Then the cartesian coordinates (x,y,z), the cylindrical coordinates (r,θ,z), and the spherical coordinates (ρ,φ,θ) of a point are related as follows:

$$\text{cart} \leftrightarrow \text{cyl} \qquad \begin{cases} x = r\cos\theta, \\ y = r\sin\theta, \end{cases} \qquad \begin{cases} r = \sqrt{x^2+y^2}, \\ \theta = \arctan\dfrac{y}{x}, \end{cases} \qquad \begin{cases} \sin\theta = \dfrac{y}{\sqrt{x^2+y^2}}, \\ \cos\theta = \dfrac{x}{\sqrt{x^2+y^2}}. \end{cases}$$

$$\text{cyl} \leftrightarrow \text{sph} \qquad \begin{cases} r = \rho\sin\phi, \\ z = \rho\cos\phi, \end{cases} \qquad \begin{cases} \rho = \sqrt{r^2+z^2}, \\ \phi = \arctan\dfrac{r}{z}, \end{cases} \qquad \begin{cases} \sin\phi = \dfrac{r}{\sqrt{r^2+z^2}}, \\ \cos\phi = \dfrac{z}{\sqrt{r^2+z^2}}. \end{cases}$$

$$\text{cart} \leftrightarrow \text{sph} \qquad \begin{cases} x = \rho\cos\theta\sin\phi, \\ y = \rho\sin\theta\sin\phi, \\ z = \rho\cos\phi, \end{cases} \qquad \begin{cases} \rho = \sqrt{x^2+y^2+z^2}, \\ \theta = \arctan\dfrac{y}{x}, \\ \phi = \arctan\dfrac{\sqrt{x^2+y^2}}{z} \\ \quad = \arccos\dfrac{z}{\sqrt{x^2+y^2+z^2}}. \end{cases}$$