

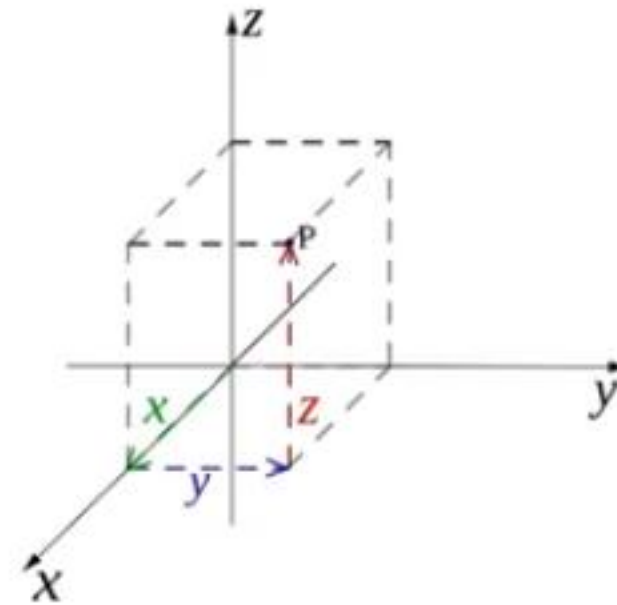
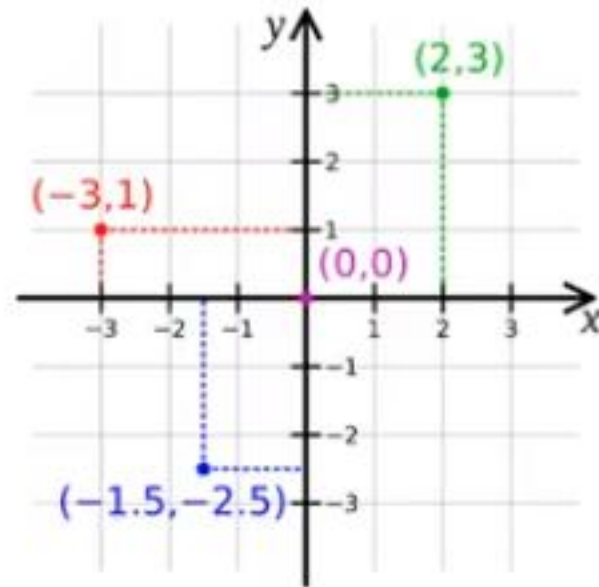
COORDINATE SYSTEMS

LECTURE 1 (P1)

Applied Physics PH-122

COORDINATE SYSTEM

A coordinate system is defined as a system which uses one or more numbers to uniquely determine the position of a point or other geometric elements in space.

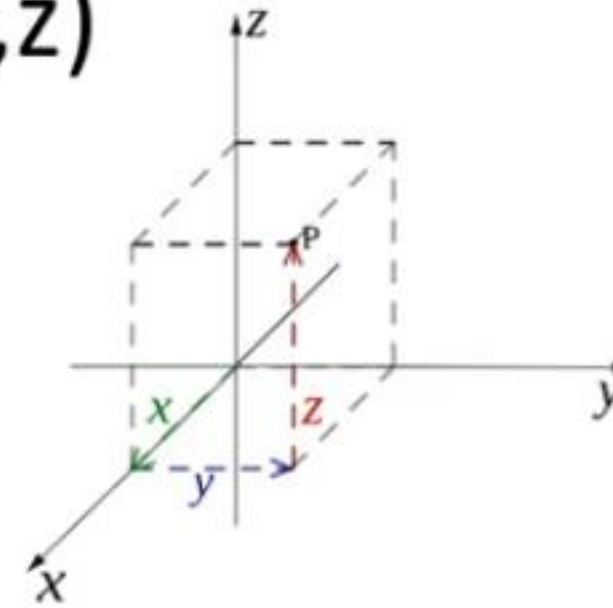


Commonly used coordinate systems

- Cartesian or rectangular coordinate system.
- Polar coordinate system.
- Spherical coordinate system.

Cartesian coordinate system

- Three perpendicular axes; x , y and z with unit vectors \hat{i} , \hat{j} , \hat{k} respectively.
- Coordinates written as (x, y, z)



Polar coordinate system

- Polar coordinate system determines each point in space by distance of the point from reference point and an angle from reference direction.
- The reference point is called pole (analogous to origin of cartesian coordinate system).
- The distance from pole to point is represented by 'r' and is called radial distance or radius.
- The angular coordinate is represented by θ .

