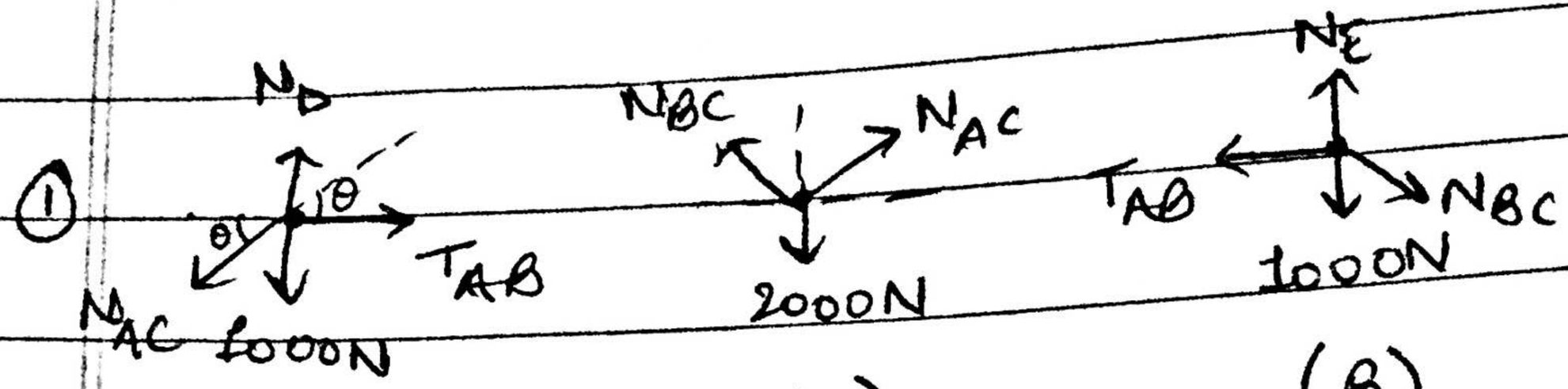
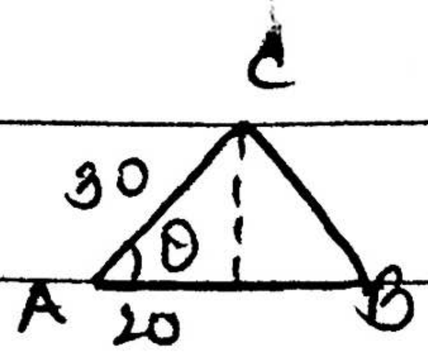
6/10/20

★ Tutorial Sheet 2





$$\theta = \cos^{-1}\left(\frac{2}{3}\right) = 48^\circ$$

$$T_{AB} - N_{AC}\cos\theta = 0 \quad -(1)$$

$$N_D - N_{AC}\sin\theta - 1000 = 0 \quad -(2)$$

$$N_{AC}\cos\theta - N_{BC}\cos\theta = 0 \quad -(3)$$

$$N_{AC} = N_{BC}$$

$$N_{AC}\sin\theta + N_{BC}\sin\theta - 2000 = 0 \quad -(4)$$

$$2N_{AC}\sin\theta = 2000^{1000}$$

$$N_{AC} = \frac{1000}{\sin\theta} = N_{BC} = 1345.3N$$

$$T_{AB} = N_{AC}\cos\theta$$

$$= \frac{1000}{\sin\theta}\cos\theta$$

$$= \frac{1000}{\tan\theta}$$

$$\boxed{T_{AB} = 894.4\,N}$$

$$N_D = 1000 + N_{AC}\sin\theta$$

$$= 1000 + \frac{1000}{\sin\theta}\sin\theta$$

$$\boxed{N_D = 2000\,N}$$

$$N_E - N_{BC}\sin\theta - 1000 = 0 \quad -(3)$$

$$N_E = 1000 + N_{BC}\sin\theta$$

$$\boxed{N_E = 2000\,N}$$

(2) A(0,0,0) ~~B (3.7, 11.4, 0)~~

D(4,0,4) E(-6,0,5)

