1. Given the curve \( r_1(t) = (8\cos(t), 6t, 8\sin(t)) \),

(a) Calculate the length of the curve from \( t = 0 \) to \( t = \pi \).

(b) Find an arc-length parametrization for this curve.

\[
\begin{align*}
\mathbf{r}'(t) &= \langle -8\sin t, 6, 8\cos t \rangle \\
\left\| \mathbf{r}'(t) \right\| &= \sqrt{(-8\sin t)^2 + 6^2 + (8\cos t)^2} \\
&= \sqrt{64\sin^2 t + 36 + 64\cos^2 t} \\
&= \sqrt{64 + 36} = \sqrt{100} = 10.
\end{align*}
\]

So

\[
\ell(t) = \int_0^t \left\| \mathbf{r}'(t) \right\| \, dt = \int_0^t 10 \, dt = 10t.
\]

\[
\begin{align*}
&\text{a)} \quad \ell(\pi) = 10 \pi \\
&\text{b)} \quad s = 10t \quad \Rightarrow \quad s = 5/10.
\end{align*}
\]

Plugging this in, the arc-length parametrization is

\[
r(s) = \left( 8\cos \left( \frac{1}{10}s \right), \frac{6s}{10}, 8\sin \left( \frac{1}{10}s \right) \right).
\]
2. Find the equation of a plane that is parallel to \(x + 3y + z = 0\) and goes through the point \((2, 3, 4)\).

\[
\mathbf{n} = \langle 1, 3, 1 \rangle = \langle a, b, c \rangle
\]

\[
d = \mathbf{n} \cdot \langle x_0, y_0, z_0 \rangle = ax_0 + by_0 + cz_0
\]

\[
= 1 \cdot 2 + 3 \cdot 3 + 1 \cdot 4
\]

\[
= 2 + 9 + 4 = 15.
\]

So the plane is

\[x + 3y + z = 15\]