Lecture 2

10th Oct. 2019 Thursday

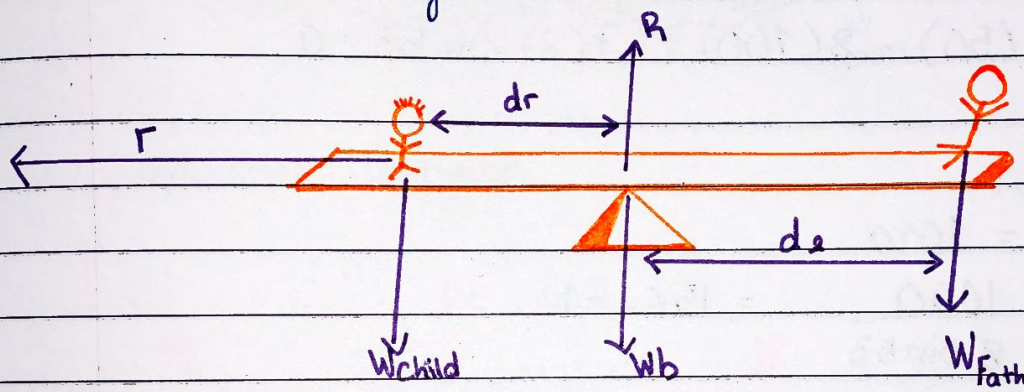
Biostatics

- Static Equilibrium (conditions for equilibrium)
  - ↳ no translation motion $\Sigma \vec{F} = 0$; $\Sigma F_x = 0$, $\Sigma F_y = 0$
  - ↳ no rotational motion $\Sigma \vec{\tau} = 0$

$\vec{\tau} = \vec{r} \times \vec{F}$ $\quad r F \sin\theta$

* ↳ a vector directed from the axis of rotation towards the force

~ Equilibrium implies the object is at rest or its center of mass moves with a constant velocity
- ↓ static
- ↳ dynamic



$R - W_C - W_b - W_F = 0$

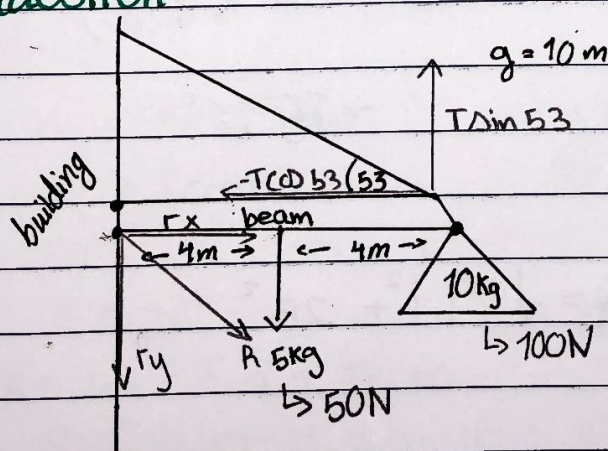
① $R = W_C + W_F + W_b$

$\tau_{W_C} + \tau_R + \tau_{W_b} + \tau_{W_F} = 0$

$d_1 W_C - d_2 W_F = 0$

② $d_1 W_C = d_2 W_F$

Question:



Find the tension in the cable and the reaction → always force exerted by the tilted joint at the wall? + guessed

