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Polar Coordinates

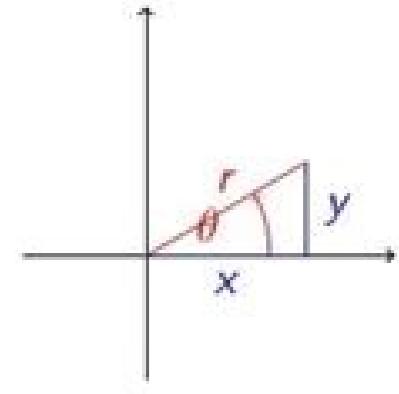
Conversion from polar to cartesian (rectangular)

$$x = r \cos \theta$$

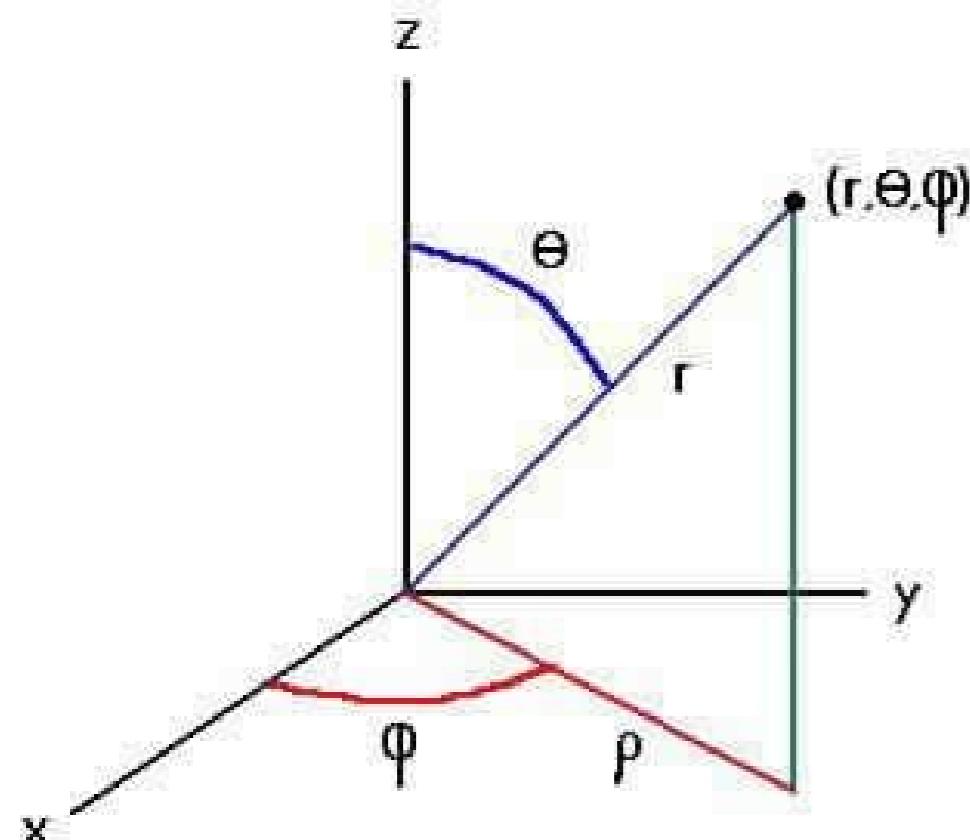
Conversion from cartesian to polar:

