This part consists of 8 multiple choice problems. Nothing more than the answer is required; consequently no partial credit will be awarded.

1. Express $36^\circ$ in radians.

A $\frac{\pi}{4}$  
B $\frac{\pi}{5}$  
C $\frac{\pi}{6}$  
D $\frac{\pi}{7}$  
E $\frac{\pi}{8}$

Solution: We have

$$36^\circ = 36 \left( \frac{\pi}{180} \right) \text{ rad} = \frac{36\pi}{180} \text{ rad} = \frac{18 \cdot 2\pi}{18 \cdot 10} \text{ rad} = \frac{2\pi}{10} \text{ rad} = \frac{\pi}{5} \text{ rad}$$

2. Express $\frac{\pi}{540}$ rad in degrees.

A $0.1^\circ$  
B $0.2^\circ$  
C $0.3^\circ$  
D $0.4^\circ$  
E $0.5^\circ$

Solution: We have

$$\frac{\pi}{540} \text{ rad} = \left( \frac{\pi}{540} \right) \left( \frac{180}{\pi} \right) = \frac{\pi \cdot 180}{540 \cdot \pi} = \frac{18}{54} = \frac{1}{3} = 0.3^\circ$$
3. Find an angle that is coterminal with the angle \( \theta = -719^\circ \) in standard position.

   A \( -3^\circ \)
   B \( -2^\circ \)
   C \( -1^\circ \)
   D \( 1^\circ \)
   E \( 2^\circ \)

Solution: Note that

\[-719^\circ = -720^\circ + 1^\circ = -2 \cdot 360^\circ + 1^\circ\]

therefore \( 1^\circ \) is coterminal with \( \theta = -719^\circ \).

4. Find an angle that is coterminal with the angle \( \theta = -\frac{19\pi}{5} \) in standard position.

   A \( \frac{\pi}{5} \)
   B \( -\frac{\pi}{5} \)
   C \( \frac{2\pi}{5} \)
   D \( -\frac{2\pi}{5} \)
   E \( \frac{3\pi}{5} \)
   F \( -\frac{3\pi}{5} \)

Solution: Note that

\[ -\frac{19\pi}{5} = -\frac{20\pi}{5} - \frac{\pi}{5} = -\left(\frac{20\pi}{5} - \frac{\pi}{5}\right) = -\frac{20\pi}{5} + \frac{\pi}{5} = -4\pi + \frac{\pi}{5} \]

therefore \( \frac{\pi}{5} \) is coterminal with \( \theta = -\frac{19\pi}{5} \).
5. Find an angle with measure between 0° and 360° that is coterminal with the angle of measure 
\( -997° \) in standard position.

\[ \begin{align*}
\text{A} & \quad 53° \\
\text{B} & \quad 63° \\
\text{C} & \quad 73° \\
\text{D} & \quad 83° \\
\text{E} & \quad 93°
\end{align*} \]

Solution: Note that 
\[ -997° + 3 \cdot 360° = 83° \]

therefore 83° is coterminal with \( \theta = -997° \).

6. Find the length of an arc of a circle with radius 10 m that subtends a central angle of 135°.

\[ \begin{align*}
\text{A} & \quad \frac{15\pi}{2} \\
\text{B} & \quad 15\pi \\
\text{C} & \quad \frac{7\pi}{2} \\
\text{D} & \quad 7\pi \\
\text{E} & \quad \frac{5\pi}{2}
\end{align*} \]

Solution: We first note that \( 135° = \frac{3\pi}{4} \) rad. So the length of the arc is 
\[ s = r\theta = (10) \frac{3\pi}{4} = \frac{15\pi}{2} \text{ m} \]
7. A central angle $\theta$ in a circle of radius $\sqrt{5}$ m is subtended by an arc of length $\sqrt{20}$ m. Find the measure of $\theta$ in radians.

A  $\frac{1}{2}$  
B  2  
C  $\frac{1}{4}$  
D  4  
E  None of the above

Solution: By the formula $\theta = s/r$, we have

$$\theta = \frac{s}{r} = \frac{\sqrt{20}}{\sqrt{5}} = \sqrt{\frac{20}{5}} = \sqrt{4} = 2 \text{ rad}$$

8. Find the area of a sector of a circle with central angle $210^\circ$ if the radius of the circle is $\sqrt{2}$ m.

A  $\frac{\pi}{6}$  
B  $\frac{5\pi}{6}$  
C  $\frac{7\pi}{6}$  
D  $\frac{11\pi}{6}$  
E  $\frac{\pi}{3}$

Solution: To use the formula for the area of a circular sector, we must find the central angle of the sector in radians:

$$210^\circ = 210 \left( \frac{\pi}{180} \right) \text{ rad} = \frac{210\pi}{180} \text{ rad} = \frac{21\pi}{18} \text{ rad} = \frac{7\pi}{6} \text{ rad}$$

Thus, the area of the sector is

$$A = \frac{1}{2} r^2 \theta = \frac{1}{2} (\sqrt{2})^2 \left( \frac{7\pi}{6} \right) = \frac{1}{2} (2) \left( \frac{7\pi}{6} \right) = \frac{7\pi}{6} \text{ m}^2$$
In the following problems you are required to show all your work and provide the necessary explanations everywhere to get full credit.

1. A DVD is approximately 12 centimeters in diameter. The drive motor of the DVD player is controlled to rotate precisely between 200 and 500 revolutions per minute, depending on what track is being read.

(a) Find intervals for the angular and linear speed of a disc as it rotates.

(b) Find the linear speed of a point on the outermost track as the disc rotates.

Solution:

(a) We have

\[ 200 \leq \text{revolutions per minute} \leq 500 \]

\[ 2\pi (200) \leq \text{angular speed} \leq 2\pi (500) \]

\[ 400\pi \text{ rad/minute} \leq \text{angular speed} \leq 1000\pi \text{ rad/minute} \]

Since \( v = rw \), it follows that

\[ 400\pi \cdot 6 \text{ cm/minute} \leq \text{linear speed} \leq 1000\pi \cdot 6 \text{ cm/minute} \]

\[ 2400\pi \text{ cm/minute} \leq \text{linear speed} \leq 6000\pi \text{ cm/minute} \]

(b) It immediately follows from (a) that the linear speed of a point on the outermost track is \( 6000\pi \) cm/minute.
2. In traveling across flat land you notice a mountain directly in front of you. Its angle of elevation (to the peak) is 3.5°. After you drive 13 miles closer to the mountain, the angle of elevation is 9° (see the figure below). Approximate the height of the mountain.

Solution: We have

\[
\cot 9° = \frac{c}{h} \quad \text{and} \quad \cot 3.5° = \frac{13 + c}{h}
\]

(see the Figure above on the right). Subtracting, we get

\[
\cot 3.5° - \cot 9° = \frac{13 + c}{h} - \frac{c}{h}
\]

\[
\cot 3.5° - \cot 9° = \frac{13}{h} + \frac{c}{h} - \frac{c}{h}
\]

\[
\cot 3.5° - \cot 9° = \frac{13}{h}
\]

\[
(cot 3.5° - cot 9°)^{-1} = \left(\frac{13}{h}\right)^{-1}
\]

\[
\frac{1}{\cot 3.5° - \cot 9°} = \frac{h}{13}
\]

\[
\frac{13}{\cot 3.5° - \cot 9°} = h
\]

which is \(\approx 1.3\) miles.