B(3.708, 11.412, 0)

$$\vec{F}_{DB} = |F_{DB}|\left(\frac{-0.292\hat{i} + 11.412\hat{j} - 4\hat{k}}{\sqrt{146.3}}\right)$$

$$\vec{F}_{EB} = |F_{EB}|\left(\frac{9.708\hat{i} + 11.412\hat{j} - 5\hat{k}}{\sqrt{249}}\right)$$

$$\vec{F}_{DB} + \vec{F}_{EB} + \vec{w} = 0$$

$$-0.02F_{DB} + 0.62F_{EB} = 0 \quad -(1)$$

$$0.95F_{DB} + 0.72F_{EB} = 0 \quad -(2)$$

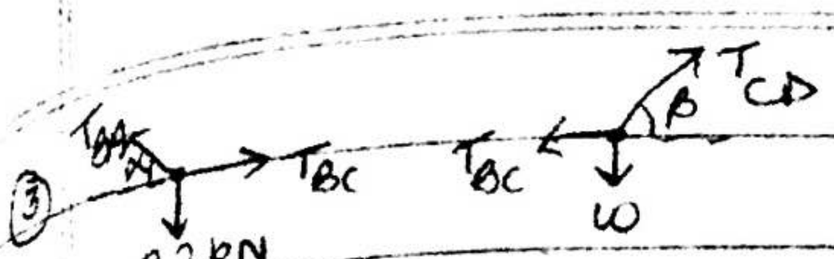
$$-0.34F_{DB} - 0.31F_{EB} - 1000 = 0 \quad -(3)$$

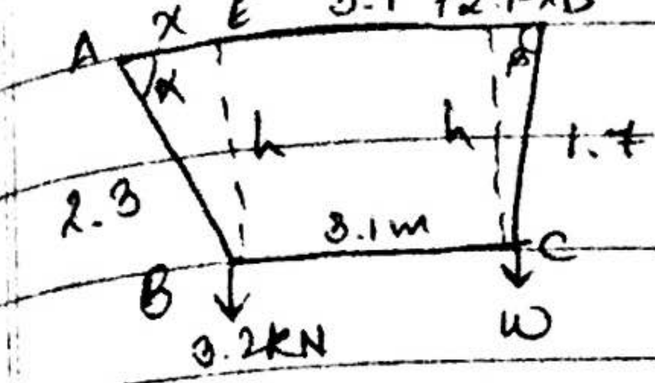
$$F_{EB} = 0.03F_{DB}$$

$$\boxed{F_{DB} = 2910.8\,N}$$

$$\boxed{F_{EB} = 124\,N}$$

③





ΔABE, $x^2 + h^2 = 2.3^2$

ΔFDC, $h^2 + (2.9-x)^2 = 1.7^2$

$\Rightarrow h^2 + x^2 + 2.9^2 - 5.8x = 1.7^2$

$\Rightarrow 2.3^2 + 2.9^2 - 1.7^2 = 5.8x$

$\Rightarrow 5.29 + 8.41 - 2.89 = 5.8x$

$\Rightarrow x = 1.86$ m

$\alpha = \cos^{-1}\left(\frac{1.86}{2.3}\right) = 36°$

$\beta = \cos^{-1}\left(\frac{1.04}{1.7}\right) = 52.2°$

$T_{BC} = T_{BA}\cos\alpha$ -①

$3.2 = T_{BA}\sin\alpha$ -②

$T_{BC} = T_{CD}\cos\beta$ -③

$T_{CD}\sin\beta = W$ -④

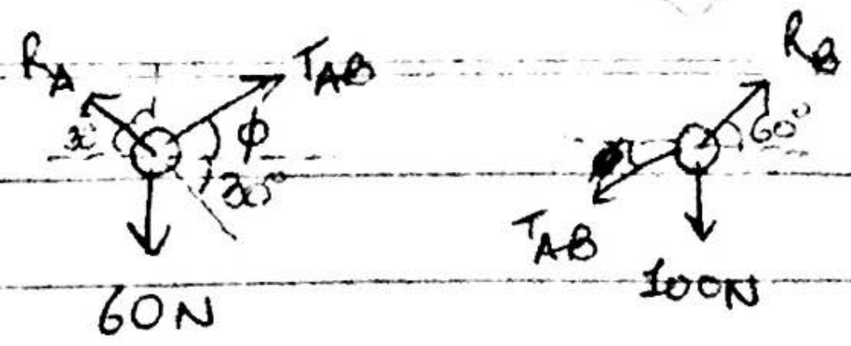
from ② $\rightarrow T_{BA} = \frac{3.2}{\sin\alpha} = 5.44$ kN

