1. Which of the following angles is coterminal with an angle of 130°, assuming both angles are drawn in the standard position?
   (1) 230°  (2) −230°  (3) 430°  (4) −310°

2. If drawn in the standard position, which of the following angles terminates in the third quadrant?
   (1) 120°  (2) −60°  (3) −210°  (4) 240°

3. If \( \sin(\theta) = \frac{15}{17} \) and \( \theta \) is an angle that terminates in the second quadrant, then which of the following is the exact value of \( \cos(\theta) \)?
   (1) \( -\frac{15}{17} \)  (2) \( -\frac{8}{17} \)  (3) \( \frac{17}{15} \)  (4) \( \frac{8}{17} \)

4. Which of the following has the same reference angle as 150°?
   (1) 210°  (2) 300°  (3) 120°  (4) 70°

5. The radian angle \( \frac{3\pi}{4} \) is equivalent to
   (1) 67.5°  (2) 135°  (3) 270°  (4) 325°
6. The angle $240^\circ$ can be written equivalently as which of the following in the radian system?

\[
\begin{align*}
(1) \quad & \frac{7\pi}{6} \\
(2) \quad & \frac{5\pi}{4} \\
(3) \quad & \frac{3\pi}{2} \\
(4) \quad & \frac{4\pi}{3}
\end{align*}
\]

\[
240^\circ \left( \frac{\pi}{180} \right) = \frac{240\pi}{180} = \frac{4\pi}{3}
\]

7. A goat is attached to a 12 foot long leash pulled tight and rotates through an angle of $230^\circ$. Which of the following is closest to the distance that the goat travels?

\[
\begin{align*}
(1) \quad & 23 \text{ ft} \\
(2) \quad & 32 \text{ ft} \\
(3) \quad & 41 \text{ ft} \\
(4) \quad & 48 \text{ ft}
\end{align*}
\]

\[
S = \theta \cdot r \\
S = 230^\circ \left( \frac{\pi}{180} \right) \\
r = 12
\]

\[
S = \left( \frac{230\pi}{180} \right) \cdot 12 = \frac{47\pi}{15} \approx 48.17
\]

8. A point lies on the unit circle whose $x$-coordinate is $\frac{1}{4}$. If the point lies in the fourth quadrant, then which of the following is its $y$-coordinate?

\[
\begin{align*}
(1) \quad & \frac{3}{4} \\
(2) \quad & -\frac{\sqrt{15}}{4} \\
(3) \quad & -\frac{\sqrt{7}}{4} \\
(4) \quad & \frac{\sqrt{11}}{2}
\end{align*}
\]

\[
\left( \frac{1}{4} \right)^2 + y^2 = 1 \\
y^2 = \frac{15}{16} \\
y = \frac{\sqrt{15}}{4} = \frac{\sqrt{15}}{4}
\]

9. The terminal ray of an angle, $\theta$, is drawn in standard position on the unit circle that has coordinates of $\left( \frac{\sqrt{3}}{2}, \frac{1}{2} \right)$. Based on this information, what is the value of $\cos(\theta)$?

\[
\begin{align*}
(1) \quad & \frac{1}{2} \\
(2) \quad & -\frac{1}{2} \\
(3) \quad & \frac{\sqrt{3}}{2} \\
(4) \quad & -\frac{\sqrt{3}}{2}
\end{align*}
\]

\[
\begin{align*}
\text{x-coordinate} \\
\frac{\sqrt{3}}{2}
\end{align*}
\]

\[
3
\]
10. If \( f(x) = 10\sin(2x) + 8 \) then \( f\left(\frac{\pi}{4}\right) = \) 

(1) \( 4\sqrt{2} \)  
(2) \( 8 \)  
(3) \( 18 \)  
(4) \( 28\sqrt{3} \) 

\[ f\left(\frac{\pi}{4}\right) = f\left(90^\circ\right) = 10\sin\left(2 \times 90^\circ\right) + 8 \]
\[ = 10\sin\left(90^\circ\right) + 8 \]
\[ = 10 \times 1 + 8 \]
\[ = 18 \]

11. The terminal ray of an angle drawn in standard position passes through the point \((.508, .862)\) on the unit circle. Which of the following is closest to the tangent of this angle?

