ENGINEERING MECHANICS

Notes by-

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$\therefore 1-\cos^2\theta = (0.4\cos\theta)^2 + 0.234^2 - 2(0.4 \times 0.234\cos\theta)$.

$\therefore 1-\cos^2\theta = 0.16\cos^2\theta + 0.0548 - 0.1872\cos\theta$

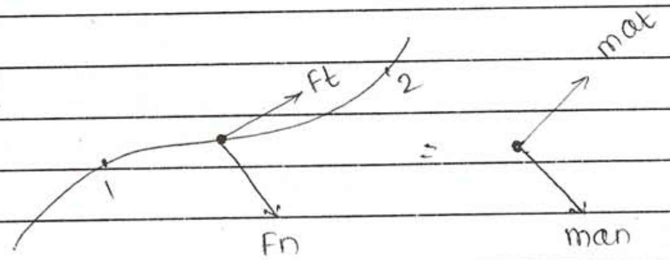
$\therefore -1.16\cos^2\theta + 0.1872\cos\theta - 0.9452 = 0 \Rightarrow 1.16\cos^2\theta - 0.1872\cos\theta - 0.9452 = 0$

$\therefore \cos\theta =$ ~~0.987~~ ~~0.9882~~ 0.9869

$\therefore$ ~~$\theta = 9.34°$~~

$\boxed{\theta = 9.28°}$

WORK - ENERGY (Forces / Dist.)



$F_t = m \cdot a_t$

$= m \cdot \frac{dv}{dt}$

$= m \cdot \frac{dv}{ds} \cdot \frac{ds}{dt} = m \cdot v \cdot \frac{dv}{ds}$.

$\therefore F_t ds = m \cdot v \cdot dv$

F·ds has physical meaning as, force × dist = Work done.

$\therefore \int_1^2 F_t \, ds = \int_{v_1}^{v_2} mv \cdot dv$

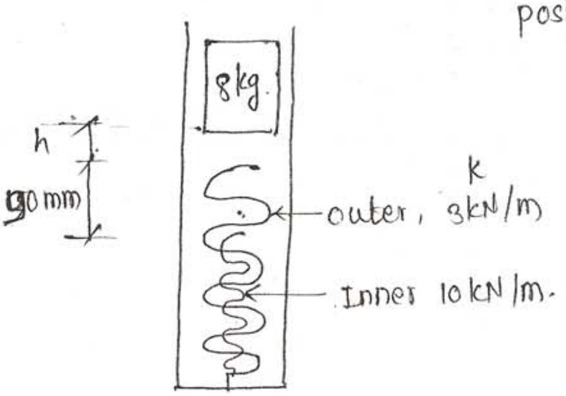
$\therefore U_{1-2} = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$

= change in K.E.

$\therefore \boxed{T_1 + U_{1-2} = T_2}$ ← WE Principle.

Note :- For problems involving acceln, time directly - Newtons law.
For problems involving disp, force — — - WE eqn.

Pro :- 8 kg plunger release from rest is stopped by two springs. If max. deflectn of the outer spring is observed to be 150 mm Find the ht. 'h' from which the plunger was dropped ?



From the given position to the final position,

$T_1 = 0$.

$T_2 = 0 \rightarrow$ Finally plunger stops.

$V_g = 8g\,[h + 0.15]$

Max. deflect^n of outer spring is 150 mm.

U_{os} = Work done by outer spring

$= \frac{K}{2}(x_1^2 - x_2^2)$

↑ Initial deformat^n ↑ Final Deformat^n.

$= \frac{3000}{2}(0 - 0.15^2)$

$= -33.75 = 33.75$

U_{is} = Work done by inner spring

$= \frac{10000}{2}(0 - 0.06^2)$

$= -18. = 18$

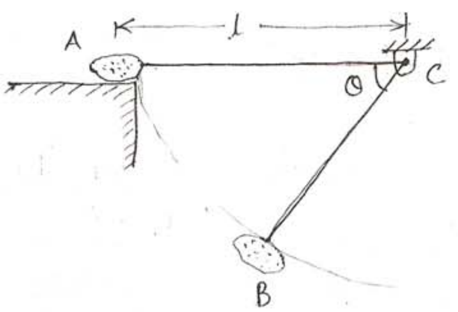
$\therefore U_g = U_{os} + U_{is} = +51.75.$

$\therefore -51.75 = 8g\,(h + 0.15)$

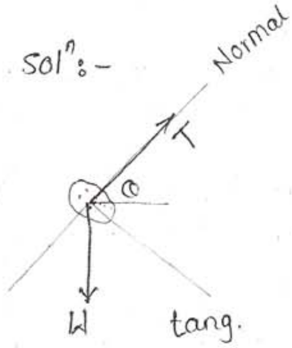
$\therefore h + 0.15 = +0.659$

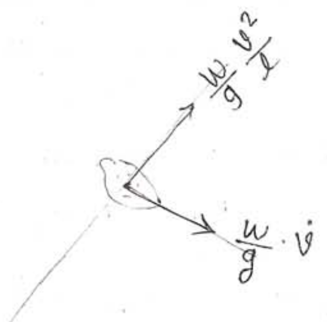
$\therefore$ **h = 0.509 m**

Pro:- A bag is gently pushed from A & swings in a vertical plane at the end of the ~~role~~ rope. If the max. tension in the rope cannot exceed twice the wt. of the bag, find θ at which the rope will break.



Sol^n:-





$\therefore 2W - W\sin\theta = \frac{W}{g}\cdot\frac{v^2}{l}$

$\therefore 2 - \sin\theta = \frac{v^2}{g.l}$

any θ, but at the instant of breaking. Tension is twice the wt. of bag.