This part consists of 4 multiple choice problems. Nothing more than the answer is required; consequently no partial credit will be awarded.

1. The point \((-1/3, y)\) is on the unit circle in Quadrant II. Find its \(y\)-coordinate.

\[ A \quad \frac{1}{3} \]
\[ B \quad -\frac{1}{3} \]
\[ C \quad \sqrt{2}/2 \]
\[ D \quad \sqrt{3}/2 \]
\[ E \quad \frac{2\sqrt{2}}{3} \]

Solution: Since the point is on the unit circle, we have

\[
\left( \frac{1}{3} \right)^2 + y^2 = 1
\]

\[
y^2 = 1 - \left( \frac{1}{3} \right)^2 = 1 - \frac{1}{9} = \frac{8}{9}
\]

\[
y = \pm \sqrt{\frac{8}{9}} = \pm \frac{\sqrt{8}}{\sqrt{9}} = \pm \frac{\sqrt{4 \cdot 2}}{3} = \pm \frac{2\sqrt{2}}{3}
\]

Since the point is in Quadrant II, its \(y\)-coordinate must be positive, so \(y = \frac{2\sqrt{2}}{3}\).

2. Find the terminal point determined by the number \(t = \pi/6\).

\[ A \quad \left( \frac{1}{2}, \frac{\sqrt{3}}{2} \right) \]
\[ B \quad \left( -\frac{1}{2}, \frac{\sqrt{3}}{2} \right) \]
\[ C \quad \left( \frac{\sqrt{3}}{2}, \frac{1}{2} \right) \]
\[ D \quad \left( \frac{\sqrt{3}}{2}, -\frac{1}{2} \right) \]
\[ E \quad \text{None of the above} \]

Solution: The terminal point is \(\left( \frac{\sqrt{3}}{2}, \frac{1}{2} \right)\), since it’s in Quadrant I.
3. Suppose that the terminal point determined by \( t \) is the point \( \left( \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right) \) on the unit circle. Find the terminal point determined by \( \pi - t \).

A \( \left( \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right) \)  
B \( \left( \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}} \right) \)  
C \( \left( -\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right) \)  
D \( \left( -\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}} \right) \)  
E None of the above

Solution: Since \( \left( \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right) \) is in Quadrant I, the terminal point determined by \( \pi - t \) is in Quadrant II. Therefore this point is \( \left( -\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right) \).

4. Find the terminal point determined by the number \( t = \frac{32\pi}{3} \).

A \( \left( -\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2} \right) \)  
B \( \left( \frac{1}{2}, \frac{\sqrt{3}}{2} \right) \)  
C \( \left( \frac{1}{2}, -\frac{\sqrt{3}}{2} \right) \)  
D \( \left( \frac{\sqrt{3}}{2}, \frac{1}{2} \right) \)  
E \( \left( \frac{\sqrt{3}}{2}, -\frac{1}{2} \right) \)

Solution: The reference number \( t \) is \( \frac{\pi}{3} \), since

\[
\frac{32\pi}{3} = \frac{33\pi - \pi}{3} = \frac{33}{3} - \frac{\pi}{3} = 11\pi - \frac{\pi}{3}
\]

which determines the terminal point \((1/2, \sqrt{3}/2)\). Since the terminal point determined by \( t \) is in Quadrant II, its \( x \)-coordinate is negative and \( y \)-coordinate is positive. Thus, the desired terminal point is \( \left( -\frac{1}{2}, \frac{\sqrt{3}}{2} \right) \).
In the following problems you are required to show all your work and provide the necessary explanations everywhere to get full credit.

1. The population of the world in 2000 was 6.1 billion, and the estimated relative growth rate was 1.4% per year. If the population continues to grow at this rate, when will it double?

Solution: We use the population growth function with $r = 0.014$ and $n(t) = 2 \cdot n_0$. This leads to an exponential equation, which we solve for $t$.

\[
\begin{align*}
n_0 e^{0.014t} &= 2 \cdot n_0 \\
e^{0.014t} &= 2 \\
0.014t &= \ln 2 \\
t &= \frac{\ln 2}{0.014} \approx 49.5
\end{align*}
\]

Thus, the population will reach 12.2 billion in approximately 49.5 years.

2. The 1989 Loma Prieta earthquake that shook San Francisco had a magnitude of 7.1 on the Richter scale. The 1906 earthquake on the Colombia-Ecuador border had an estimated magnitude of 8.9 on the Richter scale. How many times more intense was the 1906 earthquake than the 1989 event?

Solution: If $I_1$ and $I_2$ are the intensities of the 1906 and 1989 earthquakes, then we are required to find $I_1/I_2$. To relate this to the definition of magnitude, we divide numerator and denominator by $S$.

\[
\begin{align*}
\log \frac{I_1}{I_2} &= \log \frac{I_1/S}{I_2/S} \\
&= \log \frac{I_1}{S} - \log \frac{I_2}{S} \\
&= 8.9 - 7.1 = 1.8
\end{align*}
\]

Therefore

\[
\frac{I_1}{I_2} = 10^{\log(I_1/I_2)} = 10^{1.8} \approx 63
\]

The 1906 earthquake was about 63 times as intense as the 1989 earthquake.