
1. (4 points) Find a vector function for the curve of intersection of \( x^2 + y^2 = 9 \) and \( y + z = 2 \).

   \textit{Solutions:}
   
   We have: \( x^2 + y^2 = 9 \) \( \Rightarrow \) \((3 \cos(t))^2 + (3 \sin(t))^2 = 9\), then \( x = 3 \cos(t) \) and \( y = 3 \sin(t) \).[2]
   
   Since \( y + z = 2 \), then: \( z = 2 - 3 \sin(t) \). [1]
   
   Therefore, we have: \( \langle 3 \cos(t), 3 \sin(t), 2 - 3 \sin(t) \rangle \).[1]

2. (4 points) A bug is crawling outward along the spoke of a wheel that lies along a radius of the wheel. The bug is crawling at 1 unit per second and the wheel is rotating at 1 radian per second. Suppose the wheel lies in the \( y - z \) plane with center at the origin, and at time \( t = 0 \) the spoke lies along the positive \( y \) axis and the bug is at the origin. Find a vector function \( r(t) \) for the position of the bug at time \( t \).

   \textit{Solutions:}
   
   The \textit{x-value} of the vector function will be always 0, as the wheels lies in the \( y - z \) plane, i.e. \( x(t) = 0 \).[1]. Now, ignoring the bug and fixing a point in the wheel. Since the wheel is rotating at 1 rad/s (\textit{counterclockwise}), its period is \( 2\pi \) and we can describe the position of this point as: \( y = r \cos(t) \) and \( z = r \sin(t) \), where \( r \) is the distance from the point to the center of the wheels [2].

   Introducing the bug back, we know it will only change the value of \( r \) as it is crawling upward at speed of 1 \textit{unit}/s. Then, \( r = t \). [1]

   Therefore, \( x(t) = 0 \), \( y(t) = t \cos(t) \), and \( z(t) = t \sin(t) \rightarrow r(t) = \langle 0, t \cos(t), t \sin(t) \rangle \).

   Also right for \textit{clockwise} \( z(t) = t \sin(t) \rightarrow r(t) = \langle 0, t \cos(-t), t \sin(-t) \rangle \).

\textbf{Level of Completeness: 2 points.}