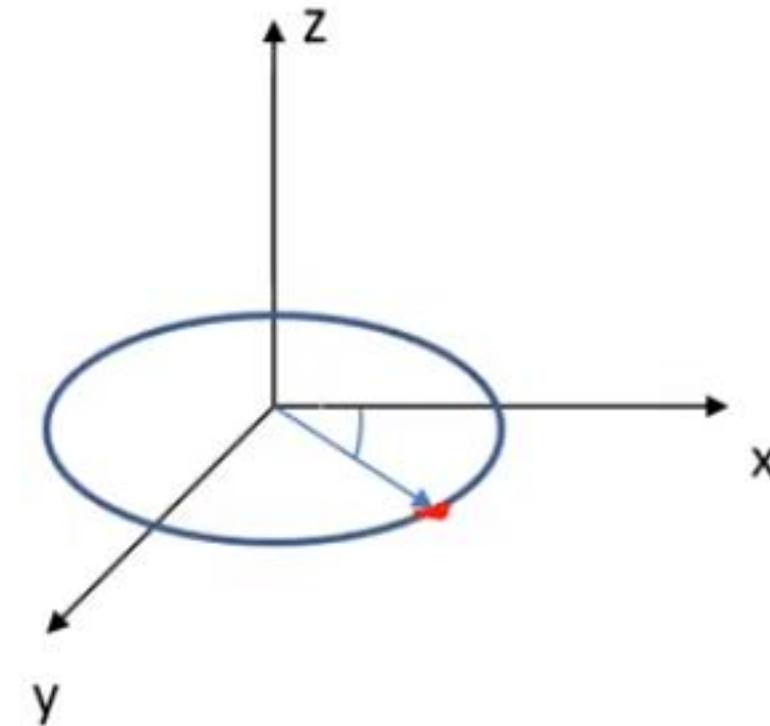
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Polar and cartesian coordinate systems

Coordinates are written as (r, θ, z)

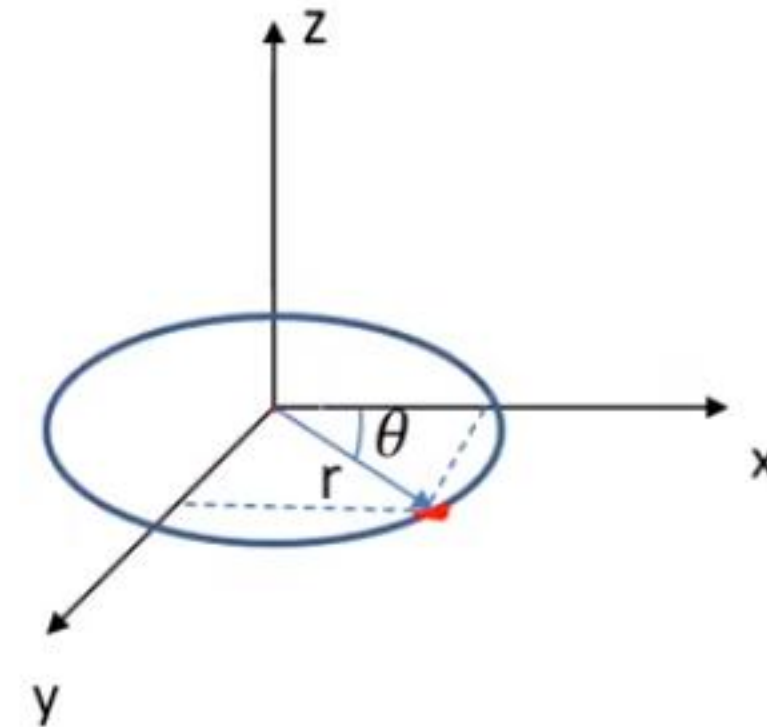
| Polar to cartesian transformation | Cartesian to polar transformation |
|-----------------------------------|---|
| $x = r \cos \theta$ | $r = (x^2 + y^2)^{1/2}$ |
| $y = r \sin \theta$ | $\theta = \tan^{-1} \left(\frac{y}{x} \right)$ |
| $z = z$ | $z = z$ |



