Hymon Gnomnom Chapter 12
"Equilibrium"

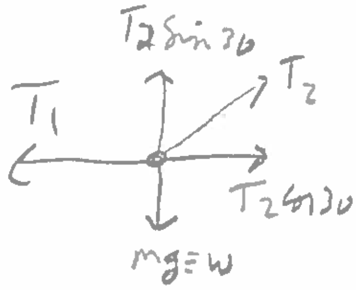
Q1 $W = 100\,N$

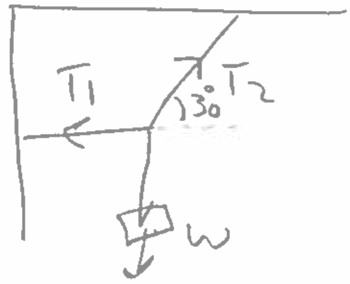
$T_1, T_2 = ?$

$T_2 \sin 30 = 100$

$$T_2 = \frac{100}{\sin 30} = 200\,N$$

$$T_1 = T_2 \cos 30 = 173\,N$$

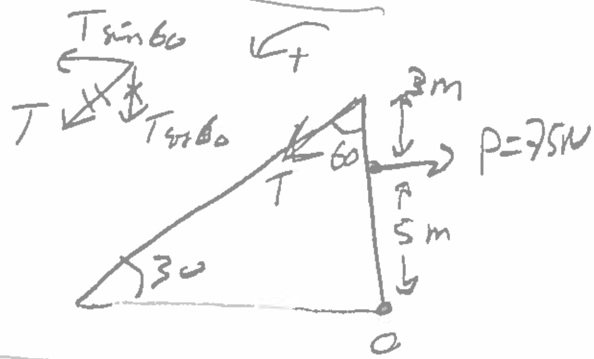




Q2 $\sum \tau_O = 0$ $T = ?$

$$(T \sin 60)(8) - (75)(5) = 0$$

$$T = \frac{375}{8 \sin 60} = 54.13\,N$$

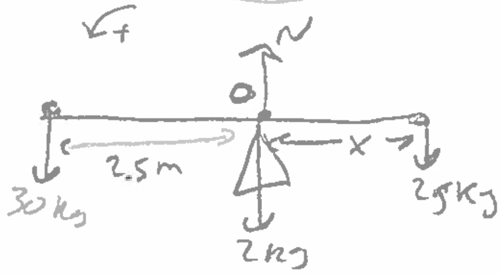


Q3 $\sum F = 0 \Rightarrow N = (30+25+2)(9.8)$

$N = 572\,N$

$\rightarrow$ $\sum \tau_O = 0 \Rightarrow (30)(2.5)g = 25(X)g$

$\therefore X = 3\,m$



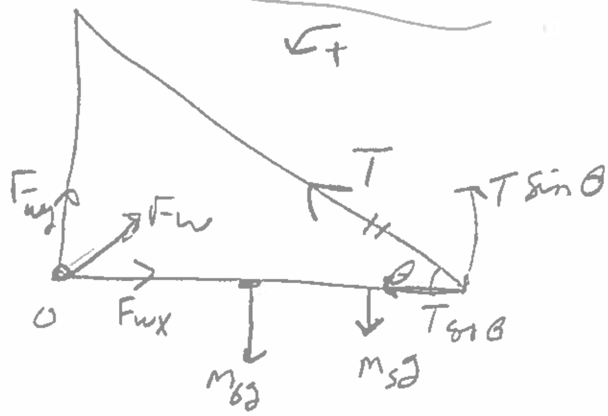
Q4 $\sum \tau_O = 0 \Rightarrow$ $T, F_w = ?$

a) $(l)\, T \sin\theta = (m_b g)(\frac{1}{2} l) + (m_s g)(\frac{3}{4} l)$

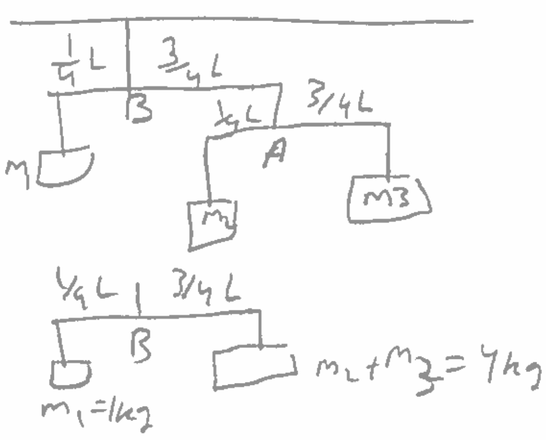
$$\therefore T = \frac{(\frac{1}{2} m_b + \frac{3}{4} m_s)\, g}{\sin\theta}$$