(1) \( .685 \)  
(2) \( 1.291 \)  
(3) \( 1.697 \)  
(4) \( 2.883 \) 

\[ \cos \theta = .508 \quad \tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{.862}{.508} = 1.697 \]
\[ \sin \theta = .862 \]

12. If \( \alpha \) is an angle drawn in the standard position with its terminal ray landing in the fourth quadrant and \( \csc(\alpha) = \frac{5}{1} \), then which of the following is the exact value of \( \cos(\alpha) \)?

(1) \( -\frac{1}{5} \)  
(2) \( -\frac{24}{25} \)  
(3) \( \frac{\sqrt{24}}{5} \)  
(4) \( \frac{\sqrt{6}}{2} \) 

\[ \csc \alpha = -\frac{5}{1} \]
\[ \sin \beta = \frac{1}{\sqrt{25}} \]
\[ \sin \beta = -\frac{1}{5} \]
\[ \cos \beta = \frac{-4}{5} \]

13. For the angle \( \theta \) it's known that \( \cot(\theta) < 0 \) and \( \sin(\theta) > 0 \). In which quadrant does the terminal ray of \( \theta \) lie?

(1) I  
(2) II  
(3) III  
(4) IV 

\[ \tan - \quad \sin + \]

Free Response Questions

14. An angle drawn in standard position measures 10 radians. In what quadrant does its terminal ray lie? Show the reasoning that leads to your answer.

\[ \frac{573^\circ}{-360^\circ} = \frac{573}{-360} \]
\[ = \frac{213}{-120} \]
\[ = \frac{3^\circ}{-20} \]

\[ \square \square \square \]
15. Given the following circle (note that it is **not** the unit circle) with the angle \( \theta \) marked, state the value of each of the following:

(a) The radius of the circle
\[
\gamma = \sqrt{58}
\]
(b) \( \sin \theta = \frac{\gamma}{\gamma} = \frac{7}{\sqrt{58}} \)
(c) \( \cos \theta = \frac{\gamma}{\gamma} = \frac{-3}{\sqrt{58}} \)
(d) \( \tan \theta = \frac{\gamma}{\gamma} = \frac{7}{-3} \)

(e) \( \sec \theta = \frac{1}{\cos \theta} = \frac{\gamma}{\gamma} = \frac{\sqrt{58}}{-3} \)

(f) \( \csc \theta = \frac{1}{\sin \theta} = \frac{\gamma}{\gamma} = \frac{\sqrt{58}}{7} \)
(g) \( \cot \theta = \frac{1}{\tan \theta} = \frac{\gamma}{\gamma} = \frac{-3}{7} \)

16. In the circle shown below, \( AB = 30 \) and the length of the minor arc from point A to point C is 40. Find the exact measure of the marked angle \( \beta \) in terms of radians. Show how you arrived at your answer.

\[
S = \theta \cdot \gamma
\]

\[
S = 40, \quad \frac{40}{15} = \theta \left(\frac{15}{15}\right)
\]

\[
\theta = \frac{8}{15}, \quad \frac{8}{3 \text{ radians}}
\]
17. For an angle \( A \) it is known that \( \sin A = \frac{3}{4} \) and \( \cos A < 0 \). Determine the value of \( \tan A \). Show how you arrived at your answer.

\[ \tan A = \frac{\sin A}{\cos A} = \frac{3}{-\sqrt{7}} \]

18. A portion of the unit circle is shown below. Based on this information, determine the value of \( \sec(150^\circ) \) in exact form. Explain how you arrived at your answer.

\[ \sec 150^\circ = \frac{1}{\cos 150^\circ} = \frac{1}{-\frac{\sqrt{3}}{2}} = -\frac{2}{\sqrt{3}} \]

19. The Vietnam Veterans Memorial in Washington, D.C., is made up of two walls, each 246.75 feet long, that meet at an angle of 125.2°. Find, to the nearest foot, the distance between the ends of the walls that do not meet.

\[ 180^\circ - 125.2^\circ = 54.8^\circ \]

\[ \frac{54.6^\circ}{2} = 27.3^\circ \]

\[ \frac{246.75}{\sin 27.3^\circ} = \frac{X}{\sin 125.2^\circ} \]

\[ X \approx \frac{246.75 \sin(125.2^\circ)}{\sin 27.3^\circ} \approx 438 \text{ ft} \]