#33 (b1)

$$I_0 = \int_{-\pi/4}^{\pi/4} \frac{du}{\cos^3 u} = \int_{-\tan\pi/8}^{\tan\pi/8} \left(\frac{1+t^2}{1-t^2}\right)^3 \cdot \frac{2\,dt}{1+t^2}$$

$$\tan\frac{u}{2} = t$$

$$du = \frac{2\,dt}{1+t^2}$$

$$\cos u = \frac{1-t^2}{1+t^2}$$

$$= 4\int_0^{\tan\pi/8} \frac{(1+t^2)^2}{(1-t^2)^3}\,dt$$

BTW, $\tan\frac{\pi}{8}$ can be written without trigs:

~~tan~~ since $\frac{1-\tan^2\frac{\pi}{8}}{1+\tan^2\frac{\pi}{8}} = \cos\frac{\pi}{4} = \frac{\sqrt{2}}{2}$, we find (solving for $\tan^2\frac{\pi}{8}$) that

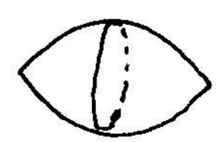
$$\tan^2\frac{\pi}{8} = \frac{1-\sqrt{2}/2}{1+\sqrt{2}/2} = \frac{2-\sqrt{2}}{2+\sqrt{2}} = \frac{(2-\sqrt{2})^2}{4-2}$$

$$\tan\frac{\pi}{8} = \frac{2-\sqrt{2}}{\sqrt{2}} = \sqrt{2}-1$$

$$I_0 = 4\int_0^{\sqrt{2}-1} \frac{(1+t^2)^2}{(1-t^2)^3}\,dt$$

#34:

In #33 (b2) we calc'd that the surface area of



was $2\pi\left(\sqrt{2} + \ln(1+\sqrt{2})\right) = 14.4236$

The volume (according to #22) is $\frac{\pi^2}{2}$

The ball with the same volume would need radius r such that

$\frac{4\pi}{3}r^3 = \frac{\pi^2}{2}$, i.e. $r = \left(\frac{3}{8}\pi\right)^{1/3}$. It's surface area would be $4\pi r^2 = 4\pi\left(\frac{3}{8}\pi\right)^{2/3} \approx 14.0173$

which is indeed smaller than the surface of our rotational body