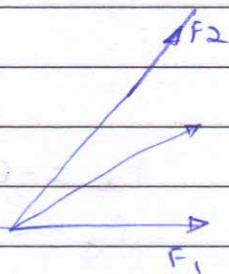
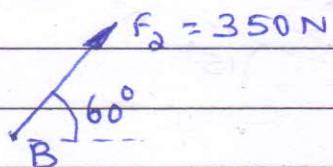


Rectangular ComponentsProblems2/7 18

$$F_1 = 500 \text{ N}$$

A



$$\vec{F}_1 = 500\text{i}$$

$$\vec{F}_2 = 350 \cos 60^\circ \text{i} + 350 \sin 60^\circ \text{j}$$

$$\vec{R} = \vec{F}_1 + \vec{F}_2$$

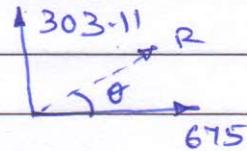
$$= 500\text{i} + 350 \cos 60^\circ \text{i} + 350 \sin 60^\circ \text{j}$$

$$= 500\text{i} + 175\text{i} + 303.11\text{j}$$

$$= 675\text{i} + 303.11\text{j}$$

$$R = \sqrt{(675^2) + (303.11)^2}$$

$$= 739.93 \text{ N}$$

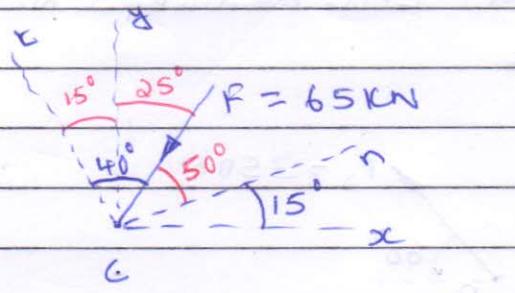


$$\theta = \tan^{-1} \frac{303.11}{675}$$

$$= 24.18^\circ$$

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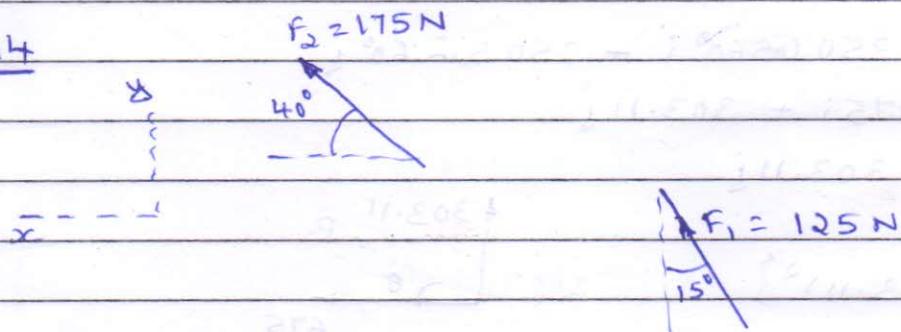
$$F_x = -65 \cos 65^\circ = -65 \sin 25^\circ = -27.47 \text{ kN}$$

$$F_y = -65 \sin 65^\circ = -65 \cos 25^\circ = -58.91 \text{ kN}$$

$$F_n = -65 \cos 50^\circ = -65 \sin 40^\circ = -41.78 \text{ kN}$$

$$F_L = -65 \sin 50^\circ = -65 \cos 40^\circ = -49.79 \text{ kN}$$

2/14



$$\begin{aligned} \vec{F}_1 &= 125 \sin 15^\circ i + 125 \cos 15^\circ j \text{ N} \\ &= 32.35 i + 120.74 j \text{ N} \end{aligned}$$

$$\begin{aligned} \vec{F}_2 &= 175 \cos 40^\circ i + 175 \sin 40^\circ j \\ &= 134.06 i + 112.49 j \text{ N} \end{aligned}$$

