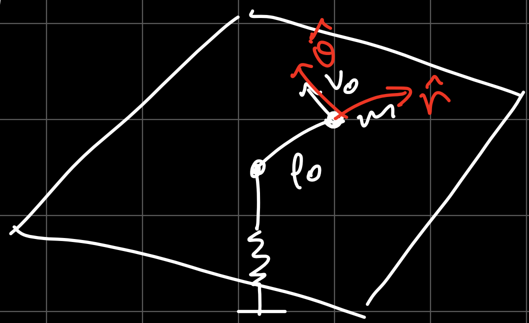
P1)



Definimos 2 situaciones: $(z=0)$

(0) $\vec{r}_0 = \rho_0 \hat{r}$ (Inicial)

$\vec{v}_0 = v_0 \hat{\theta} = \rho_0 \dot{\theta}_0 \hat{\theta}$

(1) $\vec{r}_1 = r_1 \hat{r} = 2\rho_0 \hat{r}$

$\vec{v}_1 = \cancel{\dot{r}_1}^{\,0,\ r_1 = r_{máx}} \hat{r} + r_1 \dot{\theta}_1 \hat{\theta}$

$= 2\rho_0 \dot{\theta}_1 \hat{\theta}$

Se conservan 2 cantidades:

<u>Momentum ang.</u> Como $\sum \vec{F} \cdot \hat{\theta} = 0$

$$\Rightarrow m\vec{a} \cdot \hat{\theta} = 0 \Rightarrow \underbrace{\frac{m}{r}}_{\neq 0} \frac{d}{dt}(r^2 \dot{\theta}) = 0$$

$$\Rightarrow r^2 \dot{\theta} = \text{cte.}$$

Imponeindolo sobre las situaciones:

$$r_0^2 \dot{\theta}_0 = r_1^2 \dot{\theta}_1 \Rightarrow \cancel{\rho_0^2} \dot{\theta}_0 = 4\cancel{\rho_0^2} \dot{\theta}_1 \quad (1)$$ (2 incognita, 1 ec.)

<u>Energía:</u> (Se conserva)

$$\Rightarrow EMT_0 = EMT_1$$

$$\Rightarrow K_0 + V_0 = K_1 + V_1$$ ($V_{mg} = 0$ pues altura cte. $z=0$)

$$\frac{1}{2} m v_0^2 + \cancel{V_{resorte,0}}^{\,0,\text{ en largo natural}} = \frac{1}{2} m v_1^2 + V_{resorte,1}$$

$$\frac{1}{2} m \rho_0^2 \dot{\theta}_0^2 = \underbrace{\frac{1}{2} m (4\rho_0^2 \dot{\theta}_1^2)}_{2m\rho_0^2\dot{\theta}_1^2} + \frac{1}{2} k \Delta_f^2$$

Notamos que: Como la cuerda tiene largo cte.
Si la partícula avanza de $r=\rho_0$ a $r=2\rho_0$
y inicialmente el resorte está en largo natural
$\Rightarrow$ el resorte se extiende $\rho_0 \Rightarrow \Delta_f^2 = \rho_0^2$

$$\Rightarrow \frac{1}{2} m \rho_0^2 \dot{\theta}_0^2 = 2 m \rho_0^2 \dot{\theta}_1^2 + \frac{1}{2} K \rho_0^2 \quad (2)$$

De (1): $\dot{\theta}_1 = \frac{\dot{\theta}_0}{4}$ (3)

En (2): $$\frac{1}{2} m \rho_0^2 \dot{\theta}_0^2 = \overbrace{2 m \rho_0^2 \frac{\dot{\theta}_0^2}{16}}^{\frac{1}{8} m \rho_0^2 \dot{\theta}_0^2} + \frac{1}{2} K \rho_0^2$$

$$\Rightarrow \frac{3}{\cancel{8}_{4}} m \cancel{\rho_0^2} \dot{\theta}_0^2 = \frac{1}{\cancel{2}} K \cancel{\rho_0^2}$$

$$\Rightarrow \dot{\theta}_0^2 = \frac{4}{3} \frac{K}{m} \quad (4) \quad \therefore \quad \dot{\theta}_1^2 = \frac{\dot{\theta}_0^2}{16} = \frac{1}{12} \frac{K}{m}$$

a) $v_0^2 = \rho_0^2 \dot{\theta}_0^2 = \frac{4}{3} \frac{K}{m} \rho_0^2$

b) $v_1^2 = 4 \rho_0^2 \dot{\theta}_1^2 = \frac{1}{3} \frac{K}{m} \rho_0^2 \Rightarrow \vec{v}_1 = \frac{1}{3} \frac{K}{m} \rho_0^2 \hat{\theta}$

c) $\vec{a}_1 = a_r \hat{r} + a_\theta \hat{\theta} + a_z \hat{K}$

$a_z = 0$, no se mueve en $\hat{K}$ $(z=0)$

$a_\theta = 0$ ya que $\sum \vec{F} \cdot \hat{\theta} = 0$

En $r = 2\rho_0$:

ext. resorte

$m a_r = -k\rho_0$

$\Rightarrow a_r = -\frac{k}{m}\rho_0 \quad \therefore \quad \vec{a} = -\frac{k}{m}\rho_0\,\hat{r}$