2. [12 points] Chancelor was doodling in his coloring book one Sunday afternoon when he drew an infinity symbol, or lemniscate. The picture he drew is the polar curve $r^2 = 16 \cos(2\theta)$, which is shown on the axes below. (The axes are measured in inches.)

\begin{figure}
\centering
\includegraphics[width=0.6\textwidth]{lemniscate.png}
\end{figure}

a. [4 points] Chancelor decides to color the inside of the lemniscate red. Write, but do not evaluate, an expression involving one or more integrals that gives the total area, in square inches, that he has to fill in with red.

b. [4 points] He decides he wants to outline the right half (the portion to the right of the $y$-axis) of the lemniscate in blue. Write, but do not evaluate, an expression involving one or more integrals that gives the total length, in inches, of the outline he must draw in blue.

c. [4 points] Chancelor draws another picture of the same lemniscate, but this time also draws a picture of the circle $r = 2\sqrt{2}$. He would like to color the area that is inside the lemniscate but outside the circle purple. Write, but do not evaluate, an expression involving one or more integrals that gives the total area, in square inches, that he must fill in with purple.