Cylindrical Coordinates

Cartesian coordinates are in terms of cylindrical coordinates

$$x = \rho \cos \phi$$
$$y = \rho \sin \phi$$
$$z = z$$

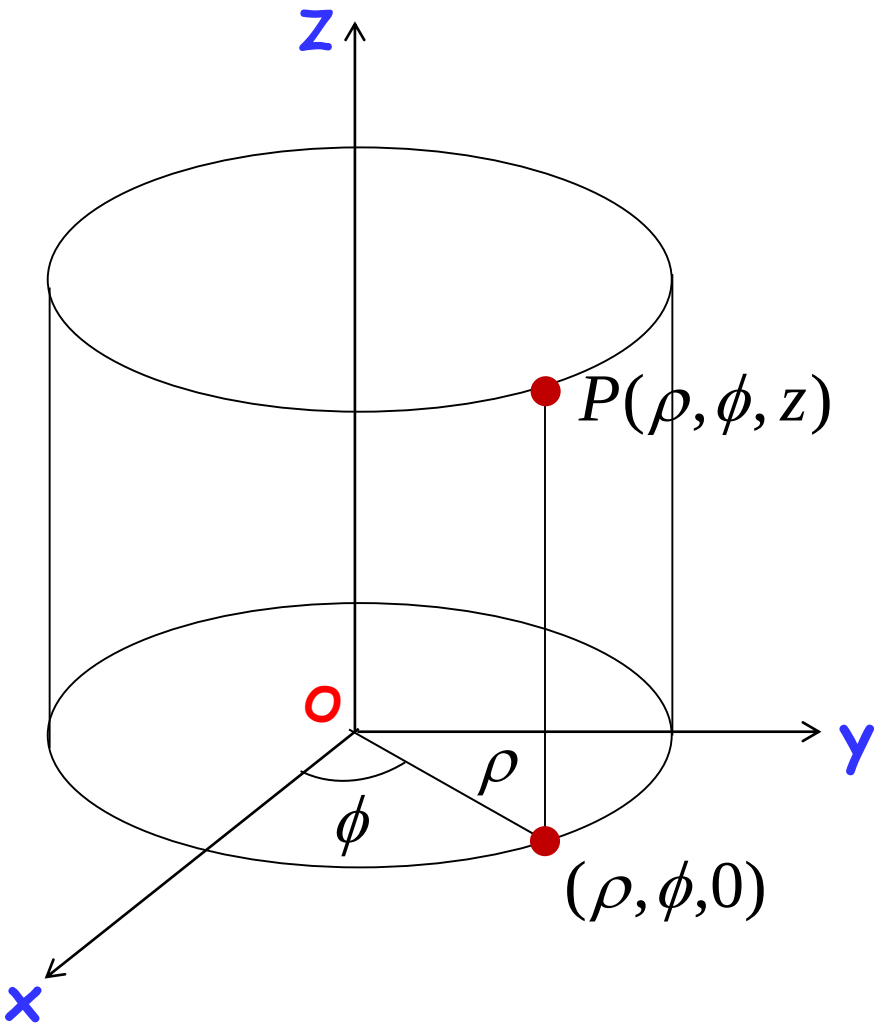
limits

$$0 < \rho < \infty$$
$$0 \le \phi \le 2\pi$$

Cylindrical coordinates are in terms Cartesian of coordinates

$$\rho = \sqrt{x^2 + y^2}$$
$$\phi = \tan^{-1}\left(\frac{y}{x}\right)$$
$$z = z$$

