

Compendium Geometry



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See also: [Conversion between Polar and Cartesian Coordinates](#), [Three-dimensional Cartesian Coordinate System](#), [Cylindrical Coordinate System](#), [Spherical Coordinate System](#)



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Conversion between 3D Coordinate Systems



Conversion from cartesian to cylinrical coordinates:

[Cartesian](#) [x, y, z] —→ [Cylindrical](#) [ρ, φ, z']

$$\begin{aligned}\rho &= \sqrt{x^2 + y^2} \\ \varphi &= \arctan(y/x) && \text{for } x > 0 \\ \varphi &= \pi/2 && \text{for } x = 0 \text{ and } y > 0 \\ \varphi &= \pi + \arctan(y/x) && \text{for } x < 0 \\ \varphi &= 3\pi/2 && \text{for } x = 0 \text{ and } y < 0 \\ z' &= z\end{aligned}$$

Conversion from cylindrical to cartesian coordinates:

[Cylindrical](#) [ρ, φ, z'] —→ [Cartesian](#) [x, y, z]

$$\begin{aligned}x &= \rho \cdot \cos \varphi \\ y &= \rho \cdot \sin \varphi \\ z &= z'\end{aligned}$$

Conversion from spherical to cartesian coordinates:

[Spherical](#) [r, θ, φ] —→ [Cartesian](#) [x, y, z]

$$\begin{aligned}x &= r \cdot \sin \theta \cdot \cos \varphi \\ y &= r \cdot \sin \theta \cdot \sin \varphi \\ z &= r \cdot \cos \theta\end{aligned}$$

Conversion from cartesian to spherical coordinates:

[Cartesian](#) [x, y, z] —→ [Spherical](#) [r, θ, φ]

$$\begin{aligned}r &= \sqrt{x^2 + y^2 + z^2} \\ \cos \varphi &= \frac{x}{\sqrt{x^2 + y^2}} && \sin \varphi = \frac{y}{\sqrt{x^2 + y^2}} && \tan \varphi = \frac{y}{x} \\ \cos \theta &= \frac{z}{r} = \frac{z}{\sqrt{x^2 + y^2 + z^2}}\end{aligned}$$

Conversion from spherical to cylindrical coordinates:

[Spherical](#) [r, θ, φ] —→ [Cylindrical](#) [ρ, φ', z']

$$\begin{aligned}\rho &= r \cdot \sin \theta \\ \varphi' &= \varphi \\ z' &= r \cdot \cos \theta\end{aligned}$$

Conversion from cylindrical to spherical coordinates:

[Cylindrical](#) [ρ, φ, z] —→ [Spherical](#) [r, θ, φ']

$$\begin{aligned}r &= \sqrt{\rho^2 + z^2} \\ \theta &= \arctan(\rho/z) \\ \varphi' &= \varphi\end{aligned}$$



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