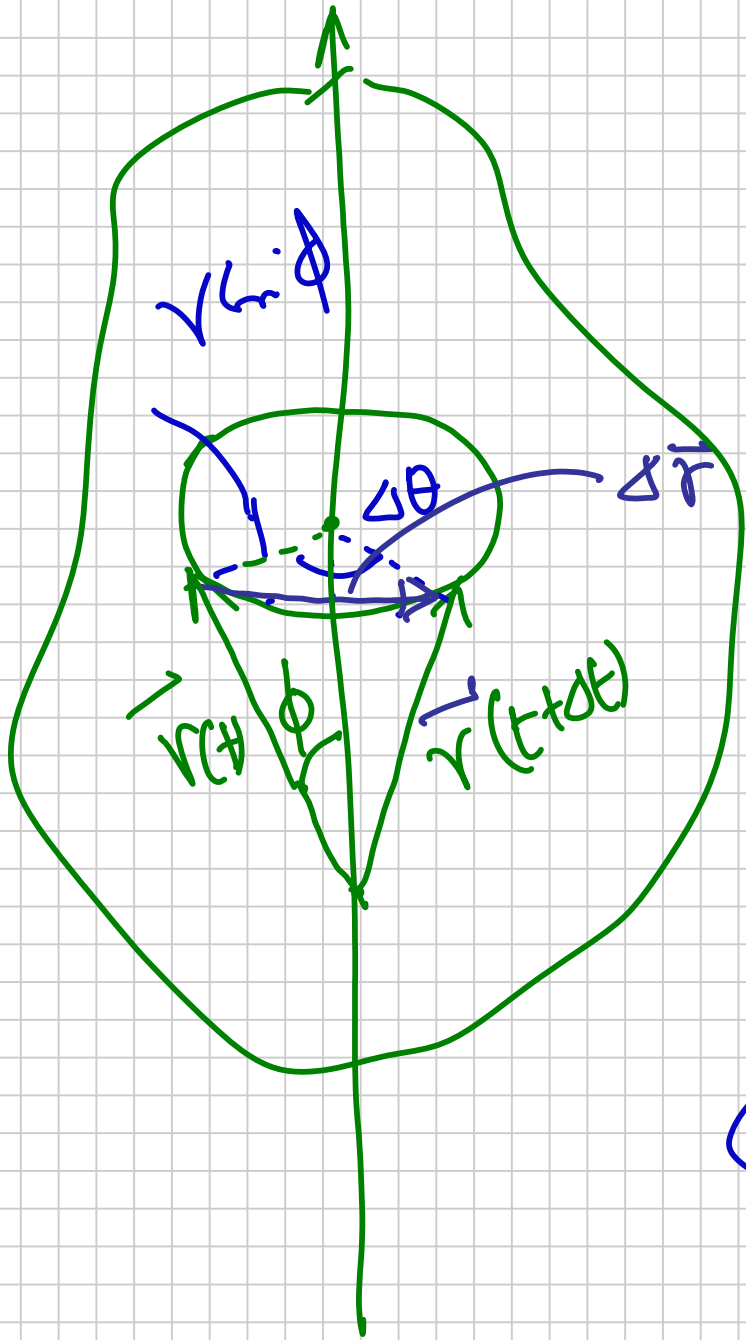


Rigid body motion
angular velocity

$$\vec{\omega} = \frac{d\theta_x}{dt} \hat{i} + \frac{d\theta_y}{dt} \hat{j} + \frac{d\theta_z}{dt} \hat{k}$$
$$= \omega_x \hat{i} + \omega_y \hat{j} + \omega_z \hat{k}$$