Cylindrical coordinates



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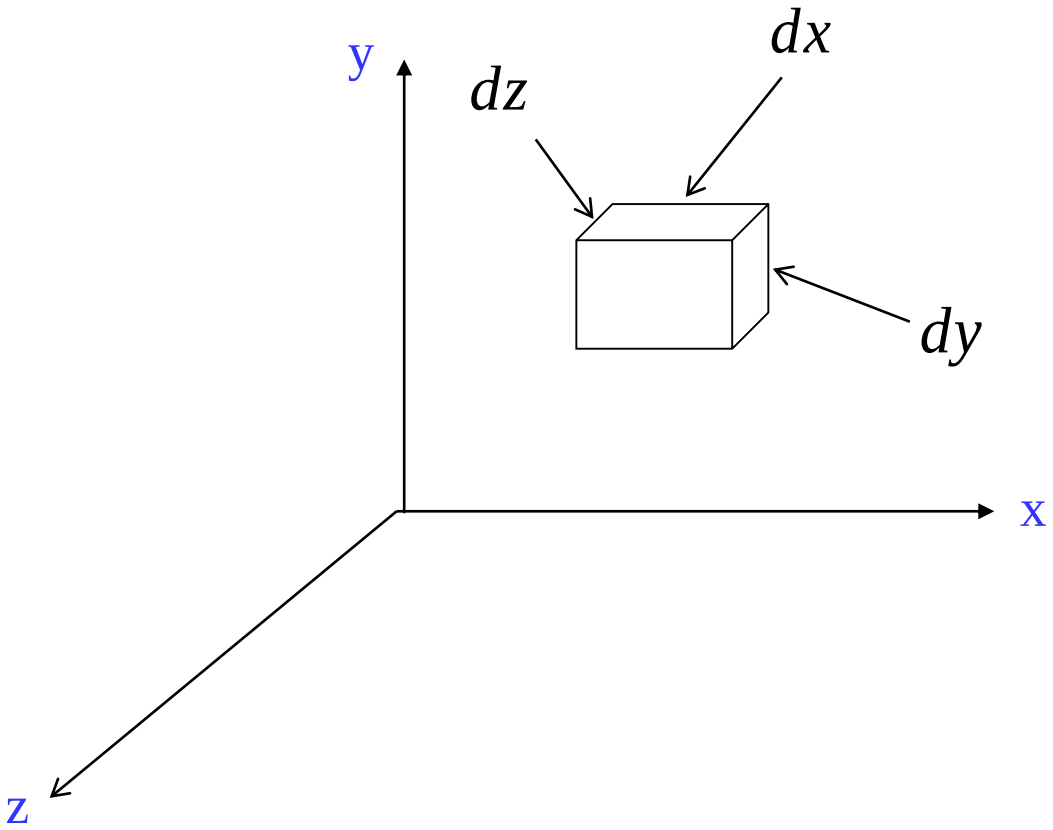
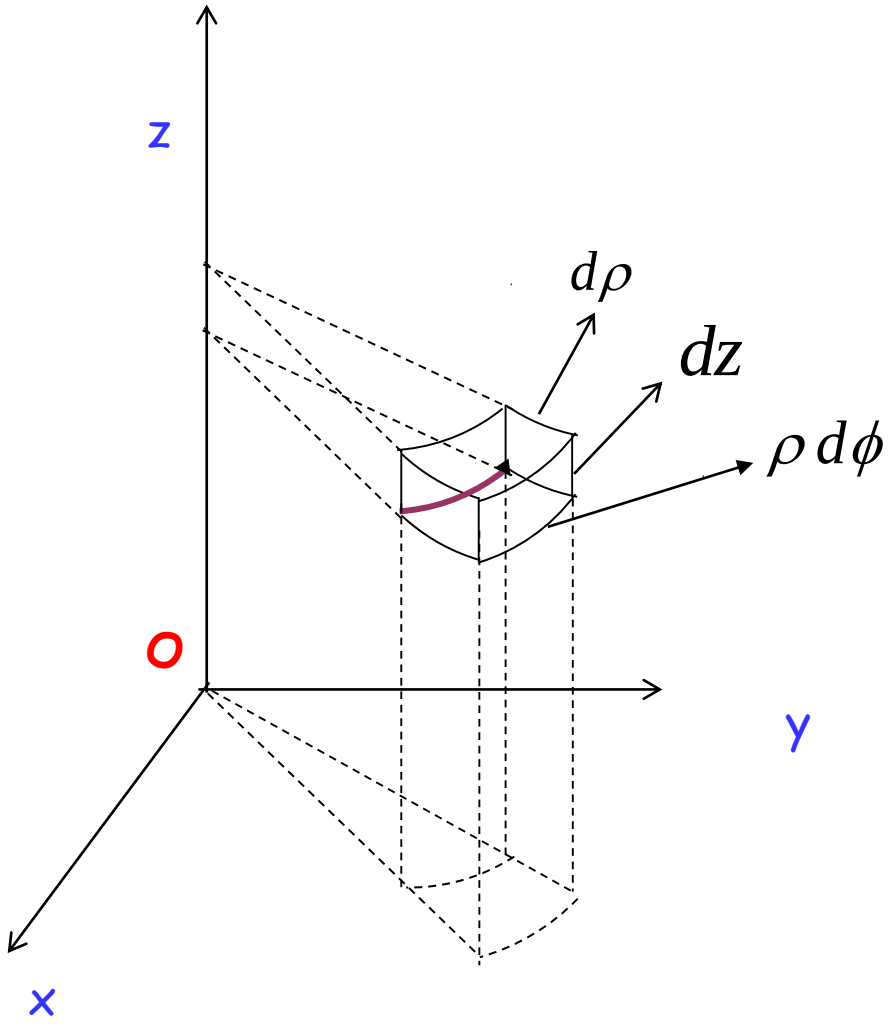
Rectangular coordinates: Volume element



