1. Suppose that the position of one particle at a time \( t \) is given by

\[
\begin{align*}
  x_1 &= 2 \cos t \\
  y_1 &= 2 \sin t
\end{align*}
\]

\( 0 \leq t \leq 2\pi \) \hspace{1cm} (1)

and the position of a second particle is given by

\[
\begin{align*}
  x_2 &= 3 \cos t \\
  y_2 &= -1 + \sin t
\end{align*}
\]

\( 0 \leq t \leq 2\pi \) \hspace{1cm} (2)

At the end of this question, you should have ONE final plot including all graphics, other plots should be suppressed with a semi-colon.

(a) Graph the paths of both particles, in different colors, in the same plot. Make sure to label the axes.

(b) Put a small green disk over plain intersection points, and a small red disk over any collision points, and label the collision point “Collision!” in large, red letters. To determine the times at which the particles intersect, we want to use the \texttt{FindRoot} function to determine when the two parameterizations yield the same coordinates. There are two possibilities (1) the paths intersect at different times and therefore the particles don’t collide or (2) the paths intersect at the same time and the particles collide. To allow for the first situation, we should give the paths different parameter names, that is we will start the command as

\[
\texttt{FindRoot} \left[ r1[t] == r2[s], ... \right]
\]

For the rest of the notation for \texttt{FindRoot}, you should use the Documentation Center. Remember that if we’ve saved the answer to the \texttt{FindRoot} command, then we can use it later with the “/.” notation.

(c) Choose one of the plain intersection points. At this point, plot the velocity vector for each particle. Make the color of each arrow match up with the color of the corresponding plot. Make sure that the arrow starts on the path and lies tangent to the path.