

1 Description Lab 1

1.1 Task 1

1.1.1 Subtask 1a

Insert $x_w = v_w = \frac{dv_w}{dt} = i_A = 0$ into equation 3 of the mathematical model.

$$\frac{dv_w}{dt} = 0 = \frac{1}{m_w + m_s(1 - \cos(\phi)^2)}(m_s l \omega^2 \sin(\phi) - m_s g \sin(\phi) \cos(\phi)) \quad (1)$$

$$m_s l \omega^2 \sin(\phi) = m_s g \sin(\phi) \cos(\phi) \quad (2)$$

$$l \omega^2 = g \cos(\phi) \quad (3)$$

Then change the fourth equation of the mathematical model to get the form $\dot{\omega}(t) = p_1 f_1(\phi(t), \omega(t), \dot{\omega}(t))$.

$$\frac{d\omega}{dt} = \frac{1}{l \left(1 - \frac{m_s}{m_w + m_s} \cos(\phi)^2\right)} \left(g \sin(\phi) - \frac{m_s}{m_w + m_s} \underbrace{l \omega^2}_{g \cos(\phi)} \sin(\phi) \cos(\phi) \right) \quad (4)$$

$$\frac{d\omega}{dt} = \frac{1}{l \left(1 - \frac{m_s}{m_w + m_s} \cos(\phi)^2\right)} \left(g \sin(\phi) \left(1 - \frac{m_s}{m_w + m_s} \cos(\phi)^2\right) \right) \quad (5)$$

$$\frac{d\omega}{dt} = \frac{g}{l} \sin(\phi) \quad (6)$$

1.1.2 Subtask 1b

1.1.3 Subtask 1c

1.1.4 Subtask 1d

1.2 Task 2

1.2.1 Subtask 1a

$$\begin{aligned} \dot{\omega} - g \sin(\phi) &= \frac{1}{\left(1 - \frac{m_s}{m_w + m_s} \cos(\phi)^2\right)} \left(g \sin(\phi) - \frac{\cos(\phi) F}{m_w + m_s} - \frac{m_s}{m_w + m_s} l \omega^2 \sin(\phi) \cos(\phi) \right) - g \sin(\phi) \\ &= \frac{1}{\left(1 - \frac{m_s}{m_w + m_s} \cos(\phi)^2\right)} \left(-\frac{\cos(\phi) F}{m_w + m_s} - \frac{m_s}{m_w + m_s} l \omega^2 \sin(\phi) \cos(\phi) + \frac{m_s}{m_w + m_s} g \cos(\phi)^2 \sin(\phi) \right) \\ &= \frac{m_w + m_s}{m_w + m_s \sin(\phi)^2} \left(-\frac{\cos(\phi) F}{m_w + m_s} - \frac{m_s}{m_w + m_s} l \omega^2 \sin(\phi) \cos(\phi) + \frac{m_s}{m_w + m_s} g \cos(\phi)^2 \sin(\phi) \right) \\ &= \frac{1}{m_w + m_s \sin(\phi)^2} (-\cos(\phi) F - m_s l \omega^2 \sin(\phi) \cos(\phi) + m_s g \cos(\phi)^2 \sin(\phi)) \end{aligned} \quad (7)$$

1.2.2 Subtask 1b

1.2.3 Subtask 1c

1.2.4 Subtask 1d

1.2.5 Subtask 1e

1.2.6 Subtask 1f

1.3 Task 3