$$\vec{R} = \vec{F}_1 + \vec{F}_2$$

$$= (32.35 + 134.06) i + (120.74 + 112.49) j$$

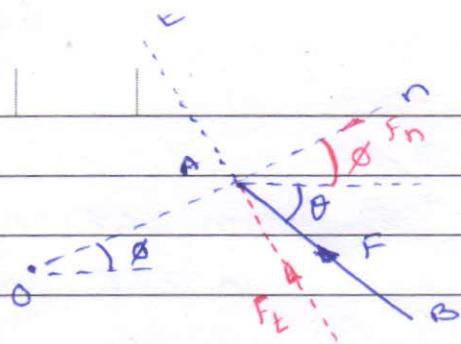
$$= 166.41 i + 233.23 j \text{ N}$$

A vector addition diagram showing the resultant vector \vec{R} with a magnitude of 166.41 and an angle of 35.51° relative to the horizontal axis.

DATE

PRACTICE

2/15



$$\vec{F} = F_n + F_t$$

$$= -F \cos(\theta + \phi)_n + F \sin(\theta + \phi)_t$$

(a) $F = 500 \text{ N}$, $\theta = 60^\circ$, $\phi = 20^\circ$

$$\vec{F} = -500 \cos(60^\circ + 20^\circ) + 500 \sin(60^\circ + 20^\circ)$$

$$= -86.82n + 492.40t \text{ N}$$

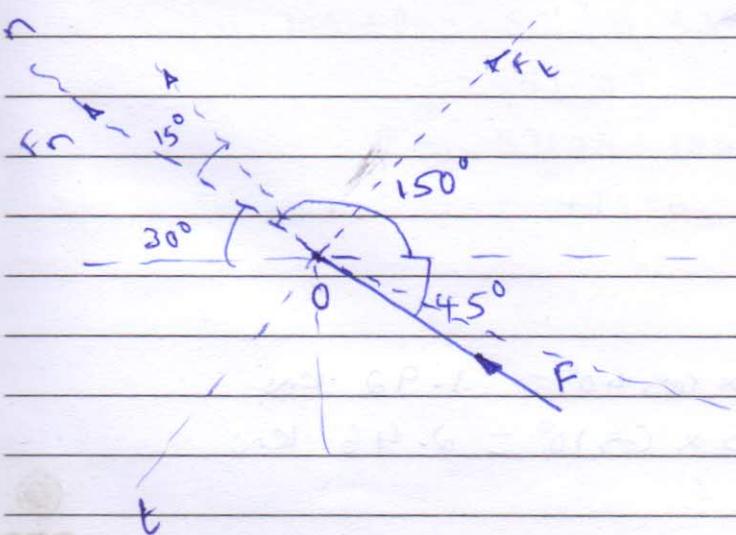
(b) $F = 800 \text{ N}$, $\theta = 45^\circ$, $\phi = 150^\circ$

$$\vec{F} = -800 \cos(45 + 150) + 800 \sin(45 + 150)$$

$$= 772.74n - 207.06t \text{ N}$$

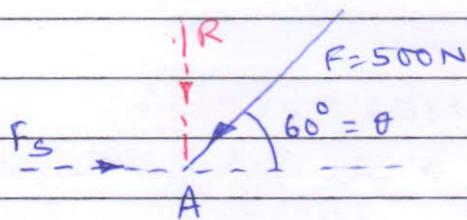
$$F_n = F \cos 15 = 800 \cos 15 = 772.74$$