$\Sigma F_x = 0$

$-T\cos 53 + R_x = 0$

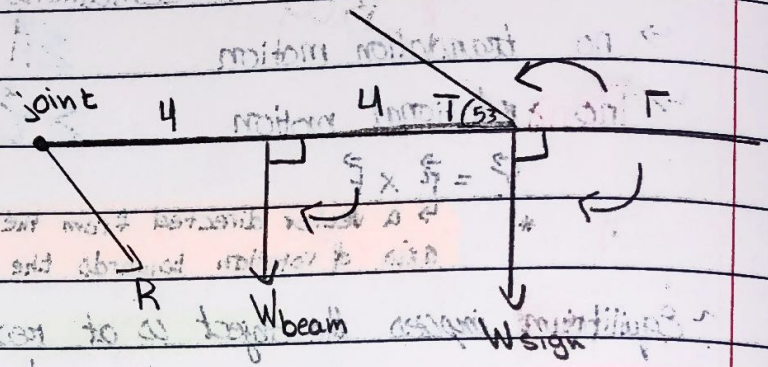
① $R_x = T\cos 53$

$\Sigma F_y = 0$

$T\sin 53 - R_y - 150 = 0$

② $R_y = T\sin 53 - 150$

$\Sigma \tau = 0$



$\cancel{\Sigma R}^{0} - T_{Wb} - T_{Ws} + \tau_T = 0 \Rightarrow$

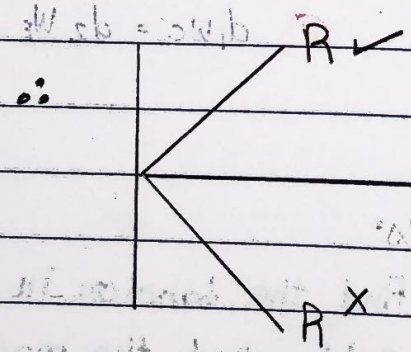
③ $-4(50) - 8(100) + T(8)\sin 53 = 0$

$8T\sin 53 = 1000$

$T = \dfrac{1000}{8\sin 53} = 156.5\,N$

$R_x = T\cos 53 = 156.5\cos 53 = 94.1\,N$

$R_y = 156.5\sin 53 = -25\,N$ ← number should not be negative



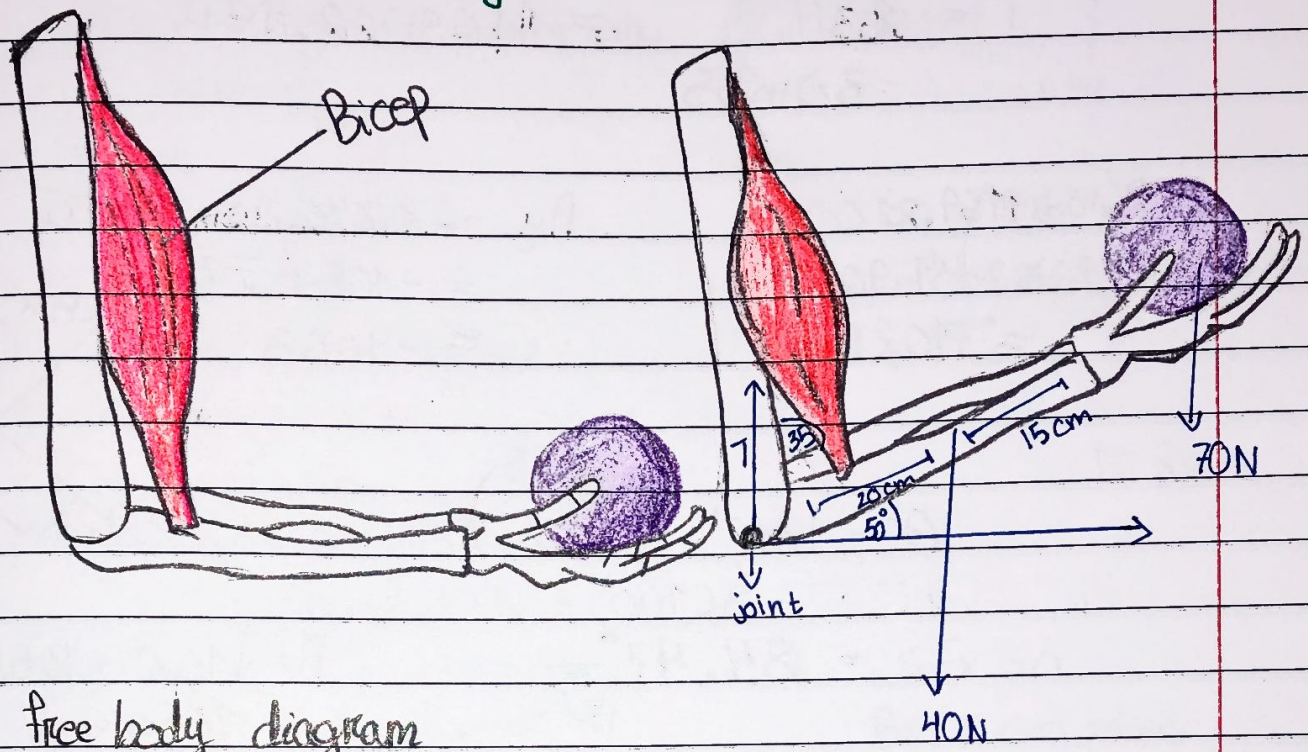
$\therefore$

$\theta = \tan^{-1}\left(\dfrac{25}{94.1}\right)$

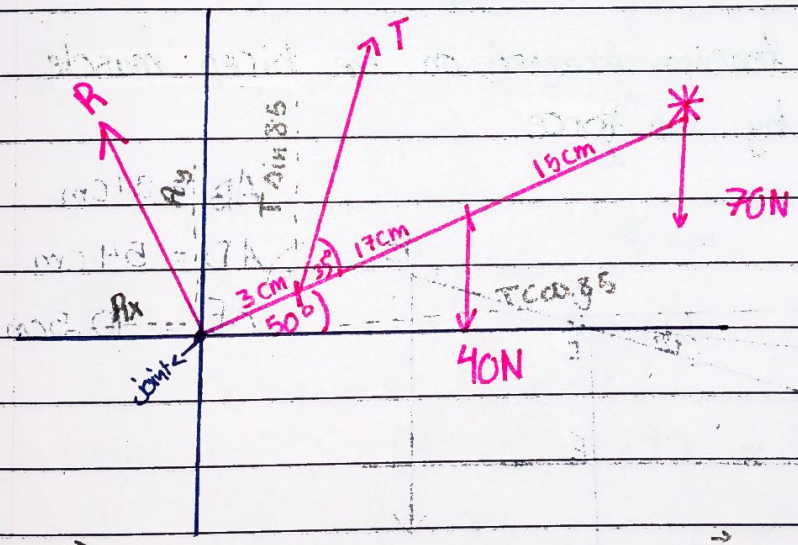
$= 75.12°$

$R = \sqrt{94.1^2 + 25^2}$

