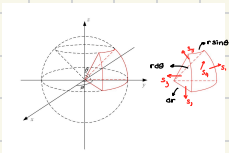

$dV = r^2 \sin\theta \, dr\, d\theta\, d\phi$

$V = \int_0^2 \int_{45°}^{90°} \int_{45}^{90} r^2 \sin\theta \, dr\, d\theta\, d\phi$

$= \int_0^2 \int_{\frac{\pi}{2}}^{\frac{\pi}{2}} \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} r^2 \sin\theta \, dr\, d\theta\, d\phi$

$= \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \left[\frac{1}{3}r^3\right]_0^2 \sin\theta \, d\theta\, d\phi$

$= \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{1}{3} \cdot 8 \sin(\theta) \Big]_{\frac{\pi}{4}}^{\frac{\pi}{2}} d\phi$

$= \frac{8}{3}\left(\frac{\pi}{2} - \frac{\pi}{4}\right) \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \sin\theta \, d\theta$

$= \frac{8}{3}\left(\frac{\pi}{4}\right) \left[-\cos\theta\right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$

$= \frac{2\pi}{3}\left[-\cos\frac{\pi}{2} + \cos\frac{\pi}{4}\right]$

$= \frac{2\pi}{3} \cdot \cos\frac{\pi}{4} = \frac{\sqrt{2}}{3}\pi \approx 1.48$

S_1: r constant

$dS_1 = r^2 \sin\theta \, d\theta\, d\phi \, \underset{\sim}{a_r}$

$S_1 = \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} r^2 \sin\theta \, d\theta\, d\phi \, \underset{\sim}{a_r}$

$= r^2 \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} [\phi]_{\frac{\pi}{4}}^{\frac{\pi}{2}} \sin\theta \, d\theta \, \underset{\sim}{a_r}$

$= r^2 \left(\frac{\pi}{4}\right) \left(-\cos\theta\right)\Big]_{\frac{\pi}{4}}^{\frac{\pi}{2}} \underset{\sim}{a_r}$

$= r^2 \left(\frac{\pi}{4}\right)(0 + \frac{\sqrt{2}}{2}) \, \underset{\sim}{a_r}$

$= \frac{\sqrt{2}}{8}\pi r^2 \, \underset{\sim}{a_r}$

$\hookrightarrow r = 2$

$= \frac{\sqrt{2}}{8} \cdot 4\pi \, \underset{\sim}{a_r} = \frac{\sqrt{2}}{2}\pi \underset{\sim}{a_r} = \frac{1}{\sqrt{2}}\pi \underset{\sim}{a_r} \approx 2.22 \, \underset{\sim}{a_r}$

S_2: θ constant

$dS_2 = r \sin\theta \, d\phi \, dr$

$S_2 = \int_0^2 \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} r \sin\theta \, d\phi \, dr$

$= \sin\theta \int_0^2 r \, [\phi]_{\frac{\pi}{4}}^{\frac{\pi}{2}} \, dr$

$= \sin\left(\frac{\pi}{2} - \frac{\pi}{4}\right) \left[\frac{1}{2}r^2\right]_0^2$

$= \sin\left(\frac{\pi}{4}\right)\left(\frac{4}{2} - 0\right)$

$= \sin\left(\frac{\pi}{4}\right)$

$\hookrightarrow \theta = \frac{\pi}{4}$

$= \frac{\pi}{2} \approx 1.57$

S_3: θ constant

$dS_3 = r \sin\theta \, d\phi \, dr$

$S_3 = \int_0^2 \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} r \sin\theta \, d\phi \, dr$

$= \int_0^2 r \, [\phi]_{\frac{\pi}{4}}^{\frac{\pi}{2}} \sin\theta \, dr$

$= \int_0^2 r \sin\theta \, dr$

$= \frac{\pi}{4} \int_0^2 r \sin\theta \, dr$

$= \frac{\pi}{4} \sin\theta \left[\frac{1}{2}r^2\right]_0^2$

$= \frac{\pi}{4} \sin\theta \, (2 - 0)$

$\hookrightarrow \theta = \frac{\pi}{4}$

$= \frac{\pi}{4} \cdot \frac{\sqrt{2}}{2}(2) = \frac{\sqrt{2}\pi}{4\sqrt{2}} = \frac{\pi}{2\sqrt{2}} \approx 1.11$

S_4: θ constant

$dS_4 = r \sin\theta \, d\phi \, dr$

$S_4 = \int_0^2 \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} r \sin\theta \, d\phi \, dr$

$= \sin\theta \int_0^2 r \, [\phi]_{\frac{\pi}{4}}^{\frac{\pi}{2}} \, dr$

$= \sin\left(\frac{\pi}{2} - \frac{\pi}{4}\right) \left[\frac{1}{2}r^2\right]_0^2$

$= \sin\left(\frac{\pi}{4}\right)\left(\frac{4}{2} - 0\right)$

$= \sin\theta\left(\frac{\pi}{2}\right)$

$\hookrightarrow \theta = \frac{\pi}{2}$

$= \frac{\pi}{2} \approx 1.57$

$S_4 = S_3$

$S = S_1 + S_2 + S_3 + S_4 + S_5$

$= S_1 + S_2 + 2S_3 + S_5$

$= 2.22 + 1.57 + 2(1.57) + 1.11$

$= 8.04$