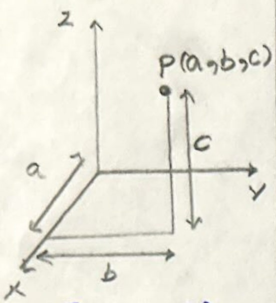
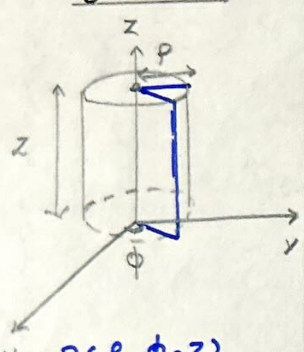
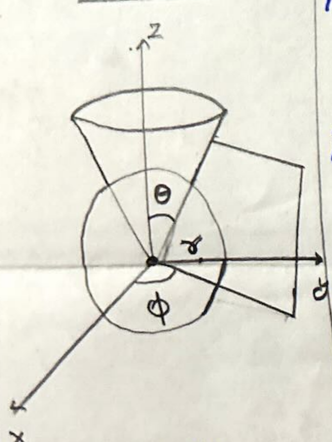
Coordinate System	Planes & coordinates with limits	Differential elements	Relation b/w coordinate points	Transformation of vector
Cartesian  $P(x,y,z)$	i) x-plane (x) $-\infty < x < \infty$ ii) y-plane (y) $-\infty < y < \infty$ iii) z-plane (z) $-\infty < z < \infty$	Diff length $\vec{dl} = dx\,\vec{a_x} + dy\,\vec{a_y} + dz\,\vec{a_z}$ Diff surfaces: $\vec{ds_1} = dx\,dy\,\vec{a_z}$ $\vec{ds_2} = dy\,dz\,\vec{a_x}$ $\vec{ds_3} = dx\,dz\,\vec{a_y}$ Diff Volume: $dv = dx\,dy\,dz$	R in.t. of cyl: $x = \rho\cos\phi$ $y = \rho\sin\phi$, $z = z$ Rect in.t of Sph: $x = r\sin\theta\cos\phi$ $y = r\sin\theta\sin\phi$ $z = r\cos\theta$	R. in.t cyl: $\begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix} = \begin{bmatrix} \cos\phi & -\sin\phi & 0 \\ \sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$ $\begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix} = \begin{bmatrix} \sin\theta\cos\phi & \cos\theta\cos\phi & -\sin\phi \\ \sin\theta\sin\phi & \cos\theta\sin\phi & \cos\phi \\ \cos\theta & -\sin\theta & 0 \end{bmatrix} \begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix}$
cylindrical  $P(\rho,\phi,z)$	i) Radius plane (ρ) $0 < \rho < \infty$ ii) Angle plane (ϕ) $0 < \phi < 2\pi$ iii) Height plane (z) $-\infty < z < \infty$	Diff length $\vec{dl} = d\rho\,\vec{a_\rho} + d\phi\,\vec{a_\phi} + dz\,\vec{a_z}$ Diff surface area: $\vec{ds_1} = \rho\,d\phi\,d\rho\,\vec{a_z}$ $\vec{ds_2} = \rho\,d\phi\,dz\,\vec{a_\rho}$ $\vec{ds_3} = dz\,d\rho\,\vec{a_\phi}$ Diff Volume: $dv = \rho\,d\phi\,d\rho\,dz$	cyl in.t of Rect $\rho = \sqrt{x^2+y^2}$ $\phi = \tan^{-1}(y/x)$ $z = z$ cyl in.t of Sph: $\rho = r\sin\theta$ $\phi = \phi$ $z = r\cos\theta$	$\begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix} = \begin{bmatrix} \cos\phi & \sin\phi & 0 \\ -\sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix}$ $\begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix} = \begin{bmatrix} \frac{\rho}{\sqrt{\rho^2+z^2}} & \frac{z}{\sqrt{\rho^2+z^2}} & 0 \\ 0 & 0 & 1 \\ \frac{z}{\sqrt{\rho^2+z^2}} & -\frac{\rho}{\sqrt{z^2+\rho^2}} & 0 \end{bmatrix} \begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix}$
Spherical  $P(r,\theta,\phi)$	i) Radius plane (r) $0 < r < \infty$ ii) polar plane (θ) $0 < \theta < \pi$ iii) Azimuth angle (ϕ) $0 < \phi < 2\pi$	Diff length: $\vec{dl} = dr\,\vec{a_r} + r\sin\theta\,d\phi\,\vec{a_\phi} + r\,d\theta\,\vec{a_\phi}$ Diff surface area: $\vec{ds_1} = r\sin\theta\,d\phi\,dr\,\vec{a_\phi}$ $\vec{ds_2} = r^2\sin^2\theta\,d\theta\,d\phi\,\vec{a_r}$ $\vec{ds_3} = r\,dr\,d\theta\,\vec{a_\phi}$ diff Volume $dv = r^2\,dr\sin\theta\,d\theta\,d\phi$	sph in.t of Rect $r = \sqrt{x^2+y^2+z^2}$ $\theta = \cos^{-1}\left[z/\sqrt{x^2+y^2+z^2}\right]$ $\phi = \tan^{-1}\left[y/x\right]$ sph in.t of cyl: $r = \sqrt{\rho^2+z^2}$ $\theta = \tan^{-1}(\rho/z)$ $\phi = \phi$	$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\theta\cos\phi & \sin\theta\sin\phi & \cos\theta \\ \cos\theta\cos\phi & \cos\theta\sin\phi & -\sin\theta \\ -\sin\phi & \cos\phi & 0 \end{bmatrix} \begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix}$ $\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} \sin\theta & 0 & \cos\theta \\ \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$ V.good