Question ⇒ Find the tension exerted on the bicep muscle & the force reacted by the joint.



free body diagram



$\Sigma \vec{F}_x = 0$

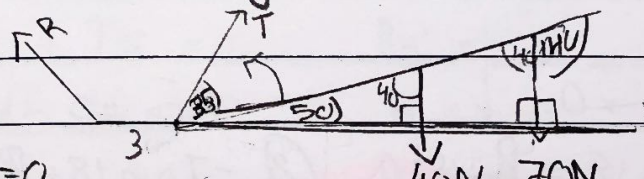
$-R_x + T\cos 85 = 0$

① $R_x = T\cos 85$

$\Sigma \vec{F}_y = 0$

$R_y + T\sin 85 - 40N - 70N = 0$

② $R_y = -T\sin 85 + 110$



$\Sigma \tau = 0$

$\tau_R - \tau_{WA} - \tau_{WB} + \tau_T = 0$

$0 - 17(40)\sin 40 - 35(70)\sin 140 + 3T\sin 35 = 0$

$3T\Delta \sin 35 = 2011.9$

$$T = \frac{2011.9}{3\Delta \sin 35} = 1169.22\ N$$

$R_x = 1169.22 \cos 85$

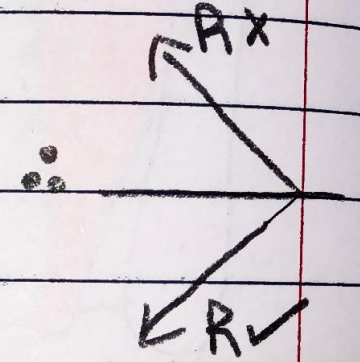
$= 101.90$

$\simeq 102N$

$R_y = -1169.22 \sin 85 + 110$

$= -1054.77$

$\simeq -1055$



$\therefore$

$\theta = \tan^{-1}\left(\frac{1055}{102}\right)$

$= 84.47°$

$R = \sqrt{102^2 + 1055^2}$

$= 1059.9\ N$