of the above.

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7. How many solutions to the equation $\tan(3x) = -\sqrt{3}$ are there in the open interval $(0, 2\pi)$?

   (A) 0 (B) 1 (C) 2 (D) 4 (E) None of the above.

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8. If the cosine of an acute angle is $1/3$ then what is the cosine of an angle half that size?

   (A) $1/6$ (B) $2/3$ (C) $1/\sqrt{6}$ (D) $\sqrt{2}/\sqrt{3}$ (E) None of the above.

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9. Rewriting the expression $\dfrac{\sec^2(x)\tan(x)\cos^5(x)\csc(x)}{\sin^3(x)\cot^2(x)}$ in terms of $\sin(x)$ and $\cos(x)$ results in which of the following?

   (A) $\sin(x)\cos^3(x)$ (B) $\sin^2(x)$ (C) $1/\sin(x)$ (D) $\cos^2(x)/\sin(x)$ (E) None of the above.

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10. Compute the sum: $\cos\frac{\pi}{2} + 2\cos\frac{2\pi}{2} + 3\cos\frac{3\pi}{2} + \cdots + 45\cos\frac{45\pi}{2}$

    (A) 0 (B) 22 (C) -24 (D) 506 (E) None of the above.

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11. If $x = \sec\theta$ and $0 \le \theta < \pi/2$ then express $\dfrac{\sqrt{x^2-1}}{x}$ in simplest form.

    (A) $\sin\theta$ (B) $\cos\theta$ (C) $\tan\theta$ (D) $\cos\theta/\sin^2\theta$ (E) None of the above.

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12. A pilot is flying over a straight highway. He determines the angles of depression to two mileposts 5 miles apart on the highway to be 30° and 45°. What is the elevation of the plane in miles?

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

13. A right triangle has sides of lengths 3, 4 and 5. What is the sine of the angle opposite the side with length 5?

(A) 3/4 (B) 4/5 (C) 3/5 (D) 1/2 (E) None of the above.

14. Convert 210° into radian measure.

(A) $\frac{7\pi}{6}$ (B) $\frac{37800}{\pi}$ (C) $\frac{7\pi}{3}$ (D) $\frac{7}{25}$ (E) None of the above.

15. If $\cos(\theta) = -1/3$ and $0 \leq \theta \leq \pi$ then what is the value of $\sin(\theta)$?

(A) No such θ exists. (B) $-2\sqrt{2}/3$ (C) $2/3$ (D) $2\sqrt{2}/3$ (E) None of the above.

16. Which of the following equals $\cos^{-1}\left(\frac{2\sqrt{5}}{5}\right) + \cos^{-1}\left(\frac{3\sqrt{10}}{10}\right)$?

(A) $\pi/4$ (B) $\pi/3$ (C) $\pi/2$ (D) $3\pi/4$ (E) None of the above.

17. Suppose $\sec\theta = -\sqrt{41}/4$ and $\tan\theta = 5/4$. What is $\sin\theta$?

(A) $-5/\sqrt{41}$ (B) $5/\sqrt{41}$ (C) $-4/\sqrt{41}$ (D) $4/5$ (E) None of the above.

18. If $\tan(x) = -35/7$ then what is $\cot(x)$?

(A) 35/7 (B) −35/7 (C) 7/35 (D) −7/35 (E) None of the above.

19. How many solutions does the equation $\cos(\theta) = \tan(\theta)$ have if θ satisfies $0 < \theta \leq 2\pi$?

(A) 0 (B) 1 (C) 2 (D) 4 (E) None of the above.

20. Describe the behavior of the graph of $y = \cos(x)$ as x increases from 43π to 45π.

(A) decreases, then increases (B) strictly increasing (C) strictly decreasing (D) increases, then decreases (E) None of the above.

21. Consider the diagram below with the indicated angle measurements in degrees. Which segment has the longest length? (Note: picture is not drawn to scale.)

(A) AB (B) CD (C) AE (D) CE (E) None of the above.

22. On a circle with radius 15 centimeters, what is the length in centimeters of the arc intercepted by a central angle of 130°?

(A) $65\pi/6$ cm (B) $1080\pi/13$ cm (C) $325\pi/4$ cm (D) 80π cm (E) None of the above.

23. Let ℓ be a line which passes through the origin in the xy-plane. If ℓ makes an angle of 60° with the positive x-axis, what is the slope of ℓ?

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