## Conversion between 2-dimensional coordinates

| | Cartesian | Polar |
|---|---|---|
| Cartesian | | $x = r\cos\theta$<br>$y = r\sin\theta$ |
| Polar | $r = \sqrt{x^2 + y^2}$<br>$\tan\theta = y/x$ | |

$$\theta = \begin{cases} \tan^{-1}(y/x) & \text{if } x > 0,\ y \geq 0 \\ \tan^{-1}(y/x) + 2\pi & \text{if } x > 0,\ y < 0 \\ \tan^{-1}(y/x) + \pi & \text{if } x < 0 \\ \pi/2 & \text{if } x = 0,\ y > 0 \\ 3\pi/2 & \text{if } x = 0,\ y < 0 \\ \text{indeterminate} & \text{if } x = y = 0 \end{cases}$$

## Conversion between 3-dimensional coordinates

| | Cartesian | Cylindrical | Spherical |
|---|---|---|---|
| Cartesian | | $x = r\cos\theta$<br>$y = r\sin\theta$<br>$z = z$ | $x = \rho\sin\varphi\cos\theta$<br>$y = \rho\sin\varphi\sin\theta$<br>$z = \rho\cos\varphi$ |
| Cylindrical | $r = \sqrt{x^2 + y^2}$<br>$\tan\theta = y/x$<br>$z = z$ | | $r = \rho\sin\varphi$<br>$\theta = \theta$<br>$z = \rho\cos\varphi$ |
| Spherical | $\rho = \sqrt{x^2 + y^2 + z^2}$<br>$\tan\varphi = \sqrt{x^2 + y^2}/z$<br>$\tan\theta = y/x$ | $\rho = \sqrt{r^2 + z^2}$<br>$\tan\varphi = r/z$<br>$\theta = \theta$ | |