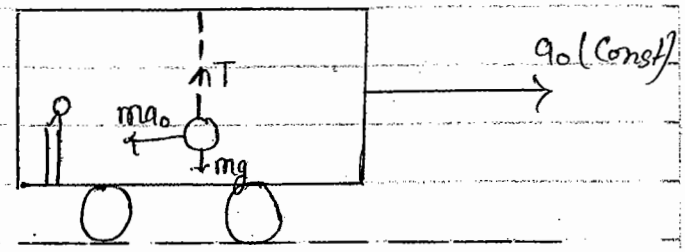
* Simple Pendulum in linearly accelerated frame :-

Let string makes angle θ with downward vertical in equilibrium position.



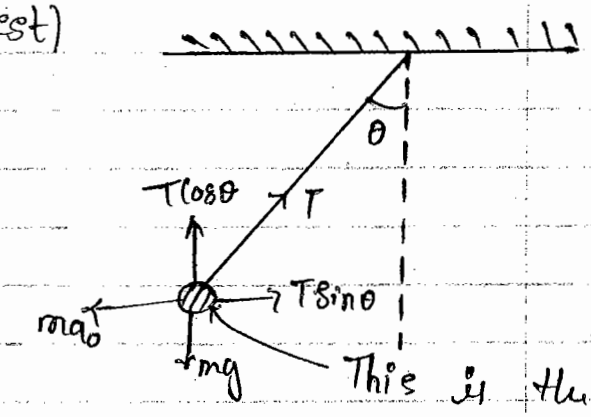
$$T\sin\theta = ma_0 \quad -(i)$$

$$T\cos\theta = mg \quad -(ii)$$

(i) / (ii)

$$\tan\theta = \frac{a_0}{g}$$

$$\boxed{\theta = \tan^{-1}\frac{a_0}{g}}$$

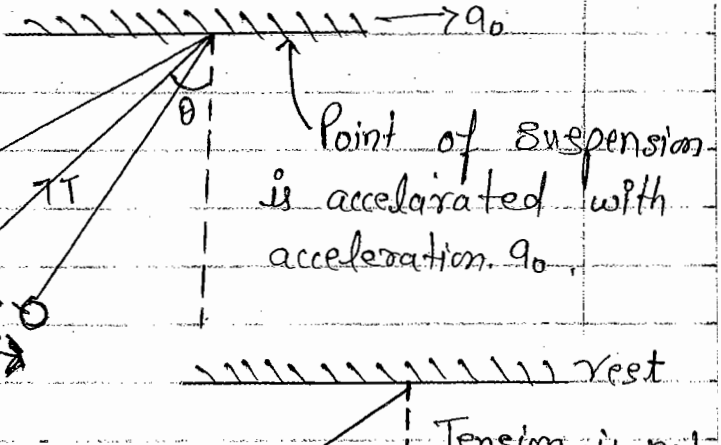


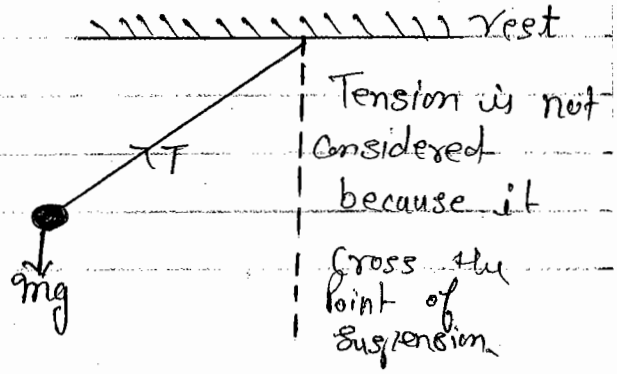
* Time Period of oscillation in accelerated frame :-

