

## 1 | Evaluating a Cylindrical Integral

Considering the function:

$$f(x, y, z) = \sqrt{x^2 + y^2} \quad (1)$$

To evaluate the integral, we will convert it to cylindrical coordinates. We note first that the integral is to be evaluated inside the cylinder of  $x^2 + y^2 = 16$ , which means that we wish to evaluate it in a circle with center at the origin with radius 4.

Furthermore, we understand that the bounds of the function are to be evaluated between  $[-5, -4]$ .

If we set up the integral, we will get:

$$\int_{-5}^{-4} \int_C \sqrt{x^2 + y^2} \, dx \, dy \, dz \quad (2)$$

This is convenient. We can evaluate the inner integral first like in  $\mathbb{R}^2 \rightarrow \mathbb{R}^1$ , then simply evaluate the other integral after.

Let's do so.

Note that the inner integral is a normal cylindrical coordinate setup. Therefore, we can take the following substitution:

$$\sqrt{x^2 + y^2} = r \quad (3)$$

Furthermore, that:

$$dx \, dy = dr \, d\theta \quad (4)$$