Polar and cartesian coordinate systems

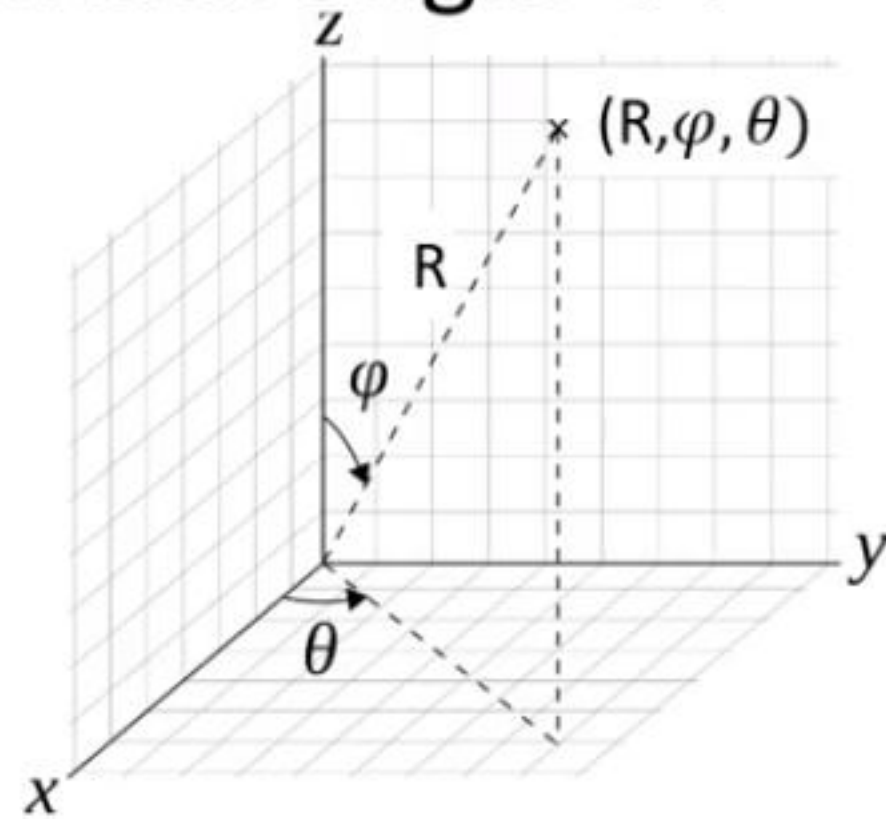
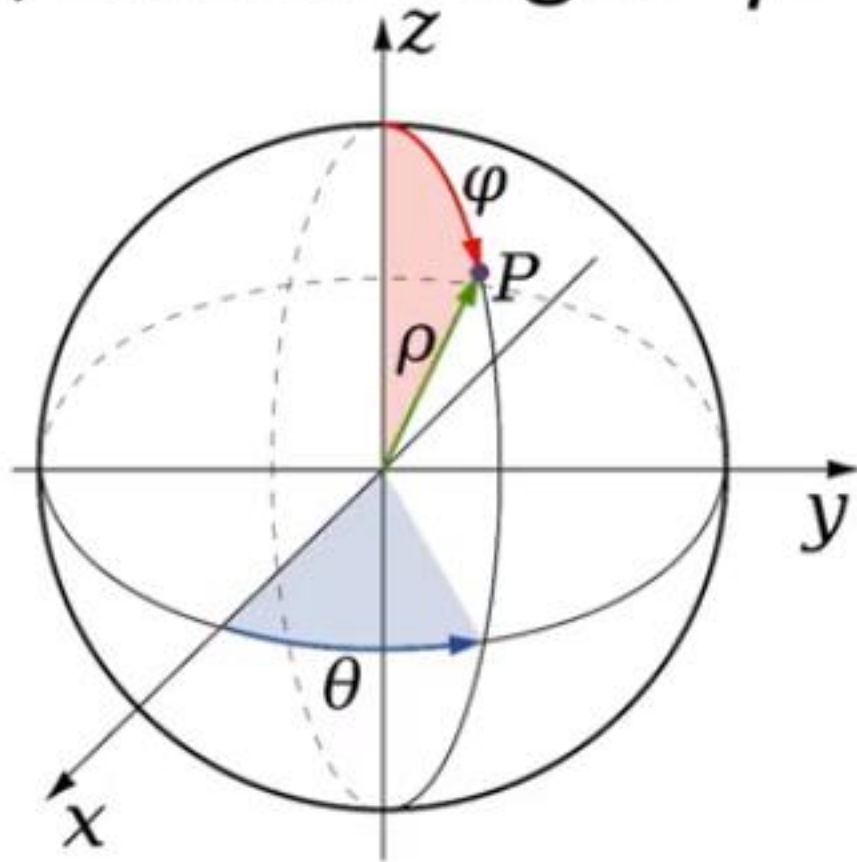
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Spherical coordinate system

- Spherical coordinate system is represented by radial distance ' R ' (sometimes represented by ρ), zenith angle ' φ ' and azimuth angle ' θ '



Spherical and cartesian coordinate systems

| Spherical to cartesian transformation | Cartesian to spherical transformation |
|---------------------------------------|---|
| $x = R \sin \varphi \cos \theta$ | $R = (x^2 + y^2 + z^2)^{1/2}$ |
| $y = R \sin \varphi \sin \theta$ | $\theta = \tan^{-1} \left(\frac{y}{x} \right)$ |
| $z = R \cos \varphi$ | $\varphi = \tan^{-1} (r/z)$ |

