

# Polar coordinates

## Conversion from polar to cartesian

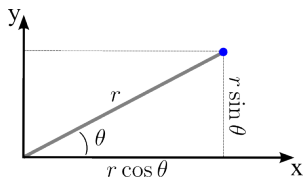
$$x = r \cos \theta$$

$$y = r \sin \theta$$

## Conversion from cartesian to polar

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

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



# Cylindrical coordinates

Conversion from cylindrical to cartesian

$$x = r \cos \theta$$

$$y = r \sin \theta$$

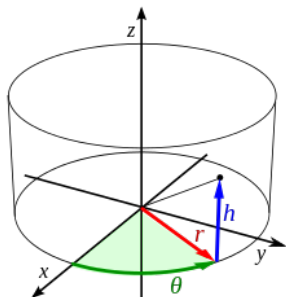
$$z = z$$

Conversion from cartesian to cylindrical

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

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

$$z = z$$



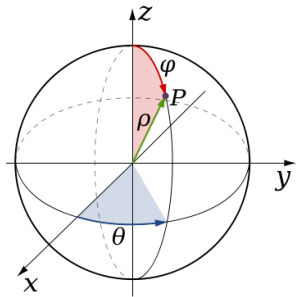
# Spherical coordinates

## Conversion from spherical to cartesian

$$x = \rho \sin \phi \cos \theta$$

$$y = \rho \sin \phi \sin \theta$$

$$z = \rho \cos \phi$$



## Conversion from cartesian to spherical

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

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

$$\cos \phi = \frac{z}{\rho}$$