$$F_t = -F \sin 15 = -800 \sin 15 = -207.06$$



DATE

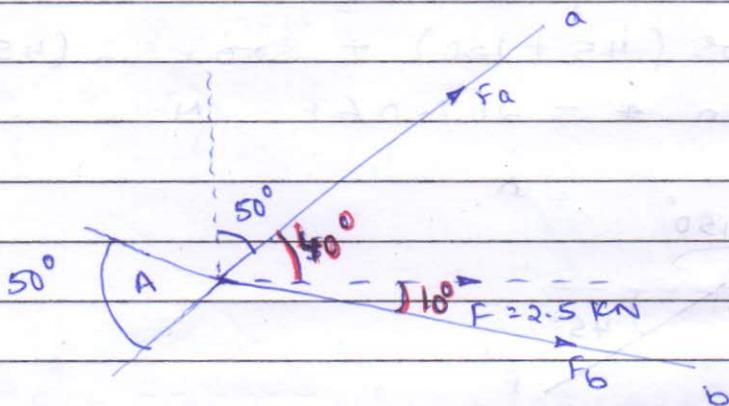
2/20



$$\begin{aligned} F_s &= F \cos \theta \\ &= 500 \times \cos 60^\circ \\ &= 250 \text{ N} \end{aligned}$$

$$\begin{aligned} R &= F \sin \theta \\ &= 500 \times \sin 60^\circ \\ &= 433.01 \text{ N} \end{aligned}$$

2/22



$$\frac{F}{\sin 50^\circ} = \frac{F_a}{\sin 10^\circ} = \frac{F_b}{\sin 40^\circ}$$

$$\begin{aligned} F_a &= \frac{2.5 \times \sin 10^\circ}{\sin 50^\circ} \\ &= 0.57 \text{ kN} \end{aligned}$$

$$\begin{aligned} F_b &= \frac{2.5 \times \sin 40^\circ}{\sin 50^\circ} \\ &= 2.10 \text{ kN} \end{aligned}$$

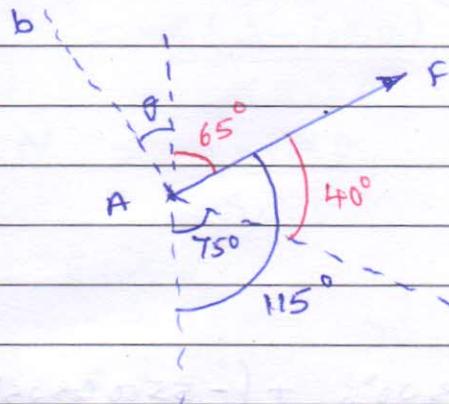
$$P_a = F \cos 40^\circ = 2.5 \times \cos 40^\circ = 1.92 \text{ kN}$$

$$P_b = F \cos 10^\circ = 2.5 \times \cos 10^\circ = 2.46 \text{ kN}$$

2/25

$$P_a = 325 \text{ N}$$

$$F_b = 325 \text{ N}$$



Explain

$$F_a^2 = F^2 + F_b^2 - 2FF_b \cos(65+0)$$

$$F_b^2 = F^2 + F_a^2 - 2FF_a \cos 40^\circ$$

$$325^2 = 424.25^2 + F_a^2 - 2 \times 424.25 \times F_a \cos 40^\circ$$

$$325^2 = 424.25^2 + F_a^2 - 650 F_a$$

$$F_a^2 - 650 F_a + 424.25^2 - 325^2 = 0$$

$$F_a^2 - 650 F_a + 74363.06 = 0$$

$$F_a = \frac{650 \pm \sqrt{650^2 - 4 \times 74363.06}}{2}$$

$$= 2 \times 1$$

$$P_a = F \cos 40^\circ$$

$$F = \frac{325}{\cos 40^\circ} = 424.25 \text{ N}$$

$$= \frac{650 \pm 353.62}{2}$$

$$= 501.81 \text{ or } 148.19 \text{ N}$$

$$\frac{F}{\sin(40^\circ + 65^\circ + \theta)} = \frac{F_a}{\sin(65+0)} + \frac{F_b}{\sin 40^\circ}$$

$$\frac{424.25}{\sin(105+\theta)} = \frac{325}{\sin 40^\circ}$$

$$\sin(105+\theta) = \frac{424.25 \times \sin 40^\circ}{325}$$

$$= 0.839$$

$$105+\theta = \sin^{-1} 0.839$$

$$= 57.03$$

$$\theta = 57.03 - 105$$

$$= -47.96$$

DATE

2/28

y

x

A

B

C

$$F_n = 5500 \text{ N}$$

45°

25°

$$F_n = 5500 \text{ N}$$

$$\vec{R} = \vec{F_n} + \vec{F_n}$$

$$= +5500 \sin 20^\circ i + 5500 \cos 20^\circ j + (-5500 \cos 25^\circ + 5500 \sin 25^\circ)$$

