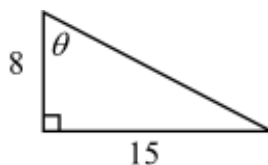


1. Which of the following angles is supplementary to $\theta = 52^\circ 47' 55''$?

- A. $37^\circ 20' 13''$
- B. $37^\circ 12' 5''$
- C. $127^\circ 20' 13''$
- D. $127^\circ 12' 5''$
- E. None of the above

2. Find $\sec \theta$



- A. $\frac{17}{8}$
- B. $\frac{8}{17}$
- C. $\frac{15}{8}$
- D. $\frac{17}{15}$
- E. $\frac{15}{8}$

3. Newton's Law of Cooling is given by $T(t) = C + (T_0 - C)e^{kt}$, where T_0 is the initial temperature of an object, C is the temperature of the environment, t is time in minutes, $T(t)$ is the temperature of the object after t minutes, and k is some constant. Suppose a cup of coffee is served at a temperature of 185°F in a room at a temperature of 65°F . After 2 minutes, the temperature of the coffee is 155°F . Determine the value of the constant k to three decimal places.

- A. -0.144
- B. -0.062
- C. -1.919
- D. -0.088
- E. None of the above

4. A tire with a radius of 30 inches is rolling on a level surface at a speed of 35 rpm. How many seconds will it take for the tire to roll a distance of 250 feet?

A. 0.45 seconds
B. 1.33 seconds
C. 2.27 seconds
D. 6.27 seconds
E. 27.28 seconds

5. Which of the following are true.

I. as $x \rightarrow \frac{3\pi}{2}^+$, $\tan x \rightarrow -\infty$

II. $y = 2 \sin x + 3$ has a minimum value of $y = 1$ at $x = \frac{3\pi}{2}$

III. as $x \rightarrow \frac{3\pi}{2}^-$, $\sec x \rightarrow -\infty$

A. I
B. II
C. I and II
D. I, II, and III
E. None of them are true

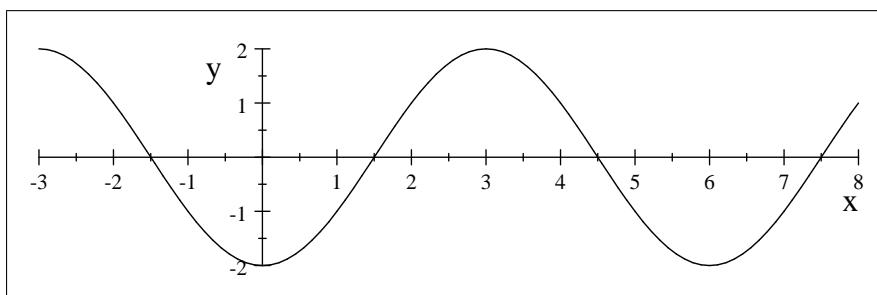
6. Scientists sometimes use the formula $f(t) = a \sin(bt + c) + d$ to simulate temperature variations during the day, with time t in hours, temperature $f(t)$ in $^{\circ}\text{C}$, and $t = 0$ corresponding to midnight. Assume that $f(t)$ is decreasing at midnight. If the low temperature of 20°C occurs at 4:00am, and the high temperature is 35°C , around what time does the temperature first reach 28°C ?

A. between 10:00am and noon
B. between noon and 2:00pm
C. between 2:00pm and 4:00pm
D. between 4:00pm and 6:00pm
E. Cannot be determined

7. Find all solutions of the equation $\cot x = \sqrt{3}$

- A. $\frac{\pi}{6} + \pi n$
- B. $\frac{\pi}{3} + \pi n$
- C. $\frac{\pi}{3} + 2\pi n, \frac{2\pi}{3} + 2\pi n$
- D. $\frac{\pi}{6} + 2\pi n, \frac{5\pi}{6} + 2\pi n$
- E. $\frac{2\pi}{3} + 2\pi n, \frac{4\pi}{3} + 2\pi n$

8. The graph below could be represented by which of the following equations?



- A. $y = 2 \sin \left(3\pi x - \frac{3}{2} \right)$
- B. $y = 2 \sin \left(\frac{\pi}{3} x - \frac{3}{2} \right)$
- C. $y = 2 \sin \left(\frac{\pi}{3} x - \frac{3}{2}\pi \right)$
- D. $y = 2 \sin \left(3\pi x - \frac{3}{2}\pi \right)$
- E. $y = 2 \sin \left(\frac{\pi}{3} x - \frac{\pi}{2} \right)$