$$r = \sqrt{x^2 + y^2}$$

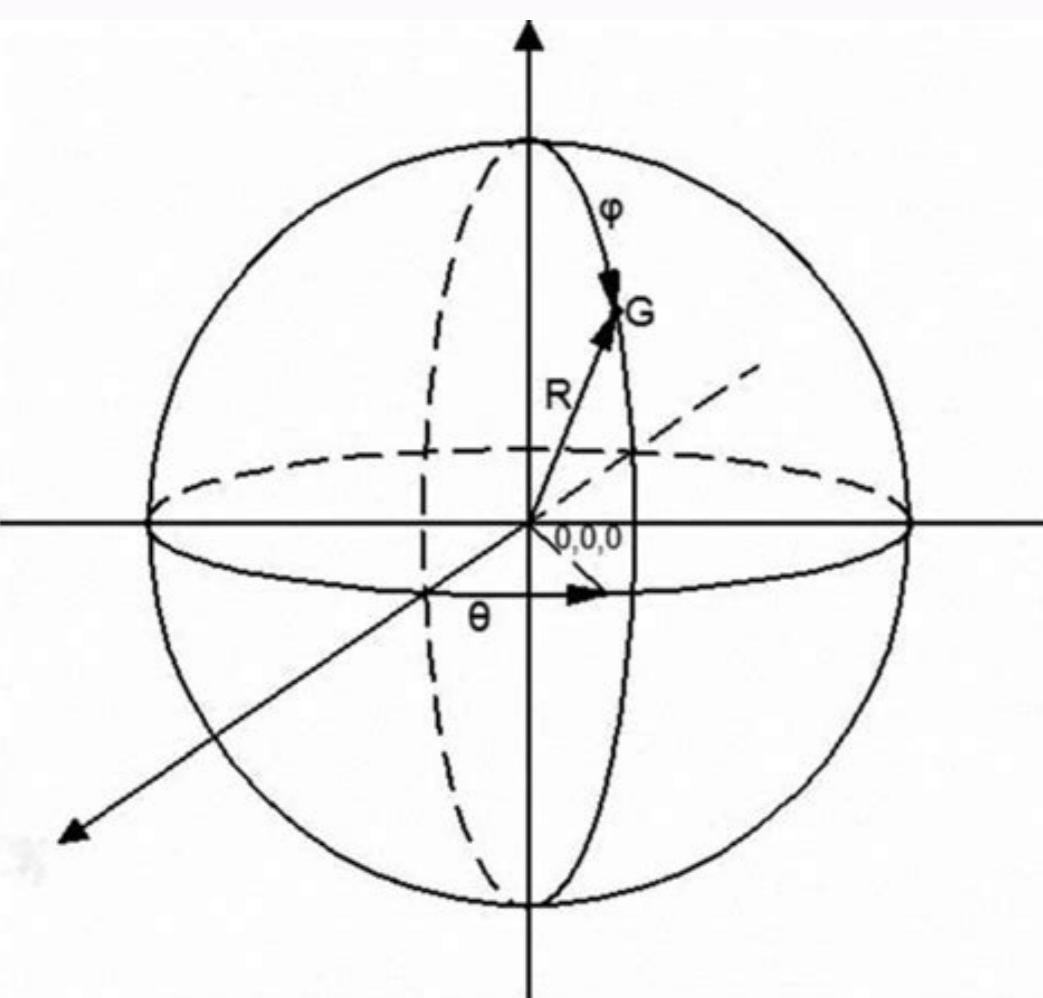
$$\cos \theta = \frac{x}{r} \quad \sin \theta = \frac{y}{r} \quad \tan \theta = \frac{y}{x}$$



$$\cos \theta = \frac{x}{r} \quad \sin \theta = \frac{y}{r} \quad \tan \theta = \frac{y}{x}$$



Spherical Coordinates



The diagram illustrates three coordinate systems in 3D space:

- (a) Rectangular coordinates:** A point $P(x, y, z)$ is shown in a Cartesian coordinate system with axes x , y , and z .
- (b) Cylindrical coordinates:** A point $P(r, \theta, z)$ is shown in a coordinate system with axes x , y , and z . The radial distance r is measured from the z -axis, the azimuthal angle θ is measured from the x -axis, and the height z is measured along the z -axis.
- (c) Spherical coordinates:** A point $P(\rho, \theta, \phi)$ is shown in a coordinate system with axes x , y , and z . The radial distance ρ is measured from the origin, the polar angle θ is measured from the positive x -axis, and the azimuthal angle ϕ is measured from the positive y -axis.

A decorative wavy pattern is visible at the bottom left of the slide.

$$\theta = \cos^{-1} \left(\frac{z}{\sqrt{x^2 + y^2 + z^2}} \right)$$

$$\phi = \tan^{-1}(y/x)$$

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