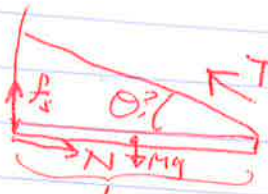
Solutions to Practize Quiz 4. Phy 2048C.

Problem 1. (a)



$\sum \tau = 0$; $\sum F_x = 0$; $\sum F_y = 0$

$-Mg\frac{L}{2} + T\sin\theta L = 0$; $N - T\cos\theta = 0$; $T\sin\theta + f_s - Mg = 0$

Solve system of eqns. for θ

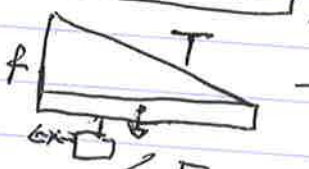
$T\cos\theta = N$; $N\mu_s + T\sin\theta - Mg = 0$

$Mg = T(\cos\theta\mu_s + \sin\theta)$

$-\frac{T(\cos\theta\mu_s + \sin\theta)}{2} + T\sin\theta = 0 \longrightarrow$ divide by $\cos(\theta)$ $\longrightarrow -\frac{\mu_s}{2} + \tan\theta - \frac{\tan\theta}{2} = 0$

$\tan\theta = \mu_s \Rightarrow \boxed{\theta = \tan^{-1}(\mu_s)}$

Problem 1 (b)



→ Solve for x

$\sum \tau = 0$; $\sum F_x = 0$; $\sum F_y = 0$

$-Mg\frac{L}{2} - Mgx + T\sin\theta L = 0$; $N - T\cos\theta = 0$; $T\sin\theta + f_s - 2Mg = 0$

$N = T\cos\theta$; $T\sin\theta + \mu_s T\cos\theta = 2Mg$

$-2MgL - 4Mgx + 4T\sin\theta L = 0$

$-2Mg(L + 2x) + 4T\sin\theta L = 0$

$(T\sin\theta + \mu_s T\cos\theta)(2x + L) + 4T\sin\theta L = 0$

$-2x(T\sin\theta + \mu_s T\cos\theta) = L(T\sin\theta + \mu_s T\cos\theta) + 4T\sin\theta L$

$x = -\frac{L}{2} + \frac{2T\sin\theta L}{T\sin\theta + \mu_s T\cos\theta} \approx 0.44m$

Problem 1 ©

Solve for μ_s ; $X = 0.1\ m$

$$X = -\frac{L}{2} + \frac{2\sin\theta\, L}{\sin\theta + \mu_s\cos\theta}$$

$$\left(\frac{X}{L} + \frac{1}{2}\right)(\sin\theta + \mu_s\cos\theta) = 2\sin\theta$$

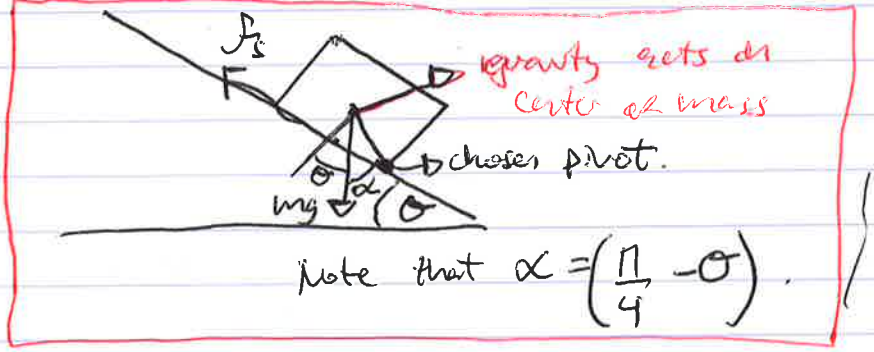
$$\mu_s = \frac{2\sin\theta\left(\frac{X}{L} + \frac{1}{2}\right)^{-1} - \sin\theta}{\cos\theta} \approx 0.63$$

This is good algebra practice.

Problem 2. Compare θ when it slides and when it tips. which one is less?

$\sum \tau = 0$; $\sum F_y = 0$; $F_x = 0$

$mg\sin\left(\frac{\pi}{4} - \theta\right) = 0$; $mg\cos\theta = N$



$mg\sin\theta - f_s = 0$

$mg\sin\theta - \mu_s mg\cos\theta = 0$

$\tan\theta = \mu_s$

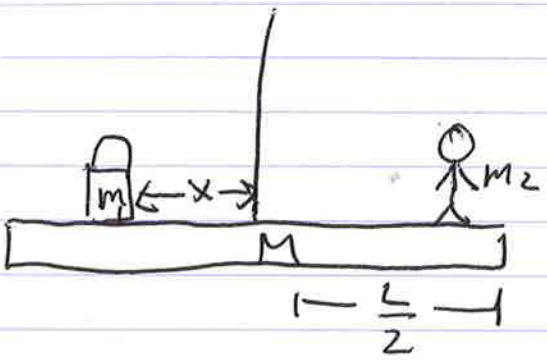
$\theta = \tan^{-1}(\mu_s)$

$\theta = 43^\circ$

$\theta = \frac{\pi}{4}$

$43 < 45$ hence it slides

Problem 3.



$$\Sigma \tau = 0$$

$$-m_2 g \frac{L}{2} + m_1 g x = 0$$

$$x = \frac{m_2}{m_1}\frac{L}{2} = 0.76\,m$$

Problem 4

D → Days
A_0 → Ahmed initial
S_0 → Sebas initial
S_1 → " final in scenario 2

Scenario 1

$$A_0 - 75 \times D = 900$$
$$S_0 - 25 \times D = 0$$

Scenario 2

$$A_0 - 25D = 2100$$
$$S_0 - 75D = S_1$$

Solve for S_1

$$A_0 = 2100 + 25D$$

$$2100 + 25D - 75D = 900$$

$$D = -(900 - 2100)/50 = 24$$

$$S_0 = 25(24) = 600$$

$$S_1 = 600 - 75 \times 24 = -1200$$