ω ← vector



$$|\Delta \vec{r}| = 2r \sin \phi \cdot \sin \frac{\Delta \theta}{2}$$

$\Delta \theta \sim \text{small}$

$$|\Delta \vec{r}| = 2r \sin \phi \frac{\Delta \theta}{2}$$

$$= r \sin \phi \Delta \theta$$

$$\left| \frac{d\vec{r}}{dt} \right| = r \sin \phi \frac{d\theta}{dt}$$

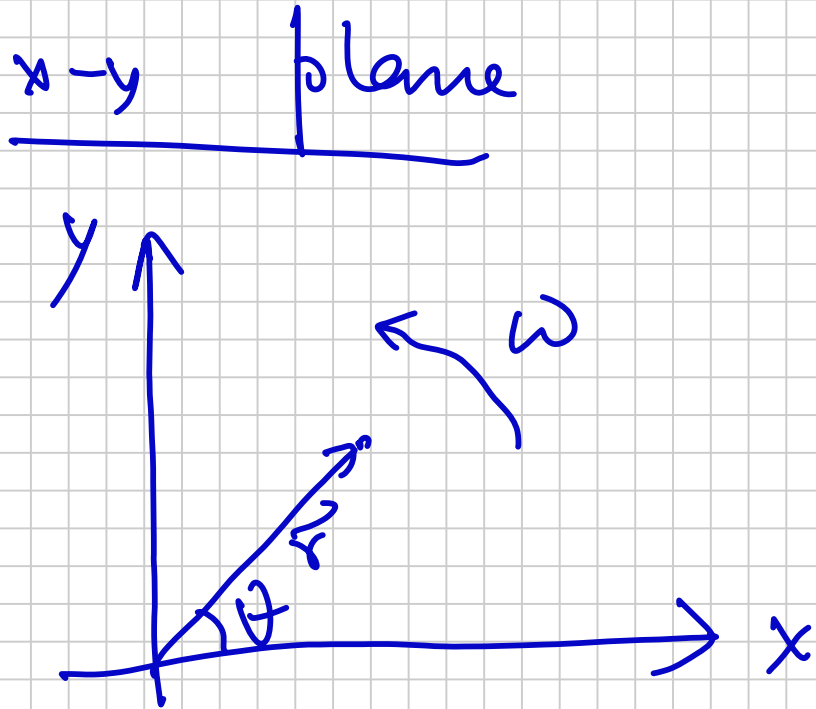
$$\frac{d\vec{r}}{dt} = \hat{n} \times \vec{r} \frac{d\theta}{dt}$$

$$\frac{d\vec{r}}{dt} = \dot{r} \hat{r} + r \frac{d\hat{r}}{dt}$$

$$\vec{v} = \dot{r} \hat{r} + \vec{\omega} \times r \hat{r}$$

$$\vec{v} = \frac{d\vec{r}}{dt}$$

$$\vec{\omega} = \dot{\theta} \hat{k}$$



$$\vec{\omega} = \omega \hat{k}$$

$$\vec{v} = \vec{\omega} \times \vec{r}$$

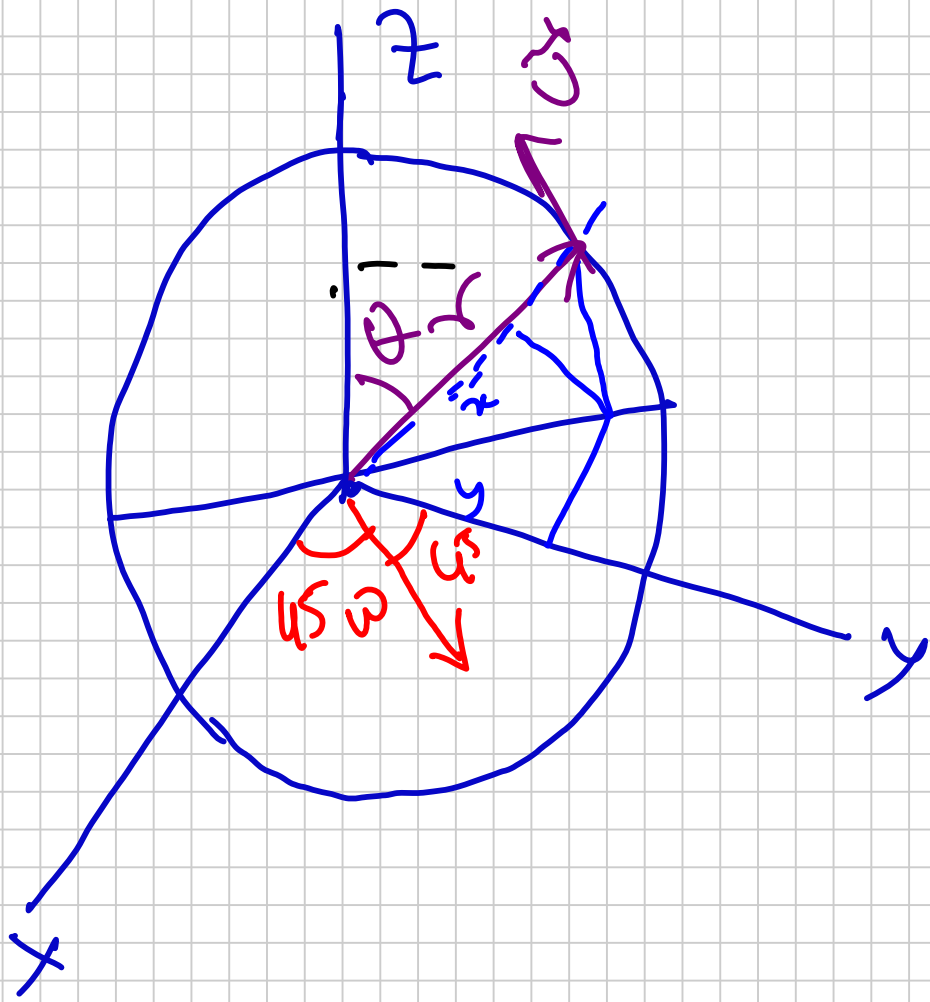
$$= \omega \hat{k} \times (x \hat{i} + y \hat{j})$$