b) $\sum F_x = 0 \Rightarrow F_{wx} = T \cos\theta$

$\sum F_y = 0 \Rightarrow F_{wy} = m_b g + m_s g - T \sin\theta$



Q5) $m_3 = 1\,kg$ | $m_1 = ??$ 6



$\sum \tau_A = 0$

$(\frac{1}{4}L) m_2 = (\frac{3}{4}L)(m_3)$

$\therefore m_2 = (\frac{3}{4})(1)(4) = 3\,kg$

$\sum \tau_B = 0$

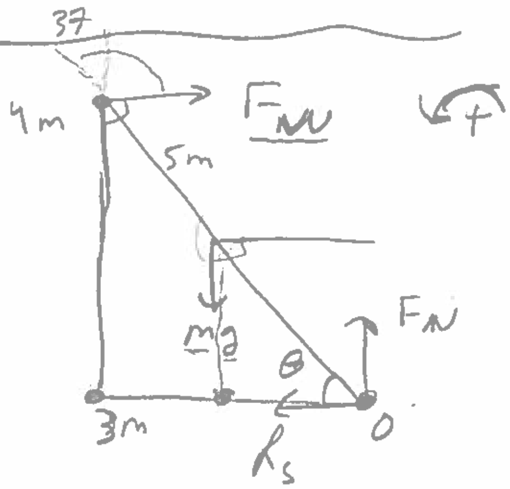
$(\frac{1}{4}L)(m_1) = (\frac{3}{4}L)(m_2 + m_3)$

$\frac{1}{4} m_1 = (\frac{3}{4})(4)$

$m_1 = 12\,kg$

Q6) $\mu_s = ?$ $\theta = \tan^{-1}\frac{4}{3} = 53.1°$

$W = 400\,N$



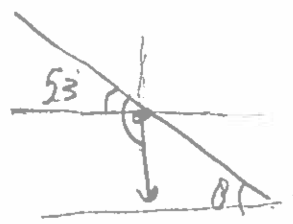
$\sum F_x = 0 \Rightarrow F_W = f_s$?? ①

$\sum F_y = 0 \Rightarrow F_N = mg = 400\,N$

$\sum \tau_O = 0$

A: cos 53 B: sin 53

$(mg)(2.5)(\sin 53+90) - (F_W)(5 \sin 37+90) = 0$



$602 = F_W(4)$

$F_W = 150.5$ ②

② in ① $\Rightarrow f_s = 150.5 = \mu_s N$

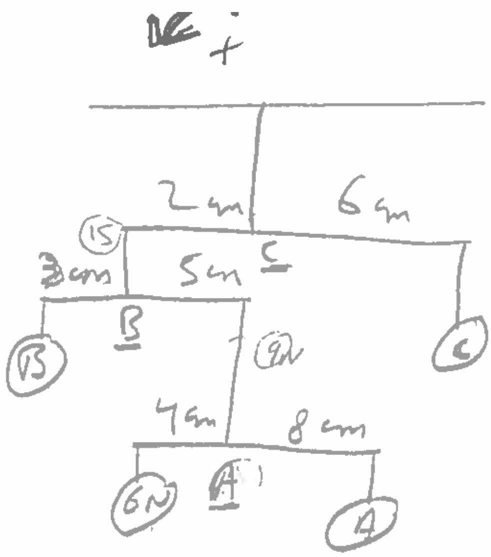
$\therefore \mu_s = \frac{150.5}{400} = 0.376$

$A = 3/2 = 1.5\,m$
$= (2.5)\sin(53+90)$
$= (2.5)\cos 53$

$B = 4\,m$
$= 5 \sin 53$
$= 5 \sin(37+90)$

②

(Q7) $\sum \tau_A = 0$



$6 \times 4 = 8 \times A$

$\therefore A = 3N$

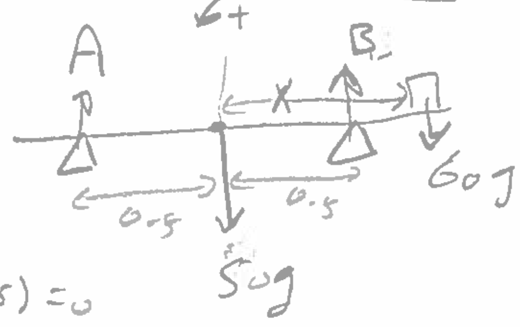
$\sum \tau_B = 0 \Rightarrow B \times 3 = 9 \times 5$