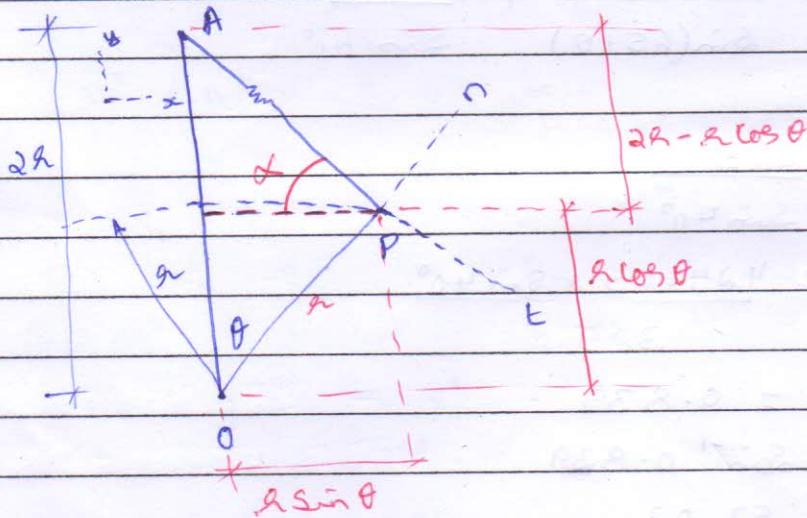
$$= 1881.11i + 5168.31j - 4984.69i + 2324.40j$$

$$= -3103.58i + 7492.71j$$

$$R = \sqrt{(-3103.58)^2 + (7492.71)^2}$$

$$= 8110.05 \text{ N}$$

2/30



$$\begin{aligned}
 AP^2 &= \ell^2 = (r \sin \theta)^2 + (2R - 2r \cos \theta)^2 \\
 &= r^2 \sin^2 \theta + (2R)^2 + (2r \cos \theta)^2 - 2 \times 2R \times 2r \cos \theta \\
 &= r^2 \sin^2 \theta + 4R^2 + 4r^2 \cos^2 \theta - 4R^2 \cos \theta \\
 &= r^2 (\sin^2 \theta + \cos^2 \theta) + 4R^2 (1 - \cos \theta) \\
 &= r^2 + 4R^2 (1 - \cos \theta) \\
 &= r^2 (1 + 4(1 - \cos \theta))
 \end{aligned}$$

