18. (14 points) Consider the curve \( \mathbf{r}(t) = -2 \sin t \mathbf{i} + 3 \cos t \mathbf{j} \).

(a) Eliminate the parameter and find an equation for this curve which involves only \( x \) and \( y \).
(b) Sketch the curve.
(c) Which point on the curve corresponds to \( t = \frac{\pi}{4} \).
(d) Graph \( \mathbf{r}'(\frac{\pi}{4}) \). Put the tail of your vector on your answer to (c).
(e) Graph \( \mathbf{r}''(\frac{\pi}{4}) \). Put the tail of your vector on your answer to (c).

\[
\begin{align*}
\begin{cases}
    x &= -2 \sin t \\
    y &= 3 \cos t \\
\end{cases}
\end{align*}
\]

\[
\frac{x^2}{\frac{9}{4}} + \frac{y^2}{2} = 1
\]

At \( \frac{\pi}{4} \), the object is on \( \left(-\sqrt{2}, \frac{3 \sqrt{2}}{2}\right) \).

d) \( \mathbf{r}'(t) = -2 \cos t \mathbf{i} - 3 \sin t \mathbf{j} \)

\[
\mathbf{r}' \left( \frac{\pi}{4} \right) = -\sqrt{2} \mathbf{i} - \frac{3 \sqrt{2}}{2} \mathbf{j}
\]

c) \( \mathbf{r}''(t) = 2 \sin t \mathbf{i} - 3 \cos t \mathbf{j} \)

\[
\mathbf{r}'' \left( \frac{\pi}{4} \right) = \sqrt{2} \mathbf{i} - \frac{3 \sqrt{2}}{2} \mathbf{j}
\]