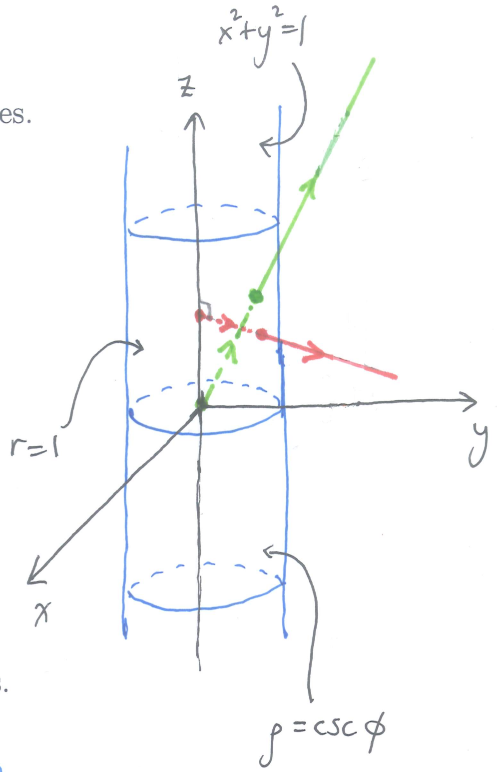
3. Consider the triple integral

$$I = \iiint_E \frac{1}{(x^2+y^2+z^2)^2}\, dV$$

where $E = \{(x, y, z) : x^2 + y^2 \geq 1\}$.

a. Express I in terms of iterated integrals in cylindrical coordinates.

$$I = \int_0^{2\pi}\int_{-\infty}^{\infty}\int_1^{\infty} \frac{1}{(r^2+z^2)^2}\, r\, dr\, dz\, d\theta$$



b. Express I in terms of iterated integrals in spherical coordinates.

$$I = \int_0^{2\pi}\int_0^{\pi}\int_{\csc\phi}^{\infty} \frac{1}{(\rho^2)^2}\, \rho^2 \sin\phi\, d\rho\, d\phi\, d\theta$$

c. Evaluate I.

$$I = \int_0^{2\pi}\int_0^{\pi} \left[-\frac{1}{\rho}\right]_{\rho=\csc\phi}^{\rho=\infty} \sin\phi\, d\phi\, d\theta = \int_0^{2\pi}\int_0^{\pi} \sin^2\phi\, d\phi\, d\theta$$

$$= \int_0^{2\pi}\int_0^{\pi} \frac{1-\cos 2\phi}{2}\, d\phi\, d\theta = \int_0^{2\pi} \left[\frac{1}{2}\phi - \frac{1}{4}\sin 2\phi\right]_{\phi=0}^{\phi=\pi} d\theta$$

$$= \frac{\pi}{2}\cdot\int_0^{2\pi} d\theta = \frac{\pi}{2}\cdot 2\pi = \pi^2$$