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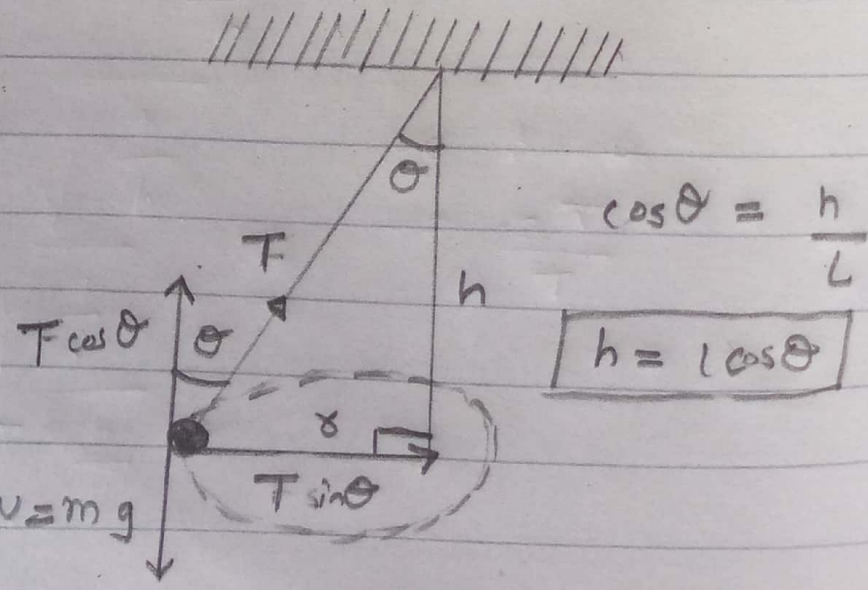
BSCS-I General Physics
S#33 Seat # EB20102066
BSCS - 307
Assignment #01

Time Period of a Conical Pendulum:

Suppose a conical Pendulum consists of a bob of mass 'm' moving in a horizontal circle ~~of~~ with constant speed 'v' at the end of a string of length 'L'. and makes an angle 'θ' with the vertical. If 'h' be the depth of the bob below the support.



$$\cos\theta = \frac{h}{L}$$

$$\boxed{h = L\cos\theta}$$

The tension 'T' in the string can be resolved into two components:

here Horizontal $T\sin\theta$

here vertical $T\cos\theta$

The vertical component balances weight

$$T\cos\theta = W$$

$$T\cos\theta = mg \longrightarrow (1)$$

while horizont component is providing necessary centripetal force.

$$T\sin\theta = F_c$$

$$T\sin\theta = mv^2/r \longrightarrow (2)$$

Dividing eq (2) by (1)

$$\Rightarrow \frac{T\sin\theta}{T\cos\theta} = \frac{mv^2/r}{mg}$$

$$\Rightarrow \tan\theta = \frac{v^2}{rg}$$

$$v = \sqrt{rg\tan\theta} \longrightarrow (3)$$

(3) shows velocity:

But for tangential velocity:

$\because V = r\omega$

where

ω = angular speed

T = Time Period (also)

(3) $\Rightarrow$

$$r\omega = \sqrt{rg\tan\theta}$$

Squaring on B.S

$$r^2\omega^2 = rg\tan\theta \longrightarrow (4)$$

From figure: $\tan\theta = \frac{r}{h}$

$\left\{\tan\theta = \frac{P}{B}\right\}$ so we get

$$r^2\omega^2 = rg \cdot \frac{r}{h} = \frac{r^2 g}{h}$$

$$\therefore \omega^2 = \frac{g}{h}$$

$$\therefore \omega = \sqrt{\frac{g}{h}}$$

we know $\because \omega = \frac{2\pi}{T}$

$$\frac{2\pi}{T} = \sqrt{\frac{g}{h}}$$

$$T = 2\pi\sqrt{\frac{h}{g}}$$

as $h = l\cos\theta$

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