

$\frac{1}{2} \sqrt{2\pi} \int_0^1 \sqrt{1-t^2} dt = \frac{1}{2} \sqrt{2\pi} \left[ \frac{1}{2} \left( t \sqrt{1-t^2} + \arcsin t \right) \right]_0^1 = \frac{1}{2} \sqrt{2\pi} \left( \frac{1}{2} \left( 1 \sqrt{1-1^2} + \arcsin 1 \right) \right) = \frac{1}{2} \sqrt{2\pi} \left( \frac{1}{2} \left( 0 + \frac{\pi}{2} \right) \right) = \frac{1}{2} \sqrt{2\pi} \left( \frac{\pi}{4} \right) = \frac{\pi}{4} \sqrt{2\pi}$