$$\vec{v} = \omega (x \hat{j} - y \hat{i})$$

$$\vec{v} = \omega r \left[j \cos \theta - i \sin \theta \right]$$

$\omega r \theta$

$$\vec{v} = \vec{v}_1 + \vec{v}_2$$



$$\vec{v} = \frac{d\vec{r}}{dt}$$

$$z = r \cos \theta$$

$$x = -r \sin \theta \frac{1}{\sqrt{2}}$$

$$y = r \sin \theta \frac{1}{\sqrt{2}}$$

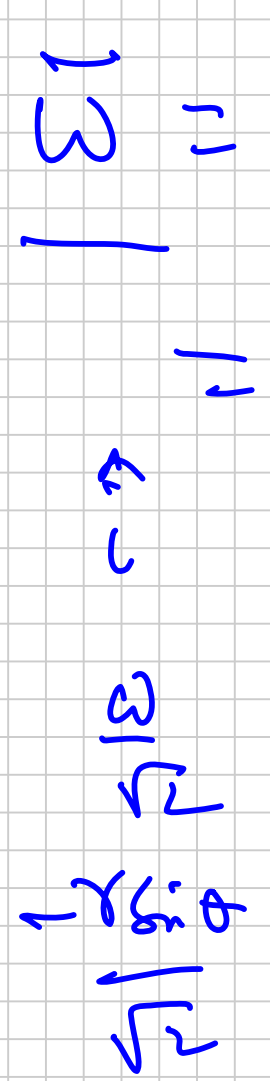
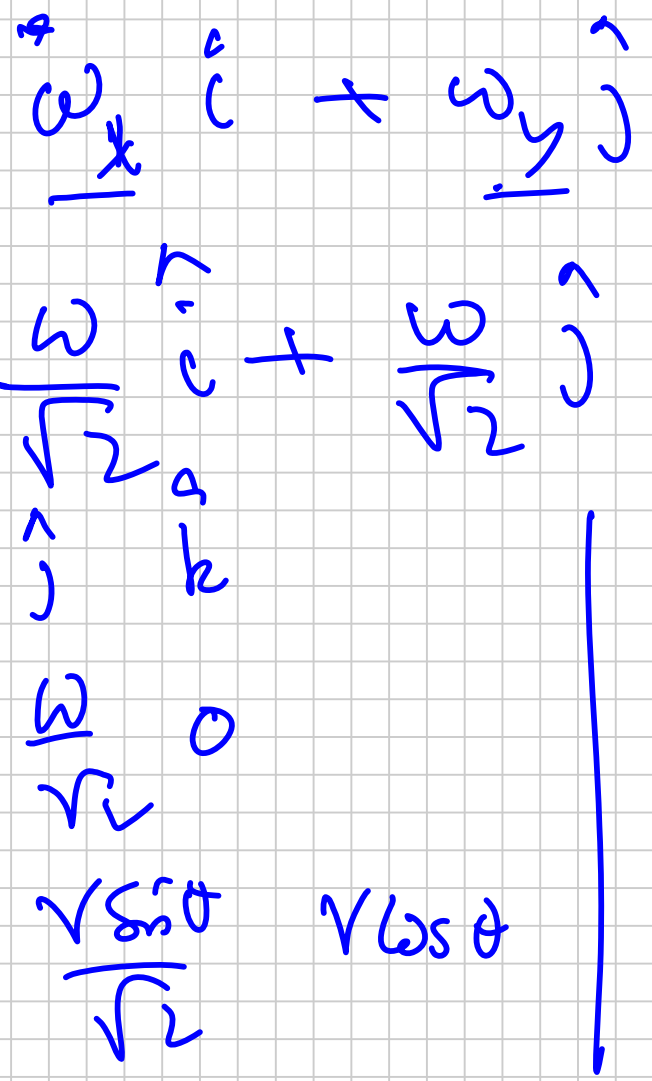
$$|\vec{r}| = r \left[-\frac{1}{\sqrt{2}} \sin \theta \hat{i} + \frac{1}{\sqrt{2}} \sin \theta \hat{j} + \cos \theta \hat{k} \right]$$

$$\vec{v} = \frac{d\vec{r}}{dt} = \omega r \left[-\frac{1}{\sqrt{2}} \cos \theta \hat{i} + \frac{1}{\sqrt{2}} \cos \theta \hat{j} - \sin \theta \hat{k} \right]$$

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