

$$\begin{aligned}r &= \sin \theta, \frac{\pi}{3} \leq \theta \leq \frac{2\pi}{3}. \\A &= \int_{\pi/3}^{2\pi/3} \frac{1}{2} \sin^2 \theta \, d\theta = \frac{1}{4} \int_{\pi/3}^{2\pi/3} (1 - \cos 2\theta) \, d\theta = \frac{1}{4} \left[ \theta - \frac{1}{2} \sin 2\theta \right]_{\pi/3}^{2\pi/3} \\&= \frac{1}{4} \left[ \frac{2\pi}{3} - \frac{1}{2} \sin \frac{4\pi}{3} - \frac{\pi}{3} + \frac{1}{2} \sin \frac{2\pi}{3} \right] = \frac{1}{4} \left[ \frac{2\pi}{3} - \frac{1}{2} \left( -\frac{\sqrt{3}}{2} \right) - \frac{\pi}{3} + \frac{1}{2} \left( \frac{\sqrt{3}}{2} \right) \right] \\&= \frac{\pi}{12} + \frac{\sqrt{3}}{8}\end{aligned}$$