5. (11 points) A child is sitting on a Ferris wheel. If the origin is at the center of the circle and we measure \( x \) and \( y \) in meters, her motion is given by the following parametric equations:
\[
    x = 125 \sin((2\pi/9)t), \quad y = -125 \cos((2\pi/9)t),
\]
where we measure \( t \) in minutes since she boarded the ride.

(a) (2 pts.) What is the diameter of the Ferris wheel?

\[
    D = 250 \text{ meters}
\]

(b) (2 pts.) How long does it take for the Ferris wheel to make one complete revolution?

9 minutes

(c) (3 pts.) Find the speed of the child 10 minutes into the ride.

\[
    \frac{dx}{dt} = \frac{2\pi}{9} 125 \cos \left( \frac{2\pi}{9} t \right), \quad \frac{dy}{dt} = \frac{2\pi}{9} 125 \sin \left( \frac{2\pi}{9} t \right)
\]

\[
    S = \sqrt{\left( \frac{dx}{dt} \right)^2 + \left( \frac{dy}{dt} \right)^2} = \sqrt{\left( \frac{2\pi}{9} 125 \right)^2} \simeq 87.26 \text{ meters/minute}
\]

(d) (4 pts.) If at 10 minutes into the ride the child were to suddenly step off of the Ferris wheel, her motion would initially be along the tangent line at \( t = 10 \). Determine parametric equations for this tangent line.

We have,

\[
    x(10) = 125 \sin \left( \frac{2\pi}{9} 10 \right) \simeq 80
\]

\[
    y(10) = -125 \cos \left( \frac{2\pi}{9} 10 \right) \simeq -95.
\]

Also,

\[
    \frac{dx}{dt} \bigg|_{t=10} = \frac{2\pi}{9} 125 \cos \left( \frac{2\pi}{9} 10 \right) \simeq 67
\]

\[
    \frac{dy}{dt} \bigg|_{t=10} = \frac{2\pi}{9} 125 \sin \left( \frac{2\pi}{9} 10 \right) \simeq 56.
\]

So,

\[
    x(t) = 67t + 80
\]

\[
    y(t) = 56t - 95.
\]