$$\delta = AP - \ell$$

$$\tan \alpha = \frac{2\lambda - 2 \cos \theta}{\lambda \sin \theta}$$

$$= \frac{\lambda(2 - \cos \theta)}{\lambda \sin \theta}$$

$$\tan \alpha = \frac{2 - \cos \theta}{\sin \theta}$$

$$F_x = -F \cos \alpha$$

$$F_y = F \sin \alpha$$

when $\lambda = 400 \text{ mm}$, $K = 1.4 \text{ kN/m}$, $\theta = 40^\circ$

$$AP^2 = (400)^2 (1 + 4(1 - \cos 40^\circ)) \\ = 309731.56$$

$$AP = 556.53 \text{ mm}$$

$$F = K \delta$$

$$= 1.4 \times \frac{556.53 - 400}{1000}$$

$$= 0.28 \text{ kN}$$

$$\tan \alpha = \frac{2 - \cos 40^\circ}{\sin 40^\circ}$$

$$\tan \alpha = 1.919$$

$$\alpha = 62.48^\circ$$

$$F_x = -0.28 \times \cos 62.48$$

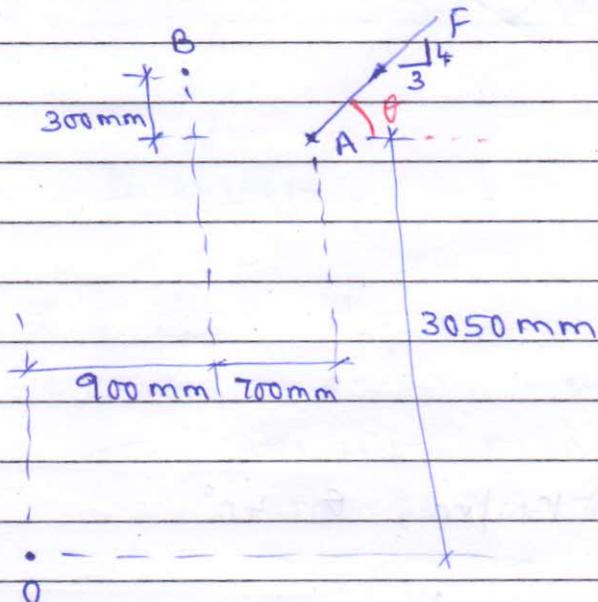
$$= -0.101 \text{ kN}$$

$$F_y = 0.28 \times \sin 62.48$$

$$= 0.195 \text{ kN}$$

Moments2/35

$$F = 225 \text{ N}$$



$$\tan \theta = \frac{4}{3}$$

$$\theta = \tan^{-1} \frac{4}{3}$$

$$= 53.13^\circ$$

$$M_0 = F_x \times y - F_y \times x$$

$$= (225 \cos 53.13) \times \frac{3050}{1000} - 225 \sin 53.13 \times \frac{(900+700)}{1000}$$

$$= 411.75 - 287.99$$

$$= 123.75 \text{ N-m} \quad \text{CCW}$$

$$M_B = -F_x \times h_1 - F_y \times x_1$$

$$= -225 \cos 53.13 \times \frac{300}{1000} - 225 \sin 53.13 \times \frac{700}{1000}$$

$$= -40.50 - 125.99$$

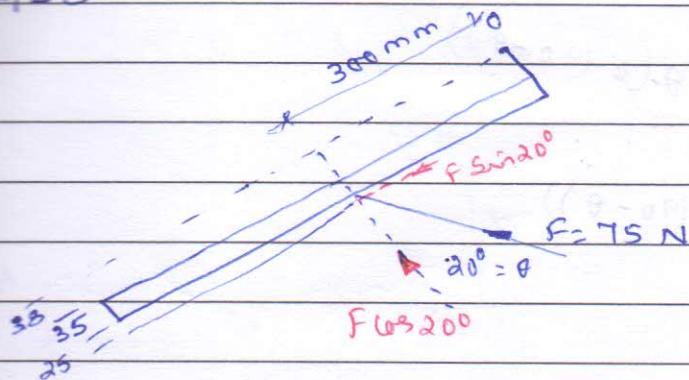
$$= -166.50 \text{ N-m}$$

$$M_C = 0 \Rightarrow M_0 = F_y \times x_2$$

$$x_2 = 123.75 / 225 \sin 53.13 = 0.69 \text{ m}$$

from left of 0

2/38



$$\begin{aligned}
 M_0 &= -F \sin \theta \times (38 + 35 + 25) - F \cos \theta (300) \\
 &= -75 \times \sin 20^\circ \left(\frac{98}{1000} \right) - 75 \times \cos 20^\circ \left(\frac{300}{1000} \right) \\
 &= -2.51 - 21.14 \\
 &= -23.65 \text{ N-m}
 \end{aligned}$$

