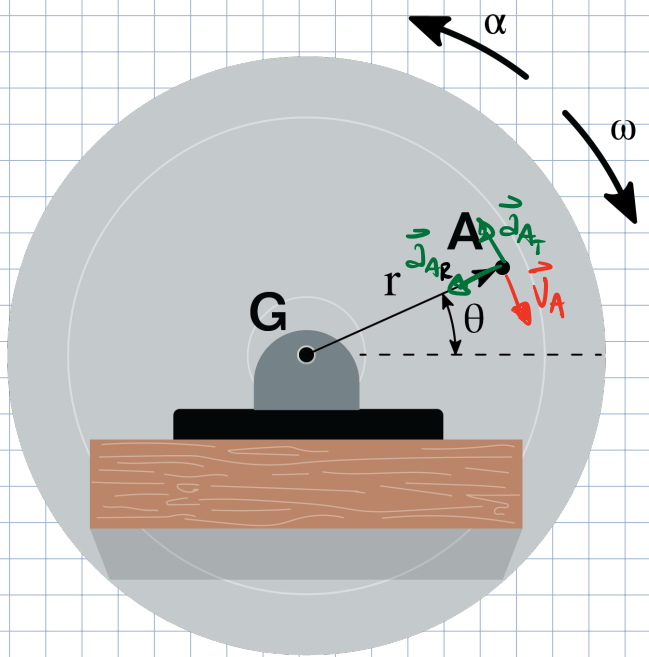
A disk is rotating with an angular velocity $\omega = 2\,rad/s$ and angular acceleration $\alpha = 1\,rad/s^2$. Determine the velocity and acceleration of point A, located a distance r = 1m from the center of the disk at a 30deg angle from the horizontal ($\theta = 30$deg).



$\vec{r} = r\cos\theta\,\hat{i} + r\sin\theta\,\hat{j}$

$\vec{V}_A = \vec{V}_G + \vec{\omega} \times \vec{r}$

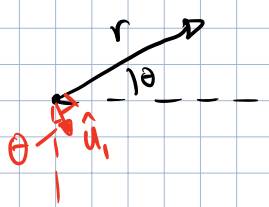
$\vec{V}_A = \vec{\omega} \times \vec{r}$

$= (-2\,rad/s\,\hat{k}) \times 1m\,(\cos 30^\circ \hat{i} + \sin 30^\circ \hat{j})$

$\vec{V} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & -2 \\ \cos 30^\circ & \sin 30^\circ & 0 \end{vmatrix} = 2\sin 30^\circ \hat{i} - 2\cos 30^\circ \hat{j}$

$\boxed{\vec{V}_A = 1\hat{i} - 1.73\hat{j}\ m/s}$

$|\vec{V}_A| = |\vec{\omega}|\,|\vec{r}| = (2\,rad/s)(1m) = 2\,m/s$



$\hat{u}_1 = \sin\theta\,\hat{i} - \cos\theta\,\hat{j}$

$\vec{V}_A = |\vec{V}_A|\,\hat{u}_1 = (2m/s)(\sin 30^\circ \hat{i} - \cos 30^\circ \hat{j}) = \boxed{1\hat{i} - 1.73\hat{j}\ m/s}$

$$\vec{a} = \vec{\alpha} \times \vec{r} - \omega^2 \vec{r} = (1\ \text{rad/s}\ \hat{k}) \times 1\text{m}(\cos 30^\circ \hat{i} + \sin 30^\circ \hat{j}) - (2\ \text{rad/s})^2 1\text{m}(\cos 30^\circ \hat{i} + \sin 30^\circ \hat{j})$$

$$= \begin{vmatrix} i & j & k \\ 0 & 0 & 1 \\ \cos 30^\circ & \sin 30^\circ & 0 \end{vmatrix} - 4\cos 30^\circ \hat{i} - 4 \sin 30^\circ \hat{j}$$

$$= -\sin 30^\circ \hat{i} + \cos 30^\circ \hat{j} - 4\cos 30^\circ \hat{i} - 4 \sin 30^\circ \hat{j}$$

$$= -5 \sin 30^\circ \hat{i} + 5 \cos 30^\circ \hat{j}$$

$$\boxed{\vec{a} = -2.5 \hat{i} + 4.3 \hat{j} \ \ m/s^2}$$