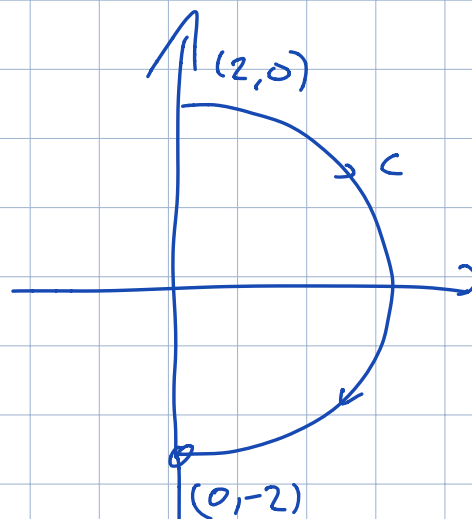
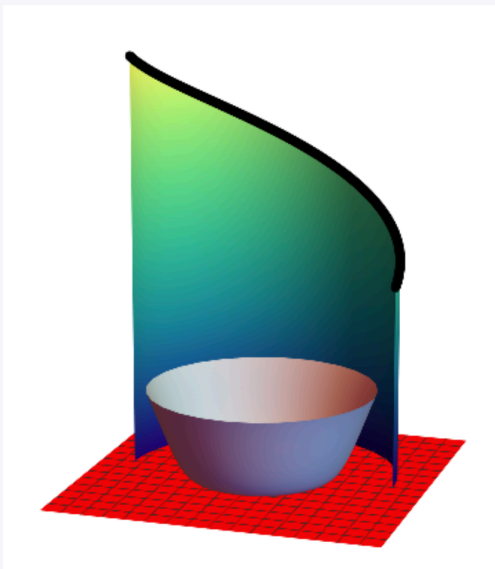


Q1 Nadine

2 Points

Nadine bought a new fancy curtain for her bathroom. The curtain rod (black in the picture) lies on the graph of the function $f(x, y) = 3 + \arctan\left(\frac{y}{x}\right)$, where x and y are measured in feet, over the arc of the circle $x^2 + y^2 = 4$ on the xy plane that starts at $(0, 2)$ and goes clockwise all the way to $(0, -2)$, as in the picture. If the curtain touches the floor, which is represented as the xy plane, find the area of the curtain. Make sure to include units.



Can parametrize $-c$:

$$\text{Let } x = 2\cos(t)$$

$$y = 2\sin(t)$$

$$t \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$$

Note: parametrization doesn't matter for ds int'l.

$$\begin{aligned} \text{Then } \int_c f ds &= \int_{-c} f ds = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left(3 + \arctan\left(\frac{2\sin t}{2\cos t}\right) \right) \sqrt{(-2\sin t)^2 + (2\cos t)^2} dt \\ &= \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} 2 \left(3 + \arctan(\tan(t)) \right) dt \\ &= \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} 6 + 2t dt = 6\pi \text{ ft}^2 \end{aligned}$$