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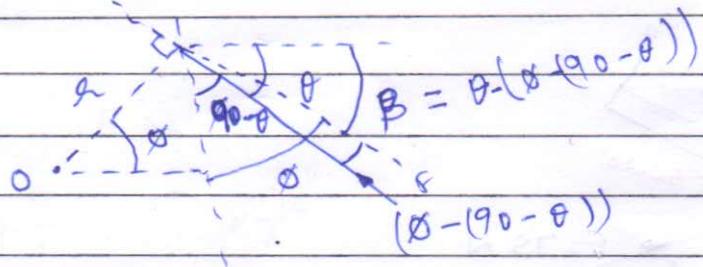
$$\begin{aligned}
 M_C &= -150 \times 125 \\
 &= -18750 \text{ N-mm} \\
 &= -18.750 \text{ N-m}
 \end{aligned}$$

For moment about point P to be zero, the force should pass through point P

$$\begin{aligned}
 M_C &= -T \cos \theta \times 200 \\
 -18750 &= -150 \times \cos \theta \times 200 \\
 \cos \theta &= \frac{-18750}{-30000} \\
 &= 0.625 \\
 \theta &= \cos^{-1}(0.625) \\
 &= 51.32^\circ
 \end{aligned}$$

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$$\beta = \theta - (\alpha - (90^\circ - \theta))$$

$$= \theta - \alpha + 90^\circ + \theta$$

$$= 2\theta - \alpha + 90^\circ$$

$$M_0 = F \cos(\alpha - (90^\circ - \theta)) \times a$$

$$= F \cos(-90^\circ + \theta + \alpha) \times a$$

$$M_0 = 500 \times \cos(-90^\circ + 60^\circ + 20^\circ) \times 0.4$$

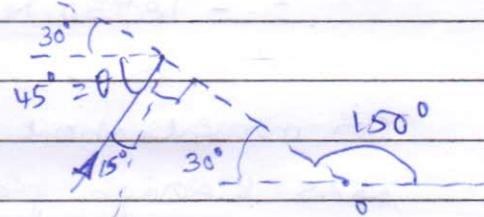
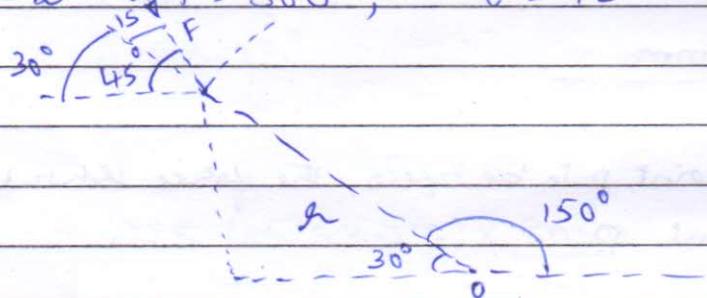
case 1

$$= -500 \times \cos(90^\circ - 60^\circ - 20^\circ) \times 0.4$$

$$= -196.96 \text{ N-m} \checkmark$$



Case 2 $F = 800$, $\theta = 45^\circ$, $\alpha = 150^\circ$



$$M_0 = F \sin \alpha \sin 15^\circ \times a$$

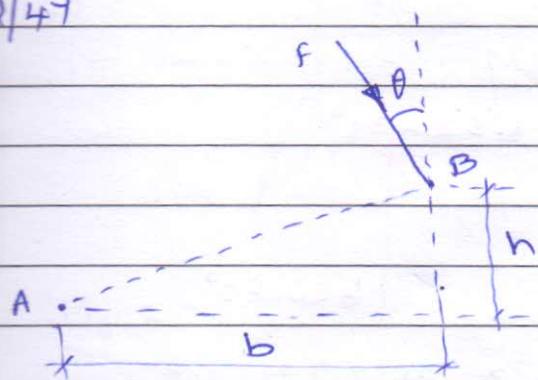
$$= 800 \sin 15^\circ \times 0.4$$

$$= 82.82 \text{ N-m} \checkmark$$

$$M_0 = 800 \cos(150^\circ - (90^\circ - 45^\circ)) \times 0.4$$

$$= -82.82 \text{ N-m}$$

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$$M_A = -F \cos \theta \times b - F \sin \theta \times h$$

