A torus is formed by rotating a circle on the Oxz plane around the z-axis (or a circle on the Oyz plane, something).

2 things define a torus: the major radius and the minor radius.

Let E define the solid torus with major radius \( K \) and minor radius \( k \).

\[ (r-K)^2 + z^2 \leq k^2 \]

where \((r, \theta)\) is the polar representation of \((x, y)\).

Then the equation for the solid torus is

We know how to parametrize this disk

\[
\begin{align*}
    r - K &= h \cos \phi \\
    z &= h \sin \phi
\end{align*}
\]

\( h \) could be 0, but that makes \( \phi \), and not the same \( \phi \) undefined. Does not matter as the Riemann integral does not care about isolated points.

So \( r = K + h \cos \phi \)

As \((r, \theta)\) is the polar expression of \((x, y)\), we have

\[
\begin{align*}
    x &= r \cos \Theta = (K + h \cos \phi) \cos \Theta \\
    y &= r \sin \Theta = (k + h \cos \phi) \sin \Theta \\
    z &= h \sin \phi
\end{align*}
\]

\( 0 < h \leq k, 0 \leq \Theta < 2\pi, 0 \leq \phi < 2\pi \)

If we only want to parametrize the "surface" of the torus then this is the same as setting \( h = k \)

\[
\begin{align*}
    x &= (K + k \cos \phi) \cos \Theta \\
    y &= (k + k \sin \phi) \sin \Theta \\
    z &= k \sin \phi
\end{align*}
\]

\( 0 \leq \Theta < 2\pi, 0 \leq \phi < 2\pi \)