

Homework #2

“Forced oscillations”

Mathematical Modelling

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19/05/2024

Task 1

From equation: $\tau = -L * F$ and $F = mg \sin(\phi)$

We have: $\tau = -L * m * g * \sin(\phi)$

Also: $\tau = I \ddot{\phi}$ where $I = mL^2$

Put everything together: $m * L^2 * \ddot{\phi} = -m * g * L * \sin(\phi)$

Result:

$$L * \ddot{\phi} + g * \sin(\phi) = 0$$

Task 2

$$x = \ell \sin(\theta) + L \sin(\phi)$$

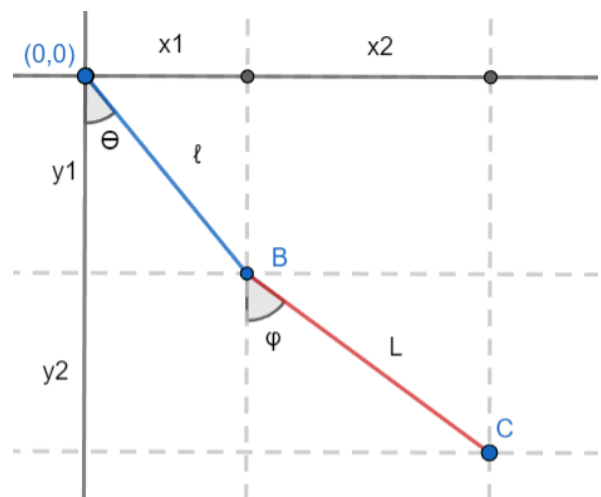
$$y = -\ell \cos(\theta) - L \cos(\phi)$$

Conditions: $\ell = L = 1$:

Result:

$$x = \sin(\theta) + \sin(\phi)$$

$$y = -\cos(\theta) - \cos(\phi)$$



Task 3

$$\omega = \dot{\phi}$$

$$L\dot{\omega} + g\sin(\phi) = -l\ddot{\theta}\cos(\theta - \phi) + l\dot{\theta}^2\sin(\theta - \phi)$$

References

1. Wikipedia. Differential Equation:
https://en.wikipedia.org/wiki/Differential_equation
2. Wikipedia. Runge–Kutta methods:
https://en.wikipedia.org/wiki/Runge%E2%80%93Kutta_methods
3. Wikipedia. Pendulum:
<https://en.wikipedia.org/wiki/Pendulum>