from ① $\rightarrow T_{BC} = \frac{3.2\cos\alpha}{\sin\alpha} = 4.32$ kN

from ③ $\rightarrow T_{CD} = \frac{4.32}{\cos\beta} = 7.06$ kN

from ④ $\rightarrow W = 7.06\sin\beta = 5.65$ kN

④



$T_{AB}\cos\phi - R_A\cos 30° = 0$ -①

$T_{AB}\sin\phi + R_A\sin 30° - 60 = 0$ -②

$R_B\cos 60° - T_{AB}\cos\phi = 0$ -③

$R_B\sin 60° - T_{AB}\sin\phi - 100 = 0$ -④

$T_{AB}\cos\phi = \frac{R_A\sqrt{3}}{2}$

$\frac{R_B}{2} - \frac{R_A\sqrt{3}}{2} = 0$

$R_B = \sqrt{3}R_A$

$\frac{R_B}{2} = T_{AB}\cos\phi$

$T_{AB}\sin\phi + R_A/2 = 60$

$\frac{\sqrt{3}R_A \times \sqrt{3}}{2} - T_{AB}\sin\phi = 100$

$2R_A = 160$

$R_A = 80$N

$R_B = 80\sqrt{3}$ N

$T_{AB}\sin\phi = 60 - \frac{80}{2} \times 1 = 20$

$T_{AB}\cos\phi = 40\sqrt{3}$

$\tan\phi = \frac{1}{2\sqrt{3}}$

$\phi = 16.11°$

$T_{AB} = \frac{40\sqrt{3}}{0.96}$

$T_{AB} \simeq 72$N

⑤ $R = F_{AB} + F_{AC} + F_{AD}$

$0\hat{i} + x\hat{j} + 0\hat{k} = R$

$\vec{F}_{AB} = 50\left(\frac{8\hat{i} - 20\hat{j} + 5\hat{k}}{\sqrt{489}}\right)$

$\vec{F}_{AC} = |F_{AC}|\left(\frac{8\hat{i} - 20\hat{j} - 10\hat{k}}{\sqrt{564}}\right)$

$\vec{F}_{AD} = |F_{AD}|\left(\frac{-8\hat{i} - 20\hat{j}}{\sqrt{464}}\right)$

$\Sigma F_x \Rightarrow 0 = 18.09 + 0.33F_{AC} - 0.37F_{AD}$ -①

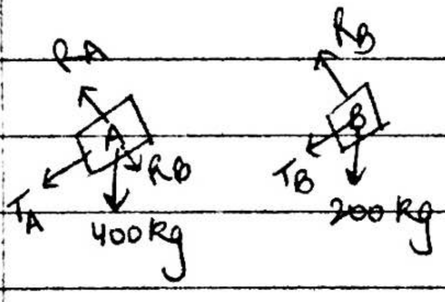
$\Sigma F_y \Rightarrow x = -46.22 - 0.84F_{AC} - 0.93F_{AD}$ -②

$\Sigma F_z \Rightarrow 0 = 11.3 - 0.42F_{AC}$ -③

from ③ → $F_{AC} = \frac{11.3}{0.42} = 26.9N$

from ① → $\frac{18.09 + 0.33 \times 26.9}{0.37} = F_{AD} = 73N$

⑥



~~$T_A + 400\sin$~~

$T_A + 400\sin 27^\circ = 0$ -①

$R_A - R_B - 400\cos 27^\circ = 0$ -②

$T_B + 200\sin 27^\circ = 0$ -③

$R_B - 200\cos 27^\circ = 0$ -④

$T_A = -400 \times \sin 27^\circ = -181,6N$

$T_B = -200\sin 27^\circ = -90,8N$

$R_B = 200\cos 27^\circ = 178,2N$

$R_A = 178.2 + 400\cos 27 = 534,6N$

$\Sigma M_0 \Rightarrow F \times 0.72 + T_B \times 0.34 + T_A \times 0.18 = 0$

$\Rightarrow F = \frac{-30.872 - 32.688}{0.72} = -88.27N$