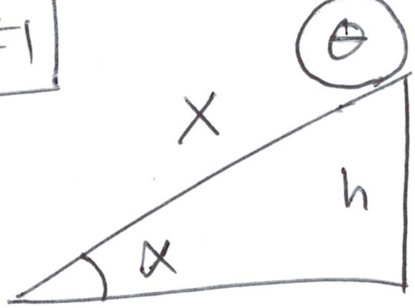
$\boxed{\text{Method \#1}}$



use $\boxed{r\theta = x}$

$$T = \frac{1}{2} m \dot{x}^2 + \frac{1}{2} I \omega^2$$

$$\equiv \frac{1}{2} m \dot{x}^2 + \frac{1}{2} \gamma m r^2 \dot{\theta}^2$$

$$L = T - V \qquad V = mgh = mg \sin\alpha \, x$$

$$\therefore \quad L = \frac{1}{2} m \dot{x}^2 + \frac{1}{2} \gamma m \dot{x}^2 - mg \sin\alpha \, x$$

$$\Rightarrow \quad m \ddot{x} (1+\gamma) - mg \sin\alpha = 0$$

$$\Rightarrow \quad \ddot{x} = -\frac{g \sin\alpha}{(1+\gamma)}$$

Lagrange Multipliers

$$\frac{d}{dt} \frac{\partial L}{\partial \dot{q}_i} - \frac{\partial L}{\partial q_i} = \lambda \frac{\partial F}{\partial q_i}$$

F : Constraint Equation.

IF $F = x_1 - x_2 + L = 0$

$$\frac{\partial F}{\partial x_1} = (+1) \qquad \frac{\partial F}{\partial x_2} = (-1)$$

$\boxed{\text{Method \#2}}$ $\quad \underline{\underline{\text{Use}}} \quad \boxed{r\theta - x = 0}$

$$L = \frac{1}{2} m \dot{x}^2 + \frac{1}{2} \gamma m r^2 \dot{\theta}^2 - mg \sin\alpha \, x$$

$$\frac{\partial L}{\partial \dot{x}} = m\dot{x} \qquad \frac{\partial L}{\partial \dot{\theta}} = \gamma m r^2 \dot{\theta} \qquad \frac{\partial L}{\partial x} = -mg\sin\alpha$$

USE: $(r)d\theta + (-1)dx = 0$ $\qquad \frac{\partial L}{\partial r} = 0$

$\boxed{x}$ $\quad m\ddot{x} + mg\sin\alpha = (-1)\lambda$ ①

$\boxed{r}$ $\quad \gamma m r^2 \ddot{\theta} + 0 = (r)\lambda$ ②

Also $\quad r\ddot{\theta} = \ddot{x}$ ③

② + ③ $\Rightarrow$ $r\lambda = \gamma m r^2 \ddot{\theta} = \gamma m r \ddot{x}$

$\Rightarrow \lambda = \gamma m \ddot{x}$

① $\Rightarrow$ $m\ddot{x} + mg\sin\alpha = -\lambda \Rightarrow -\gamma m \ddot{x}$

$$m(1+\gamma)\ddot{x} = -mg\sin\alpha$$

$$\ddot{x} = -\frac{g\sin\alpha}{(1+\gamma)}$$