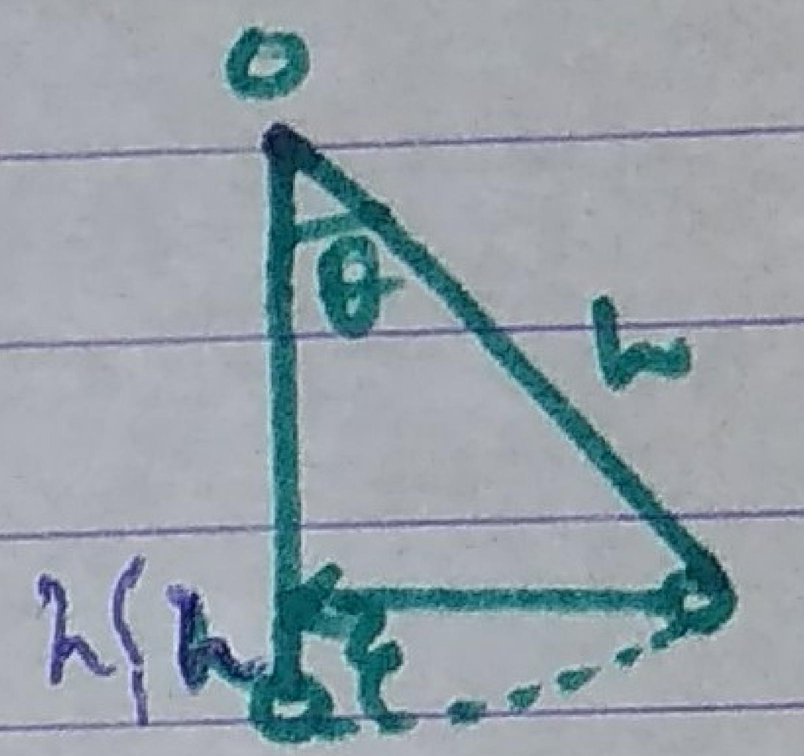
(3) Motion of a Simple Pendulam :-

ANSWER :→ Let us Consider an oscillating Simple Pendulam of mass "m" and length "l" for The angular displacement "θ" of the Pendulum we will have,



Figure

Kinetic energy of the Pendulum, $T = \frac{1}{2} m (L\dot{\theta})^2$

Potential energy of the Pendulum

$$V = mgh$$

$$= mg(L - L\cos\theta)$$

$$= mgL(1 - \cos\theta)$$

Hence the Lengrangean of the Pendulum,

$$L = T - V$$

$$= \frac{1}{2} m (L\dot{\theta})^2 - mgL(1-\text{Co}$$

This gives, $\frac{\partial L}{\partial \dot{\theta}} = ml^2 \dot{\theta}$

$\therefore \frac{d}{dt} \cdot \frac{\partial L}{\partial \dot{\theta}} = ml^2 \ddot{\theta}$

and, $\frac{\partial L}{\partial \theta} = -mgl \sin\theta$;

Hence the equation of the of the Pendulum,

$$\frac{d}{dt}\frac{\partial L}{\partial \dot{\theta}} - \frac{\partial L}{\partial \theta} = 0$$

i.e, $ml^2 \ddot{\theta} + mgl \sin\theta = 0$

i.e, $\boxed{\ddot{\theta} + \left(\frac{g}{l}\right)\theta = 0 \text{ (zero) if } \theta \to 0}$

This is the required Lagranges equation of a simple pendulam.