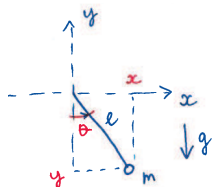


## Homework 2: Task 1



Consider the point-mass system moving in the vertical plane  $(x, y)$  in presence of the gravity assuming that any of its motions is consistent with the constraint:  $x(t)^2 + y(t)^2 - l^2 \equiv 0$ .

The dynamics of the system written in excessive coordinates  $(x, y)$  are

$$\begin{aligned} m \cdot \ddot{x} &= \frac{m}{l^2} (y \cdot g - \dot{x}^2 - \dot{y}^2) \cdot x \\ m \cdot \ddot{y} &= \frac{m}{l^2} (y \cdot g - \dot{x}^2 - \dot{y}^2) \cdot y - m \cdot g \end{aligned} \quad (1)$$

and the dynamics written in generalized coordinate  $\theta$

$$\ddot{\theta} + \frac{g}{l} \cdot \sin \theta = 0 \quad (2)$$

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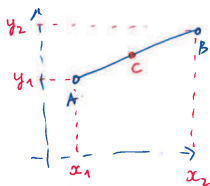
Check that a solution of (1) given by

$$x(t) = l \cdot \sin \theta(t), \quad y(t) = -l \cdot \cos \theta(t)$$

is determined by the system (2).

## Homework 2: Task 2

Consider two point masses of  $m = 1$  [kg] each connected by massless rod of length  $l$  and moving in the vertical plane.



Constraint No. 1:  $(x_1(t) - x_2(t))^2 + (y_1(t) - y_2(t))^2 = l^2, \forall t$

Constraint No. 2: Assume that the velocity of the center of the rod – point C on the plot

$$\vec{v}_C = \left[ \frac{1}{2}(\dot{x}_1 + \dot{x}_2); \frac{1}{2}(\dot{y}_1 + \dot{y}_2) \right]$$

always aligned with the rod written as the identity

$$(x_2(t) - x_1(t)) (\dot{y}_1(t) + \dot{y}_2(t)) - (y_2(t) - y_1(t)) (\dot{x}_1(t) + \dot{x}_2(t)) \equiv 0$$

## Homework 2: Task 2

Assignments:

- Write the dynamics of the system
- Integrate the dynamics, i.e. given initial conditions of the dynamics find solutions of the system as functions of time

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If necessary, use the (hand written) material provided for solving the task 😊