Max M_A will be when $\frac{dM_A}{d\theta} = 0$

$$\frac{dM_A}{d\theta} = -Fb \sin \theta - Fh (-\cos \theta) = 0$$

$$Fh \cos \theta = Fb \sin \theta$$

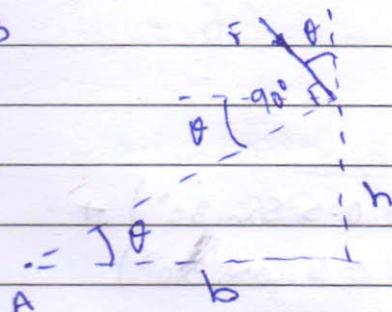
$$\frac{\sin \theta}{\cos \theta} = \frac{Fh}{Fb}$$

$$\tan \theta = \frac{h}{b}$$

$$\theta = \tan^{-1} \left(\frac{h}{b} \right)$$

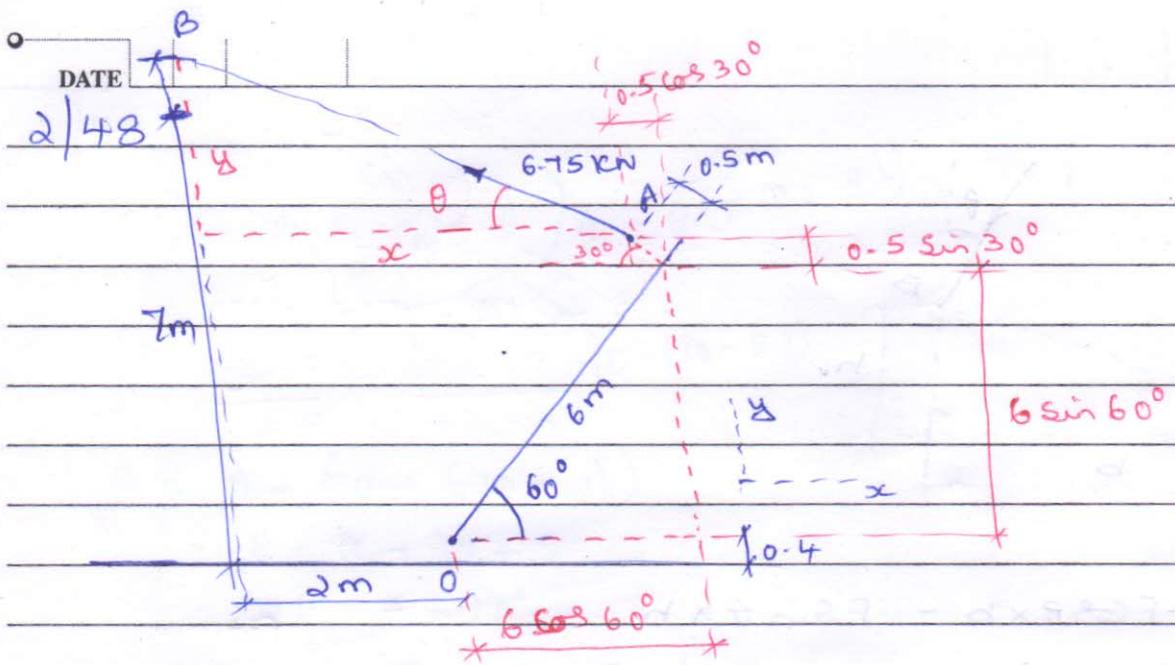
Alternatively

For M_A to be max the force should act \perp to the line AB



$$\tan \theta = \frac{h}{b}$$

$$\theta = \tan^{-1} \left(\frac{h}{b} \right)$$



$$\tan \theta = \frac{y}{x}$$

$$y = 7 - 0.4 - 6 \sin 60^\circ - 0.5 \sin 30^\circ \\ = 1.15 \text{ m}$$

$$x = 2 + 6 \cos 60^\circ - 0.5 \cos 30^\circ \\ = 4.57 \text{ m}$$

$$\therefore \theta = \tan^{-1} \frac{1.15}{4.57}$$

