1. Iodine-131 is a radioactive material that decays according to the function \( A = A_0e^{-0.087t} \), where \( A_0 \) is the initial amount present and \( A \) is the amount present at time \( t \) (measured in days). Assume that there is a sample of 100 grams of iodine-131.

   a. What is the decay rate of iodine-131? Express your answer correct to the nearest tenth of a percent.
   b. How much iodine-131 remains after 5 days? Express your answer correct to the nearest gram.
   c. When will 40 grams of iodine-131 remain? Express your answer to the nearest tenth of a day.
   d. What is the half-life of iodine-131? Express your answer to the nearest hundredth of a day.

2. Let \( \theta \) be an angle between \( 0 \) and \( 2\pi \) such that \( \cos \theta = \frac{2}{3} \) and \( \sin \theta < 0 \).
   a. In what quadrant is \( \theta \)?
   b. Find the exact value of the following: you may rationalize denominators, but it is not necessary.

\[
\begin{array}{cccc}
\sin \theta & \tan \theta & \sec \theta & \csc \theta \\
\cot \theta & \cos(-\theta) & \sin(-\theta) \\
\end{array}
\]

3. Find an equation for each graph. Note that there is no 'phase shift' in these graphs; the 'starting point' is on the \( y \)-axis.
   a. The \( y \)-intercept is \(-4\); the graph goes through the point \((2, 0)\). Each grid point represents one unit.

   ![Graph 1](image1)

   b. The graph goes through the points \((0, 0)\) and \((7.5, 3)\). Each grid point represents one unit.

   ![Graph 2](image2)
4. Given the function $f(x) = -2 \sin \left(2x - \frac{\pi}{2}\right) + 3$

   a. Find the amplitude of $f$.
   b. Find the period of $f$.
   c. Find the phase shift of $f$.
   d. Sketch the graph of $f$ over one period starting at the phase shift. Label on the graph the coordinates of the highest and lowest points on the graph, and the coordinates of the intersection points with the 'midline'. Note that each dot on the horizontal scale represents $\frac{\pi}{12}$.

5. Find the exact value of the of the following expressions:

   a. $\cos(510^\circ)$
   b. $\tan\left(\frac{5\pi}{3}\right)$
   c. $\sin^{-1}\left(\sin\left(\frac{2\pi}{3}\right)\right)$
   d. $\tan^{-1}\left(\tan\left(\frac{7\pi}{4}\right)\right)$
   e. $\cos\left(\sin^{-1}\left(\frac{8}{17}\right)\right)$
   f. $\cos^{-1}\left(\tan\left(\frac{3\pi}{4}\right)\right)$

6. Solve the equations on the interval $0 \leq \theta < 2\pi$:

   a. $\sin(2\theta) = \frac{\sqrt{3}}{2}$
   b. $\sin^2\theta = \cos^2\theta - \cos \theta$
1. a. decay constant is in exponent: \( k = 0.087 \) → \( k = 8.7\% \)

b. \( A = 100e^{-0.087(5)} \) → \( A \approx 65 \) grams

c. \( (40) = 100e^{-0.087t} \) → \( t = \frac{\ln(\frac{1}{4})}{-0.087} \approx 10.5 \) days

d. \( (50) = 100e^{-0.087t} \) → \( t = \frac{\ln(\frac{1}{5})}{-0.087} \approx 7.97 \) days

2. a. \( \theta \) is in quadrant IV

\[
\sin \theta = -\frac{\sqrt{5}}{3} \quad \tan \theta = -\frac{\sqrt{5}}{2} \\
\sec \theta = \frac{3}{2} \quad \csc \theta = -\frac{3}{\sqrt{5}} = -\frac{3\sqrt{5}}{5} \quad \cot \theta = -\frac{2}{\sqrt{5}} = -\frac{2\sqrt{5}}{5}
\]

\[
\cos(-\theta) = \cos \theta = \frac{2}{3} \quad \sin(-\theta) = -\sin \theta = \frac{\sqrt{5}}{3}
\]

3. a. \( f(x) = -4 \cos \left( \frac{\pi}{4} x \right) \)  
   b. \( f(x) = 3 \sin \left( \frac{\pi}{3} x \right) \)

4. a. Amplitude = 2  
   b. period = \( \pi \)  
   c. phase shift = \( \frac{\pi}{4} \)

   d. highest : \( (\pi, 5) \)  
   e. lowest : \( \left( \frac{\pi}{2}, 1 \right) \)  
   midline : \( y = 3 \)  
   midline points : \( \left( \frac{\pi}{4}, 3 \right); \left( \frac{3\pi}{4}, 3 \right); \left( \frac{5\pi}{4}, 3 \right) \)

5. a. \( -\sqrt{3} \)  
   b. \( -\sqrt{3} \)  
   c. \( \frac{\pi}{3} \)  
   d. \( -\frac{\pi}{4} \)  
   e. \( \frac{15}{17} \)  
   f. \( \pi \)

6. a. \( \frac{\pi}{6}, \frac{\pi}{3}, \frac{7\pi}{6}, \frac{4\pi}{3} \)  
   b. \( 0, \frac{2\pi}{3}, \frac{4\pi}{3} \)