$\boxed{\text{HW \#26}}$ CID 6265

① centrifugal force is directed behind me, pulling me straight backwards. The coriolis force will push me to my right if I lean forward.

② we have

$$\left(\frac{d^2\vec{r}}{dt^2}\right)_{S_0} = \left(\frac{d}{dt}\right)_S \left[\left(\frac{d\vec{r}}{dt}\right)_S + \vec{\Omega}\times\vec{r}\right] + \vec{\Omega}\times\left[\left(\frac{d\vec{r}}{dt}\right)_S + \vec{\Omega}\times\vec{r}\right]$$

extra term to find: $m\vec{r}\times\dot{\vec{\Omega}}$

Newton's 2nd Law: $m\left(\frac{d^2\vec{r}}{dt^2}\right)_{S_0} = \vec{F}$

$$\left(\frac{d^2\vec{r}}{dt^2}\right)_{S_0} = \left(\frac{d^2\vec{r}}{dt}\right)_S + \underbrace{\left(\frac{d}{dt}\right)_S \vec{\Omega}\times\vec{r}}_{\dot{\vec{\Omega}}\times\vec{r}} + \underbrace{\vec{\Omega}\times\left(\frac{d}{dt}\right)_S \vec{r}}_{\vec{\Omega}\times\dot{\vec{r}}} + \vec{\Omega}\times\left[\underbrace{\left(\frac{d\vec{r}}{dt}\right)_S}_{\vec{\Omega}\times\dot{\vec{r}}} + \vec{\Omega}\times\vec{r}\right]$$

$$\left(\frac{d^2\vec{r}}{dt^2}\right)_{S_0} = \left(\frac{d^2\vec{r}}{dt}\right)_S + 2\vec{\Omega}\times\dot{\vec{r}} + \dot{\vec{\Omega}}\times\vec{r} + \vec{\Omega}\times(\vec{\Omega}\times\vec{r})$$

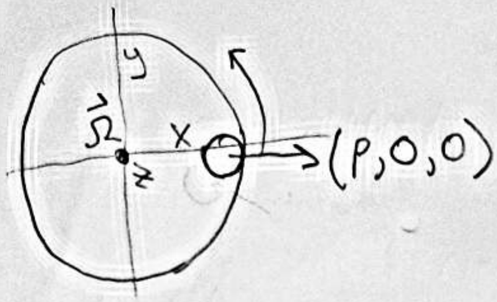
Plug into $m\left(\frac{d^2\vec{r}}{dt^2}\right)_{S_0} = \vec{F}$

$$\boxed{m\ddot{\vec{r}} = \vec{F} + 2m\dot{\vec{r}}\times\vec{\Omega} + m(\vec{\Omega}\times\vec{r})\times\vec{\Omega} + m\vec{r}\times\dot{\vec{\Omega}}}$$

when subbed in and moved to right.

Where $\ddot{\vec{r}} = \left(\frac{d^2 r}{dt}\right)_S$

③



$$3\times3 \quad 3\times1$$

A) $\vec{r}_s = R^{-1}\vec{r}_{s_0} = \begin{bmatrix} \cos\Omega t & -\sin\Omega t & 0 \\ -\sin\Omega t & \cos\Omega t & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \rho \\ 0 \\ 0 \end{bmatrix}$

$$= \begin{bmatrix} \rho\cos\Omega t \\ -\rho\sin\Omega t \\ 0 \end{bmatrix} = \vec{r}_s$$

$$\dot{\vec{r}}_s = \begin{bmatrix} -\Omega\rho\sin\Omega t \\ -\Omega\rho\cos\Omega t \\ 0 \end{bmatrix}$$

$$\ddot{\vec{r}}_s = \begin{bmatrix} -\Omega^2\rho\cos\Omega t \\ \Omega^2\rho\sin\Omega t \\ 0 \end{bmatrix} \qquad \vec{\Omega} = \langle 0, 0, \Omega \rangle$$

B) Both!

C) $F_{cor} = 2m\dot{\vec{r}} \times \vec{\Omega} = 2m \begin{vmatrix} -\Omega\rho\sin\Omega t & -\Omega\rho\cos\Omega t & 0 \\ 0 & 0 & \Omega \end{vmatrix}$

$$= 2m\langle -\rho\Omega^2\cos\Omega t, +\rho\Omega^2\sin\Omega t, 0 \rangle = F_{cor}$$

$F_{cent} = m(\vec{\Omega} \times \vec{r}) \times \vec{\Omega} = m \begin{vmatrix} 0 & 0 & \Omega \\ \rho\cos\Omega t & -\rho\sin\Omega t & 0 \end{vmatrix} \times \vec{\Omega}$

$$= m \begin{vmatrix} \rho\Omega\sin\Omega t & \Omega\rho\cos\Omega t & 0 \\ 0 & 0 & \Omega \end{vmatrix}$$

$$= m\langle \Omega^2\rho\cos\Omega t, -\rho\Omega^2\sin\Omega t, 0 \rangle = F_{cent}.$$

$$\begin{bmatrix} 2m(-\rho\Omega^2\cos\Omega t) \\ 2m(\rho\Omega^2\sin\Omega t) \\ 0 \end{bmatrix} + \begin{bmatrix} m(+\rho\Omega^2\cos\Omega t) \\ m(-\rho\Omega^2\sin\Omega t) \\ 0 \end{bmatrix} = \begin{bmatrix} -m(\rho\Omega^2\cos\Omega t) \\ m(\rho\Omega^2\sin\Omega t) \\ 0 \end{bmatrix}$$

$$= m\begin{bmatrix} -(\rho\Omega^2\cos\Omega t) \\ (\rho\Omega^2\sin\Omega t) \\ 0 \end{bmatrix} = m\ddot{\vec{r}}_s = F_{cent} + F_{cor}$$