1) \( \Gamma(x, \theta) = \langle x, A(x) \cos(\theta), B(x) \sin(\theta) \rangle \)

2) \( \Gamma_x = \langle 1, b'(x) \cos(\theta), b'(x) \sin(\theta) \rangle \)
   \( \Gamma_\theta = \langle 0, -a(x) \sin(\theta), a(x) \cos(\theta) \rangle \)

3) \[
\begin{vmatrix}
  i & j & k \\
  1 & b'(x) \cos(\theta) & b'(x) \sin(\theta) \\
  0 & -a(x) \sin(\theta) & a(x) \cos(\theta) \\
\end{vmatrix}
\]

   \[= \langle b''(x) A(x) \cos^2(\theta) + A'(x) A(x) \sin^2(\theta), -b(x) \cos(\theta), -b(x) \sin(\theta) \rangle \]

   \[= \langle b''(x) A(x), -b(x) \cos(\theta), -b(x) \sin(\theta) \rangle \)

4) \( \| \Gamma_x \times \Gamma_\theta \| = \left( (b'(x))^2 + (a(x))^2 \sin^2(\theta) + (A'(x))^2 \sin^2(\theta) \right)^{\frac{1}{2}} \)

   \[= \sqrt{(b'(x))^2 + (A'(x))^2 + (a(x))^2 \sin^2(\theta))} \]

   \[= b(x) \sqrt{1 + (b'(x))^2} \]

5) \( \text{Area}(S) = \int \int_D dS = \int_a^b b(x) \sqrt{1 + (b'(x))^2} \, dx \)
\[ \text{Area}(S) = 2\pi \int_a^b f(x) \sqrt{1 + (f'(x))^2} \, dx \]

(b) \[ f(x) = \frac{1}{x}, \quad a = 1, \quad b = \infty \]

\[ \text{Area}(S) = 2\pi \int_1^\infty \frac{1}{x} \sqrt{1 + \left( -\frac{1}{x^2} \right)^2} \, dx \]

\[ = 2\pi \int_1^\infty \frac{1}{x} \sqrt{1 + \frac{1}{x^4}} \, dx \]

\[ = 2\pi \int_1^\infty \frac{1}{x} \, dx = 2\pi \left[ \ln|x| \right]_1^\infty = 0 \]

On the other hand:

By the disk method:

\[ V = \pi \int_1^\infty \left( \frac{1}{x} \right)^2 \, dx = \pi \left[ -\frac{1}{x} \right]_1^\infty = \pi (0 - 1) = -\pi \]

So the volume is finite, but the surface area is infinite, yea!

Freaking amazing!!
\[ (\alpha) \begin{cases} x = \cosh(\alpha) \cos(\theta) \\ y = \cosh(\alpha) \sin(\theta) \\ z = \sinh(\alpha) \end{cases} \]

**Notice**

\[ x^2 + y^2 - z^2 = \cosh^2(\alpha) \cos^2(\theta) + \cosh^2(\alpha) \sin^2(\theta) - \sinh^2(\alpha) \]
\[ = \cosh^2(\alpha) (\cos^2(\theta) + \sin^2(\theta)) - \sinh^2(\alpha) \]
\[ = \cosh^2(\alpha) - \sinh^2(\alpha) \]
\[ = 1 \]

So IT Indeed Parametrizes THE DRESS.

Moreover

\[ z = 1 \implies \sinh(\alpha) = 1 \implies \alpha = \sinh^{-1}(1) \]
\[ z = -1 \implies \sinh(\alpha) = -1 \implies \alpha = -\sinh^{-1}(1) \]

Hence

\[ \Gamma(\theta, \alpha) = \langle \cosh(\alpha) \cos(\theta), \cosh(\alpha) \sin(\theta), \sinh(\alpha) \rangle \]

\[ 0 \leq \theta \leq 2\pi \]
\[ \sinh^{-1}(1) \leq \alpha \leq \sinh^{-1}(1) \]

(\text{b} 1) \[ \Gamma_0 = \langle -\cosh(\alpha) \sin(\theta), \cosh(\alpha) \cos(\theta), 0 \rangle \]
\[ \Gamma_{\alpha} = \langle \sinh(\alpha) \cos(\theta), \sinh(\alpha) \sin(\theta), \cosh(\alpha) \rangle \]

2) \[ \text{Cox} \Gamma_\alpha = \begin{pmatrix} \cosh(\alpha) & 0 & \sinh(\alpha) \\ 0 & \cosh(\alpha) \cos(\theta) & \cosh(\alpha) \sin(\theta) \\ \sinh(\alpha) & -\sinh(\alpha) \cos(\theta) & \cosh(\alpha) \end{pmatrix} \]
\[ = \left< \cosh^{-1}(x), \cos(x), \cosh^{-1}(x), \sin(x) \right>, -\cosh(x) \sinh(x) \sin^2(x) \]
\[ = \left< \cosh^{-1}(x), \cos(x), \cosh^{-1}(x), \sin(x) \right>, -\cosh(x) \sinh(x) \cos^2(x) \]
\[ 3) \quad \| \Gamma x \Gamma x \| = \left( \cosh^4(x) \cos^4(x) + \cosh^4(x) \sin^4(x) \right)^{1/2} \]
\[ = \left( \cosh^{-4}(x) + \cosh^{-4}(x) \sin^4(x) \right)^{1/2} \]
\[ = \sqrt{\cosh^4(x) \left( \cosh^{-4}(x) + \sin^4(x) \right)} \]
\[ = \cosh^2(x) \sqrt{\cosh^{-2}(x) + \sin^4(x)} \]
\[ 4) \quad \text{AMFA}(x) = \int \int \cosh(x) \sqrt{\cosh^{-2}(x) + \sinh^{-2}(x)} \, dx \, d\theta \]
\[ = 2 \pi \int_{\sinh^{-1}(1)}^{\cosh^{-1}(x)} \sqrt{\cosh^{-2}(x) + \sinh^{-2}(x)} \, dx \]