

$$\Rightarrow m\omega^2 \leq \mu mg \Rightarrow \boxed{\omega \leq \sqrt{\frac{\mu g}{d}}}$$

b) si $\omega > \sqrt{\frac{\mu g}{d}} \Rightarrow$ la partícula desliza

$$\Rightarrow r \neq \text{cte}$$

$$\Rightarrow fr - mg \sin \phi = m\ddot{r} - m r \dot{\phi}^2$$

$$N - mg \cos \phi = m r \ddot{\phi} + 2m \dot{r} \dot{\phi}$$

$$fr = \mu_d N$$

$$\phi = \frac{\omega}{\omega_0} \sin \omega_0 t, \quad \dot{\phi} = \omega \cos \omega_0 t, \quad \ddot{\phi} = -\omega \omega_0 \sin \omega_0 t$$

$$\Rightarrow \mu_d N - mg \frac{\omega}{\omega_0} \sin \omega_0 t = m\ddot{r} - m r \omega^2 \cos^2 \omega_0 t$$

$$N = mg + m r \omega \omega_0 \sin \omega_0 t + 2m \dot{r} \omega \cos \omega_0 t$$

$$\Rightarrow \boxed{\mu_d mg + \mu_d m r \omega \omega_0 \sin \omega_0 t + 2\mu_d m \dot{r} \omega \cos \omega_0 t - mg \frac{\omega}{\omega_0} \sin \omega_0 t = m\ddot{r} - m r \omega^2 \cos^2 \omega_0 t}$$

ecuación de movimiento

c) si no hay roce, en la ecuación de mov

$$-mg \frac{\omega}{\omega_0} \sin \omega_0 t = m\ddot{r} - m r \omega^2 \cos^2 \omega_0 t$$