1. (5 points) Find the area of the largest rectangle that can be inscribed in a circle of radius \( r \).

Let the area of the rectangle be \( A \).

\[
A = xy
\]

\[
= x \sqrt{4r^2 - x^2}
\]

\[
A(x) = x \sqrt{4r^2 - x^2}
\]

Domain: \( 0 < x < 2r \)

\[
A'(x) = \frac{4r^2 - 2x^2}{r \sqrt{4r^2 - x^2}}
\]

\[
A'(x) = 0 \implies \frac{4r^2 - 2x^2}{r \sqrt{4r^2 - x^2}} = 0 \implies x = \pm \sqrt{2}r
\]

\[
A(x) \text{ doesn't exist} \implies \sqrt{4r^2 - x^2} = 0 \implies x = \pm 2r
\]

\[
\max = 2r^2
\]

2. (5 points) A particle is moving with the given data. Find the position of the particle.

\[ a(t) = 10 \sin t + 3 \cos t, s(0) = 0, s(2\pi) = 12 \]

\[ S''(t) = a(t) = 10 \sin t + 3 \cos t \]

\[ S'(t) = v(t) = -10 \cos t + 3 \sin t + C \]

\[ S(t) = -10 \sin t - 3 \cos t + Ct + D \]

\[
\begin{cases}
S(0) = 0 \implies -3 + D = 0 \implies D = 3 \\
S(2\pi) = 12 \implies -3 + 2\pi C + D = 12 \implies C = \frac{6}{\pi}
\end{cases}
\]

\[ S(t) = -10 \sin t - 3 \cos t + \frac{6}{\pi} t + 3 \]