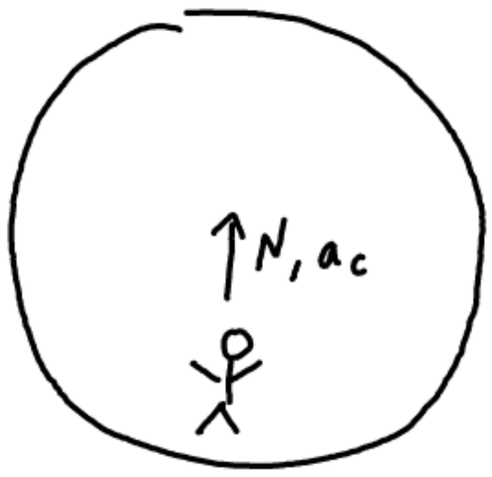
1. Space Station



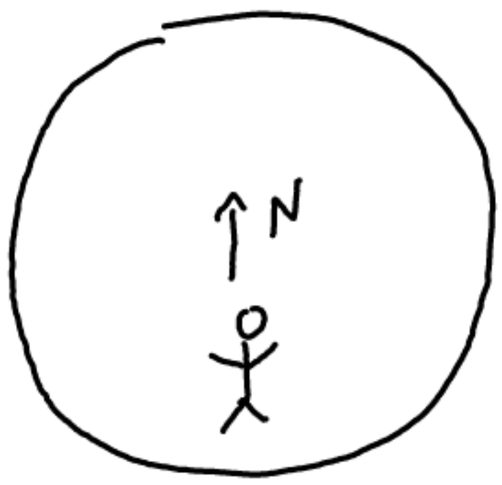
a)



centripedal acceleration a_c inward

due to normal force N.

b)



net acceleration is zero

due to balanced

$N = -F_{cf}$

$$\vec{F}_{cf} = -m\vec{A} = -m\omega^2 R\,\hat{r} = -mg\hat{r}$$

$$\omega^2 R = g$$

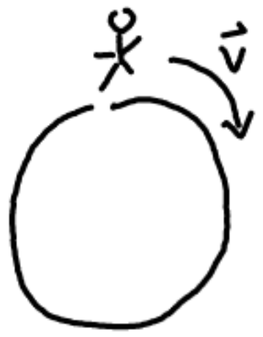
$$\omega = \sqrt{g/R} = 0.5 \text{ rad/s}$$

c) $\frac{\Delta g}{g} = \frac{\Delta R}{R} = \frac{(40-38)}{40} = \frac{2}{40} = 5\%$

2. centrifugal force $\vec{F}_{CF} = m(\vec{\Omega} \times \vec{r}) \times \vec{\Omega}$

coriolis force $\vec{F}_{cor} = 2m\dot{\vec{r}} \times \vec{\Omega}$

a)



in this case, $r \sim 0$ so $F_{CF} = 0$

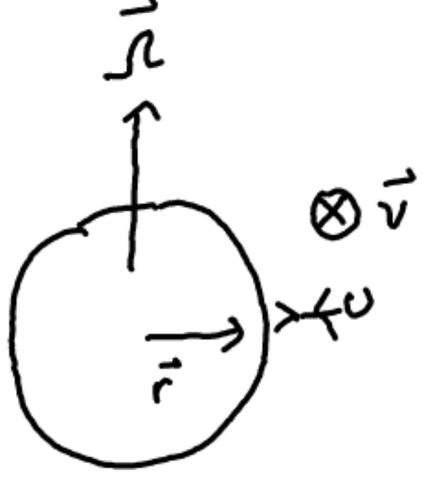
$\dot{\vec{r}}$ is positive (moving radially out from axis)

so $\vec{F}_{cor}$ points west





b)



$\vec{F}_{CF} = m(\vec{\Omega} \times \vec{r}) \times \vec{\Omega}$

$\sim \otimes \times \vec{\Omega} =$ →

$\vec{F}_{cor} \sim \dot{\vec{r}} \times \vec{\Omega} = \otimes \times \uparrow =$ →

$\vec{\Omega}$

c)

$\vec{F}_{CF}$ same as (b) →

$\vec{F}_{cor} \sim \vec{v} \times \vec{\Omega} = 0$

3. Start with finding the first derivative of $\vec{r}$ in frame S_0:

$$\vec{r}_0 = \vec{r}$$

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

$$= \dot{\vec{r}} + \vec{\Omega} \times \vec{r}$$

Then apply the second derivative:

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

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

$$= \left(\ddot{\vec{r}} + \vec{\Omega} \times \dot{\vec{r}}\right) + \left(\left(\frac{d}{dt}\right)_S \vec{\Omega} \times \vec{r} + \vec{\Omega} \times \left(\frac{d}{dt}\right)_S \vec{r} + \vec{\Omega} \times (\vec{\Omega} \times \vec{r})\right)$$

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

Then $m \ddot{\vec{r}}_{\bullet} = \vec{F}$

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

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

$$+ \underbrace{m\vec{F} \times \dot{\vec{\Omega}}}$$

new term!