$\therefore B = 15N$

$\sum \tau_C = 0$

$C \times 6 = 15 \times 2 \Rightarrow C = 5N$

(Q8) $\sum F = 0 \Rightarrow A + B = 60 + 50$ ①



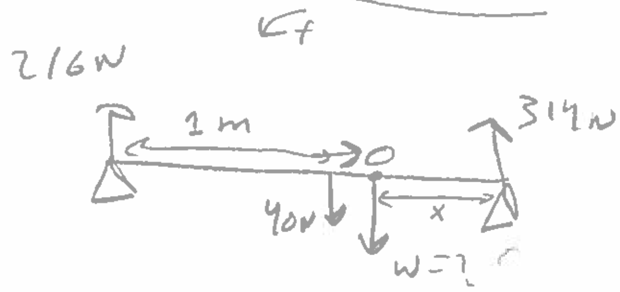
$\sum \tau_B = 0 \Rightarrow$

$(50g)(0.5) - (A)(1) + (60g)(X - 0.5) = 0$

about to be left

$\therefore x = 0.9\ m$

(Q9) $\sum \tau_O = 0 \Rightarrow$ (w=??)



$(314)(X) + (40)(1-X) = (216)(2-X)$

$314X + 40 = 432 - 216X + 40X$

$(314+216)X = (432-40) + 40X$

$530X = 392 + 40X$

$(490)X = 392$

$X = 0.8\ cm$

Q11 (V = AL) if the L ⇒ double ⇒ A ⇒ $\frac{1}{2}$

$$stress = \frac{F}{A} = \frac{mg}{A/2} = \frac{2mg}{A}$$ doubled

Q12 ΔL ⇒ 1% of L ⇒ ΔL = 0.01 L strain = ??

$$strain = \frac{\Delta L}{L} = \frac{0.01L}{L} = 0.01$$

Q13

R = 2 mm

$E = 9 \times 10^{10} \frac{N}{m^2}$

F = ?

to stretch 0.1% of its length

$\Rightarrow \Delta L = \frac{0.01}{100} L = 0.001 L$

$A = \pi R^2 = \pi (2 \times 10^{-3})^2$

stress = E strain

$F = (E)(A)\frac{\Delta L}{L}$

$= 36000\pi \left(\frac{0.001L}{L}\right)$

F = 360π

Q14 ΔL = 0.2 cm L = 2 m V = 10 cm³ ① } $F_1 = F_2$

ΔL = ? L = 8 m V = 10 cm³ ②

$$F_1 = EA\frac{\Delta L}{L} \times \frac{L}{L} \Rightarrow F_1 = E V \left(\frac{\Delta L}{L^2}\right)_1$$

$$F_2 = EA\frac{\Delta L}{L} \times \frac{L}{L} \Rightarrow F_2 = E V \left(\frac{\Delta L}{L^2}\right)_2$$

$$1 = \frac{\Delta L_1}{L_1^2} * \frac{L_2^2}{\Delta L_2}$$

$$1 = \frac{0.2}{(200)^2} * \frac{(800)^2}{\Delta L_2}$$

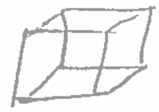
$\therefore \Delta L_2 = 3.2$ cm

Q15

$L_1 = 85.5$ cm

stress = ??

$L_2 = 85$ cm

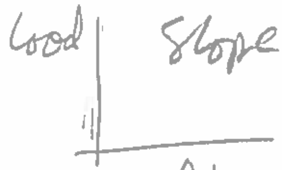


$$\text{stress} = E\ \text{strain} = 1.44\times10^{11}\left[\frac{(85.5)^3-(85)^3}{(85.5)^3\times10^{-6}}\right]\times10^{-6}$$

$$\text{stress} = 2.44\times10^{9}\ N/m^2$$

Q16

$$\frac{F}{A} = E\frac{\Delta L}{L}$$



Slope $= \frac{F}{\Delta L}$

$$\therefore \text{Slope} = \frac{F}{\Delta L} = \frac{AE}{L}$$

(E, L, F are const)

Slope ↑ ⇒ A ↑

Q17

$L, R \Rightarrow Y$

$L_2 = \frac{L}{2}$

$R_2 = \frac{R}{2}$

Young modulus dose not change for the same material.

Q18

$$\frac{F}{A} = E\frac{\Delta L}{L}$$

$$\therefore \Delta L = \frac{FL}{EA} = \frac{FL^2}{EV}$$