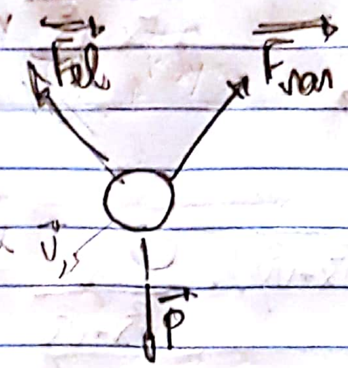
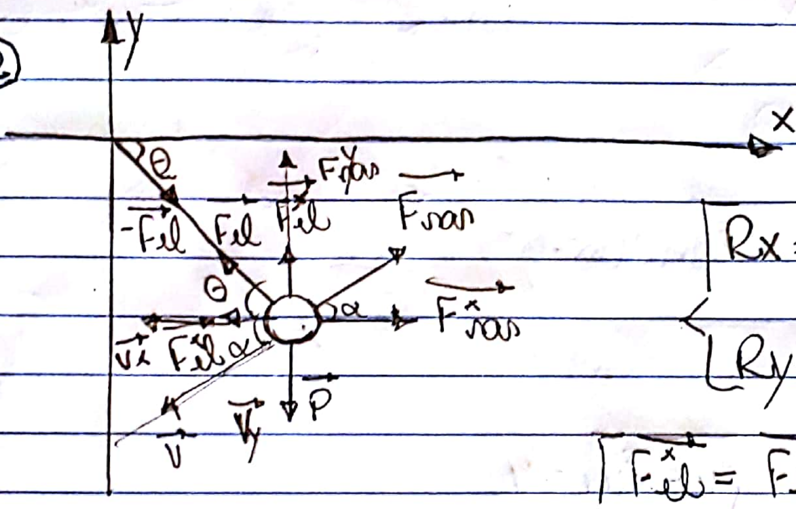
Exercício 8

a1.



a2.



$$\begin{cases} R_x = -\vec{F}^x_{el} + \vec{F}^x_{res} \\ R_y = -\vec{P} + \vec{F}^y_{el} + \vec{F}^y_{res} \end{cases}$$

$$\begin{cases} \vec{F}^x_{el} = \vec{F}_{el} \cdot \cos\theta \\ \vec{F}^y_{el} = \vec{F}_{el} \cdot \operatorname{sen}\theta \end{cases}$$

$$\begin{cases} \vec{P} = m \cdot \vec{g} \\ \vec{F}_{el} = k \cdot \Delta x \\ \vec{F}_{res} = 1/2 \cdot \rho C_d A v^2 \end{cases}$$

$$\begin{cases} \vec{F}^x_{res} = \vec{F}_{res} \cdot \cos(\alpha) \\ \vec{F}^y_{res} = \vec{F}_{res} \cdot \operatorname{sen}(\alpha) \end{cases}$$

$v = \sqrt{v_x^2 + v_y^2}$

$$\begin{cases} \operatorname{sen}(\alpha) = v_y / \sqrt{v_x^2 + v_y^2} \\ \cos(\alpha) = v_x / \sqrt{v_x^2 + v_y^2} \\ \operatorname{sen}\theta = y / \sqrt{x^2 + y^2} \\ \cos\theta = x / \sqrt{x^2 + y^2} \end{cases}$$

$$\begin{cases} R_x = -k \cdot \Delta x \cdot \frac{x}{\sqrt{x^2+y^2}} + \frac{1}{2} \cdot \rho C_d A \left(\sqrt{v_x^2+v_y^2}\right)^2 \cdot \frac{v_x}{\sqrt{v_x^2+v_y^2}} \\ R_y = -mg + k \cdot \Delta x \cdot \frac{y}{\sqrt{x^2+y^2}} + \frac{1}{2} \cdot \rho C_d A \left(\sqrt{v_x^2+v_y^2}\right)^2 \cdot \frac{v_y}{\sqrt{v_x^2+v_y^2}} \end{cases}$$

data

$R_x = m . \vec{a}$

$\Rightarrow \frac{d^2x}{dt^2} = -\frac{1}{m} . k . \Delta x . \frac{x}{\sqrt{x^2+y^2}} + \frac{\frac{1}{2} . \rho C_d A (\sqrt{v_x^2 + v_y^2}) . \frac{v_x}{\sqrt{v_x^2+v_y^2}}}{m}$

$R_y = m . \vec{a}$

$\Rightarrow \frac{d^2y}{dt^2} = -\frac{1}{m} . k . \Delta x . \frac{y}{\sqrt{x^2+y^2}} + \frac{\frac{1}{2} . \rho C_d A (\sqrt{v_x^2 + v_y^2}) . \frac{v_y}{\sqrt{v_x^2+v_y^2}}}{m} - g$

$\frac{dx}{dt} = v_x$

$\frac{dv_x}{dt} = \frac{-1}{m} . k . \Delta x . \frac{x}{\sqrt{x^2+y^2}} + \frac{\frac{1}{2} . \rho C_d A (\sqrt{v_x^2+v_y^2}) . \frac{v_x}{\sqrt{v_x^2+v_y^2}}}{m}$

$\frac{dy}{dt} = v_x$

$\frac{dv_y}{dt} = \frac{1}{m} . k . \Delta x . \frac{y}{\sqrt{x^2+y^2}} + \frac{\frac{1}{2} . \rho C_d A (\sqrt{v_x^2+v_y^2}) . \frac{v_y}{\sqrt{v_x^2+v_y^2}}}{m} - g$

$\Delta x = (\sqrt{x^2+y^2} - l_0)$