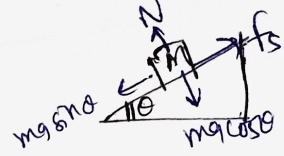
18/10/2020

Friction



① F_s = applied force

$F_{s\,max} = \mu_s N$. (Limiting condⁿ)

$F_k = \mu_k N$

② Real area = 10^{-4} x Virtual area

③ Fpulling : $\dfrac{\mu_s Mg}{(\cos\theta + \mu_s \sin\theta)}$

④ Fpushing : $\dfrac{\mu_s Mg}{(\cos\theta - \mu_s \sin\theta)}$

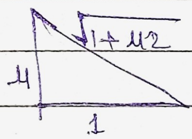
$\tan\theta = \mu_s$

Fpulling < Fpushing

⑤ special case (only pulling force)

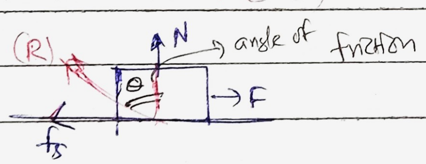
Q. At what angle pulling force must be applied, such that its value is minimum?

$\tan\theta = \mu_s$

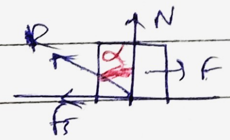


$F_{min} = \dfrac{\mu Mg}{\sqrt{1+\mu^2}}$ → tan θ

⑥ Resultant rxn force (R)

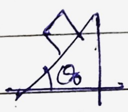


⑦ angle of friction (α)



⑧ Angle of Repose.

$\tan\theta_0 = \mu_s$

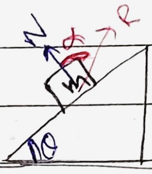


① angle of inclined plane < Repose.

— static friction.

$F_s = mg\sin\theta$ | $\tan\theta < \mu_s$

② angle of inclined plane > angle of Repose



$\tan\theta > \mu_s$

$F_k = \mu_k\, mg\cos\theta$

$mg\sin\theta - \mu_k\, mg\cos\theta = Ma$.

$\alpha = \theta$

③ Two inclined planes (One is smooth and other is Rough)

$\mu = \dfrac{(n^2-1)}{n^2}\tan\theta$

max. and min. forces

① Inclined के ıı'el

$F_{min} \le F \le F_{max}$

$mg(\sin\theta - \mu\cos\theta) \le F \le mg(\sin\theta + \mu\cos\theta)$

② Force is applied ıı'el to ground

$f_{min} \le f_{ıı\,to\,gd} \le f_{max}$

$\dfrac{mg(\sin\theta - \mu\cos\theta)}{(\cos\theta + \mu\sin\theta)} \le f_{ıı\,to\,gd} \le \dfrac{mg(\sin\theta + \cos\theta)}{(\cos\theta - \mu\sin\theta)}$

③ Force $\perp^{er}$ to inclined plane.

$f_{max} = \infty$ आयेगा,

$F_{min} = \dfrac{mg(\sin\theta - \mu\cos\theta)}{\mu}$

$2\sqrt{2} = 2.8$

(10) Truck box problem

a) Horizontal truck box.

$a_0 = \mu g$ — limiting condⁿ

① $a_{truck} < \mu_s g\ (a_0)$

$F_s = F_{applied} = Ma_T$.

② $a_{truck} > \mu_s g\ (a_0)$

$Ma_T - \mu_k Mg = Ma_{rel}$.

③ Time after which block flow off truck

$s = \frac{1}{2} a_{rel} t^2$

$v^2 = u^2 - 2a_{truck} s$

$\therefore t = \sqrt{\frac{2l}{a_{rel}}}$

b) Verticle truck-box problem.

$a_0 = \frac{g}{\mu_s}$ — limiting condⁿ

① $a_{truck} > g/\mu_s$

$F_{static} = mg$

② $a_{truck} < g/\mu_s$

$m a_{rel} = mg - m\mu_k a_T$

(10) Block on block problem

Steps: ① f_{s_1} max & f_{s_2} max काढणे दोन्ही surfaces चे resp.

② system boundry ने Acceleration काढणे.

③ $f_{s\,max}$ ची value A च्या regarding काढून $f_{s_1 max}$ शी compare करणे जास्त असेल तर both blocks will move separately.

④ and after all these, a_1 & a_2 काढणे.

(11) Block against vertical wall

— Same concept like vertical truck-box Problem

$a = \frac{g}{\mu}$

(12) chain on Horizontal Table

$x = \frac{\mu}{(\mu+1)} (L)$

x = hanging chain's length

L = length of chain