Time Period $(T) = 2\pi\sqrt{\frac{l}{g_{effective}}}$

$\therefore g_{eff} = \sqrt{g^2 + a_0^2}$

$$\therefore \boxed{T = 2\pi\sqrt{\frac{l}{\sqrt{g^2+a_0^2}}}}$$





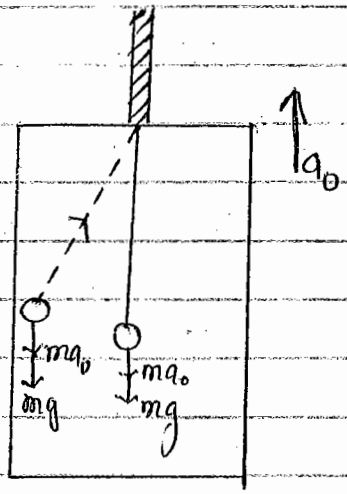
* Pendulum in a Lift :-

In this case :-

$g_{eff} = a_0 + g$

$\because T = 2\pi\sqrt{\frac{l}{g_{effective}}}$

So $\boxed{T = 2\pi\sqrt{\frac{l}{g + a_0}}}$

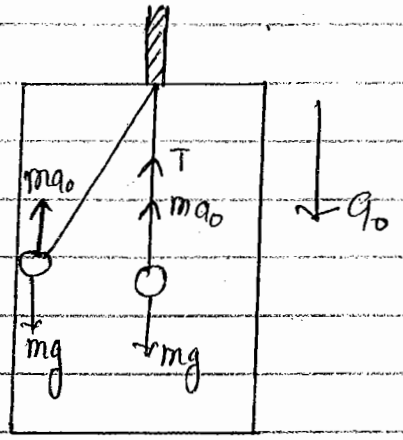


In this case :-

$g_{eff} = g - a_0$

$a_0 < g$

$\boxed{T = 2\pi\sqrt{\frac{l}{g - a_0}}}$

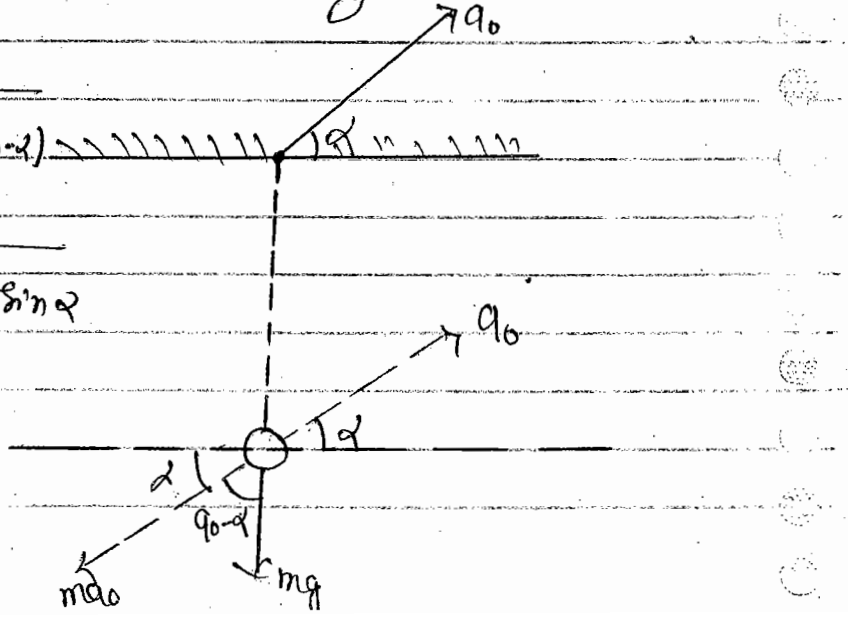


* When point of suspension is accelarated at an angle of α ~~ver~~ with horizontal :-

$g_{eff} = \sqrt{g^2 + a_0^2 + 2ga_0\cos(90-\alpha)}$

$g_{eff} = \sqrt{g^2 + a_0^2 + 2ga_0\sin\alpha}$

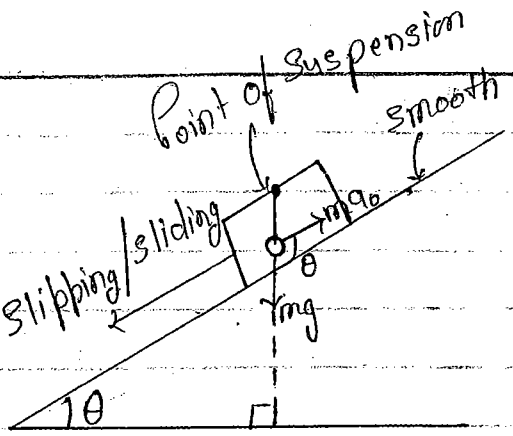
$\boxed{T = 2\pi\sqrt{\frac{l}{g_{eff}}}}$



$mg\sin\theta$ θ θ

$N = mg\cos\theta$ $\quad a = \frac{mg\sin\theta}{m}$ $\Rightarrow \boxed{a = g\sin\theta}$

Q. What is the time period of pendulum,



$a_0 = g\sin\theta$

$\theta = a_0 + \theta$

$g_{eff} = \sqrt{g^2 + a_0^2 + 2ga_0\sin(a_0+\theta)}$

$= \sqrt{g^2 + (g\sin\theta)^2 - 2g(g\sin\theta)\sin(a_0+\theta)}$

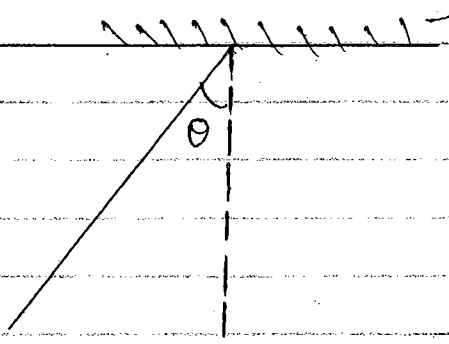
$= \sqrt{g^2 + g^2\sin^2\theta - 2g^2\sin^2\theta}$

$= g\sqrt{1 + \sin^2\theta - 2\sin^2\theta} = g\sqrt{1-\sin^2\theta}$

$g_{eff} = g\cos\theta$

So $\boxed{T = 2\pi\sqrt{\frac{l}{g\cos\theta}}}$

Q. Acceleration of point of suspension is $\sqrt{3}g$ in horizontal direction.



Sol^n

$\theta = \tan^{-1}\left(\frac{a_0}{g}\right)$

$= \tan^{-1}(\sqrt{3})$

$\boxed{\theta = 60^\circ}$ Ans