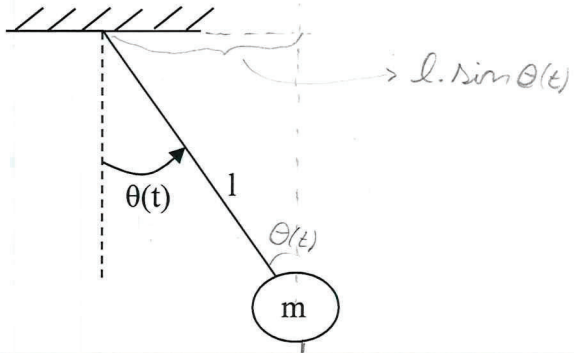
# Laboratory 5:
# System Modelling

In this laboratory you experiment to model and simulate a mechanical dynamic system (single and coupled pendulum).

(a) Let us first determine the differential equation describing the movement of a single suspended pendulum:

**Suspended Pendulum**




Physical Law: Newton 2nd Law for rotation movements

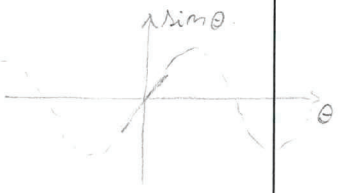
$$\sum T = I \cdot \ddot{\Theta}(t)$$

Set up equation:

$$T_g = -mgl \cdot \sin\Theta(t) \qquad I = m \cdot l^2$$

$$ml^2\ddot{\Theta}(t) = -mgl\sin\Theta(t) \;/\; \boxed{ml^2\ddot{\Theta}(t) + mgl\sin\Theta(t) = 0}$$

Linearisation: Small Angle Approximation

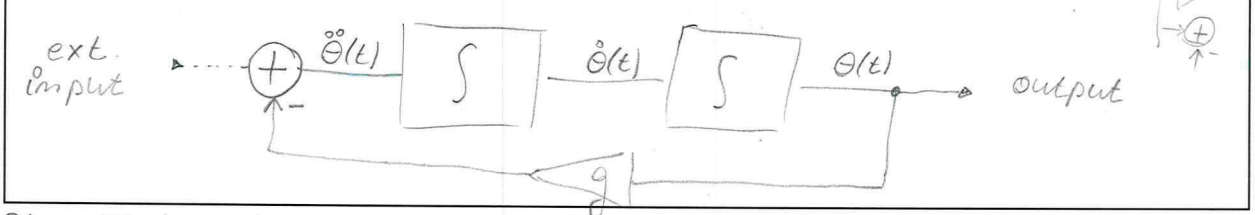



for $\Theta(t) < \pi/4 \Rightarrow \sin[\Theta(t)] \approx \Theta(t)$

Differential equation: $l \cdot \ddot{\theta}(t) + g \cdot \theta(t) = 0$

$$\ddot{\Theta} = \frac{1}{l}\left[-g \cdot \Theta\right]$$

Block diagram: isolate highest derivative + build up w/ $\boxed{S}$




Obs: Integrators have initial conditions ∀

e.g. $\dot{\Theta}(0) = 0$ rad/s, $\Theta(0) = \frac{\pi}{8}$ rad