9. On the graph of $f(x) = \cos x$, find all values of x on $[0, 4\pi)$ so that the graph of the function $f(x) < \frac{1}{2}$

- A. $\left(\frac{\pi}{6}, \frac{5\pi}{6} \right) \cup \left(\frac{13\pi}{6}, \frac{17\pi}{6} \right)$
- B. $\left(\frac{7\pi}{6}, \frac{11\pi}{6} \right) \cup \left(\frac{19\pi}{6}, \frac{23\pi}{6} \right)$
- C. $\left(\frac{\pi}{3}, \frac{2\pi}{3} \right) \cup \left(\frac{7\pi}{3}, \frac{8\pi}{3} \right)$
- D. $\left(\frac{4\pi}{3}, \frac{5\pi}{3} \right) \cup \left(\frac{10\pi}{3}, \frac{11\pi}{3} \right)$
- E. None of the above

10. A regular pentagon is inscribed in a circle with a radius of 10 inches. Find the difference in the area of the circle and the area of the pentagon (the shaded region) to two decimal places.



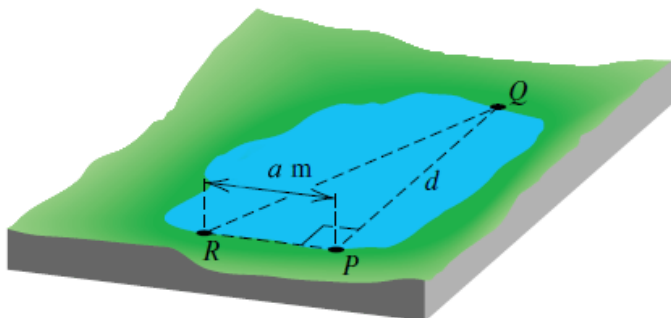
- A. 15.28 in^2
B. 76.40 in^2
C. 19.53 in^2
D. 97.65 in^2
E. None of the above
11. Which of the following is equivalent to $\cos^4 \theta + 1 - \sin^4 \theta$?
- A. $2 \cos^2 \theta$
B. $\sin^2 \theta + 2$
C. $2 - \sin^2 \theta$
D. $\cos^2 \theta - \sin^2 \theta$
E. $2 \sin^2 \theta \cos^2 \theta$
12. In a given triangle, $\gamma = 90^\circ$, $a = 12.3$, and $c = 23.5$. Find the value of b to one decimal place, and β to the nearest minute.
- A. $b = 26.5, \beta = 58^\circ 26'$
B. $b = 26.5, \beta = 31^\circ 33'$
C. $b = 20.0, \beta = 58^\circ 26'$
D. $b = 20.0, \beta = 31^\circ 33'$
E. None of the above

13. Which of the following are true for the graph of $y = -3 \sin\left(\frac{2}{3}x - \frac{\pi}{9}\right)$

- I. y has a period of $\frac{3}{2}$
- II. y has a phase shift of $\frac{\pi}{6}$
- III. y has a zero at $x = \frac{19\pi}{6}$

- A. I
- B. II and III
- C. II
- D. I, II and III
- E. None of them are true

14. To find the distance d between two points P and Q on opposite shores of a lake, a surveyor locates a point R that is 60 meters from P such that RP is perpendicular to PQ as shown in the figure. Next, using a transit, the surveyor measures angle PQR as $54^\circ 27'$. Find d .



- A. 73.75 meters
- B. 34.88 meters
- C. 42.88 meters
- D. 83.96 meters
- E. 103.20 meters

15. Approximate, to the nearest 0.01 radian, all angles θ in the interval $[0, 2\pi)$ that satisfy the equation $\csc \theta = -3.4652$.

- A. 0.29, 2.85
- B. 1.86, 4.42
- C. 1.28, 5.00
- D. 3.43, 5.99
- E. Does not exist

1. D
2. A
3. A
4. E
5. D
6. A
7. A
8. E
9. E $(\pi/3, 5\pi/3) \cup (7\pi/3, 11\pi/3)$
10. B
11. A
12. C
13. B
14. C
15. D