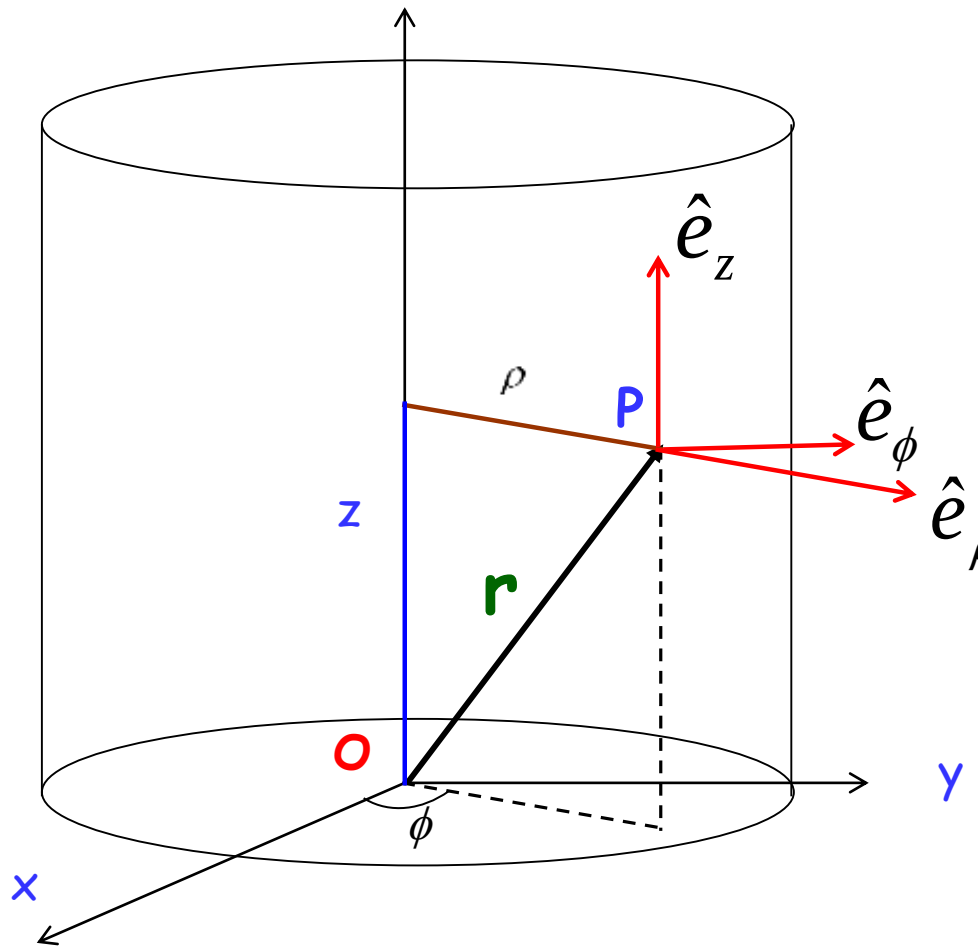
$$dv = dx\,dy\,dz$$

Volume element

$$dv = d\rho\, \rho\, d\phi\, dz$$
$$= \rho\, d\rho\, d\phi\, dz$$



unit vectors



$$\hat{e}_z = \frac{\partial \vec{r}/\partial z}{\|\partial \vec{r}/\partial z\|}$$

$$\hat{e}_\phi = \frac{\partial \vec{r}/\partial \phi}{\|\partial \vec{r}/\partial \phi\|}$$

$$\hat{e}_\rho = \frac{\partial \vec{r}/\partial \rho}{\|\partial \vec{r}/\partial \rho\|}$$

$$\vec{r} = \vec{r}(\rho, \phi, z)$$