$$\vec{\rho} = (\rho_0 + \alpha\theta)\hat{r}$$ (a)

$$\vec{v} = \alpha\dot{\theta}\,\hat{r} + (\rho_0 + \alpha\theta)\dot{\theta}\,\hat{\theta} \qquad (1)$$

$$\vec{v} = \alpha\omega_0\hat{r} + (\rho_0 + \alpha\theta)\omega_0\hat{\theta}$$

$$|\vec{v}| = \omega_0\sqrt{\alpha^2 + (\rho_0 + \alpha\theta)^2}$$

para $\rho = 2\rho_0$ $\boxed{|\vec{v}| = \omega_0\sqrt{\alpha^2 + 4\rho_0^2}}$

$$\vec{a} = \alpha\omega_0^2\hat{\theta} + \alpha\omega_0^2\hat{\theta} + \omega_0^2(\rho_0 + \alpha\theta)(-\hat{r})$$ (b)

$$\vec{a} = -\omega_0^2(\rho_0 + \alpha\theta)\hat{r} + 2\alpha\omega_0^2\hat{\theta} \qquad (2)$$

$$|\vec{a}| = \omega_0^2\sqrt{\underbrace{(\rho_0 + \alpha\theta)}_{\rho}{}^2 + 4\alpha^2}$$

para $\rho = 2\rho_0$ $\boxed{|\vec{a}| = 2\omega_0^2\sqrt{\alpha^2 + \rho_0^2}}$

$$\vec{a} = -\omega_0^2\rho\,\hat{r} + 2\alpha\omega_0^2\hat{\theta}$$

$$\vec{a} = a_t \hat{t} + a_n \hat{n} \qquad a_n = \frac{v^2}{\rho}$$ $\boxed{\text{parte c)}}$

$$\vec{v} = v \hat{t}$$

$$\vec{a} \times \vec{v} = a_n v \hat{k} = \frac{v^3}{\rho}$$

$$\rho = \frac{v^3}{|\vec{a} \times \vec{v}|} \quad \text{or} \quad a_n = \frac{|\vec{a} \times \vec{v}|}{v} = \frac{v^2}{\rho}$$

so: $$\vec{a} = -\omega_0^2 \rho \hat{r} + 2\alpha \omega_0^2 \hat{\theta}$$
$$\vec{v} = \alpha \omega_0 \hat{r} + \rho \omega_0 \hat{\theta}$$

$$|\vec{a} \times \vec{v}| = \omega_0^3 \rho^2 + 2\alpha^2 \omega_0^3$$
$$= \omega_0^3 (\rho^2 + 2\alpha^2)$$

$$v = \omega_0 \sqrt{\rho^2 + \alpha^2}$$

so: $$a_n = \frac{|\vec{a} \times \vec{v}|}{v} = \frac{\omega_0^2 (\rho^2 + 2\alpha^2)}{\sqrt{\rho^2 + \alpha^2}}$$

$$\cancel{\vec{v} = \alpha\omega_0(\hat{\rho} + \theta\hat{\theta})}$$
$$\cancel{\vec{a} = \alpha\omega_0^2(-\theta\hat{\rho} + 2\hat{\theta})}$$

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$$\hat{t} = \frac{\vec{v}}{|\vec{v}|} = \frac{\alpha}{\sqrt{\alpha^2+\rho^2}}\hat{\rho} + \frac{\rho}{\sqrt{\alpha^2+\rho^2}}\hat{\theta}$$

$$\vec{a} = a_t\hat{t} + a_n\hat{n}$$

$$a_t = \vec{a}\cdot\hat{t}$$

$$a_n = |\vec{a} - a_t\hat{t}|$$

cont (c)

$$a_t = \vec{a}\cdot\hat{t} = \frac{-\omega_0^2\rho\alpha}{\sqrt{\alpha^2+\rho^2}} + \frac{2\alpha\omega_0^2\rho}{\sqrt{\alpha^2+\rho^2}} \qquad (4)$$

$$= \frac{\omega_0^2\rho\alpha}{\sqrt{\alpha^2+\rho^2}}$$

$$a_t\hat{t} = \frac{\omega_0^2\rho\alpha^2}{\alpha^2+\rho^2}\hat{\rho} + \frac{\omega_0^2\rho^2\alpha}{\alpha^2+\rho^2}\hat{\theta}$$

$$\vec{a} - a_t\hat{t} = \left(-\omega_0^2\rho - \frac{\omega_0^2\rho\alpha^2}{\alpha^2+\rho^2}\right)\hat{\rho} + \left(2\alpha\omega_0^2 - \frac{\omega_0^2\rho^2\alpha}{\alpha^2+\rho^2}\right.$$