$$= 14.13^\circ$$

$$F_x = -6.75 \cos 14.13$$

$$= -6.55 \text{ kN}$$

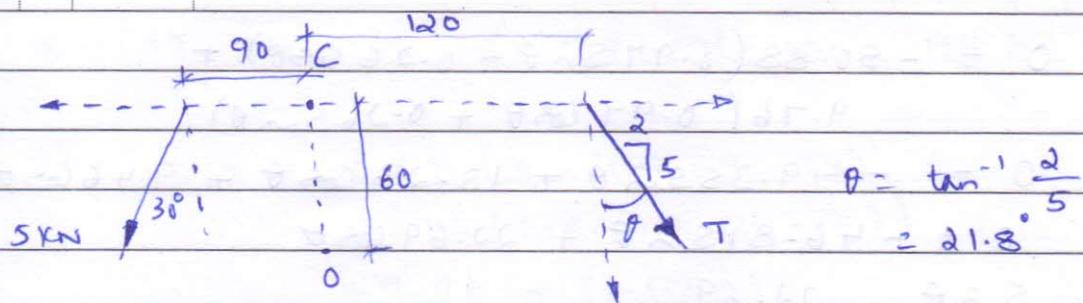
$$F_y = 6.75 \sin 14.13$$

$$= 1.65 \text{ kN}$$

$$M_0 = +6.55(6 \sin 60^\circ + 0.5 \sin 30^\circ) + \\ 1.65(6 \cos 60^\circ - 0.5 \cos 30^\circ) \\ = 35.67 + 4.24 \\ = 39.91 \text{ kN-m}$$

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$$M_0 = 0$$

$$+ T \cos \theta \times 120 + T \sin \theta \times 60 = 5 \cos 30^\circ \times 90 + 5 \sin 30^\circ \times 60$$

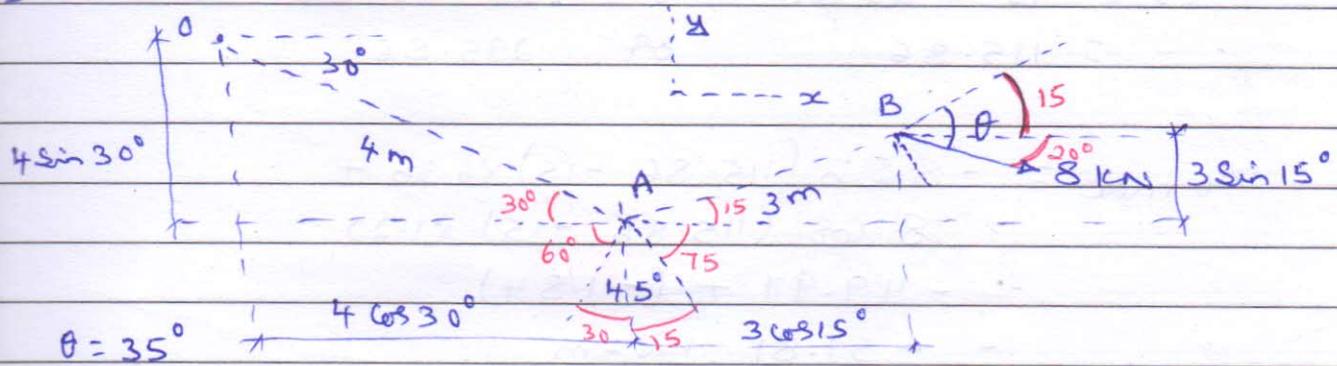
$$T \cos 21.8^\circ \times 120 + T \sin 21.8^\circ \times 60 = 389.71 + 150$$

$$111.42 T + 22.28 T =$$

$$133.70 T = 539.71$$

$$T = 4.04 \text{ kN}$$

2/55



$$\begin{aligned} M_0 &= -8 \sin 20^\circ \times (4 \cos 30^\circ + 3 \cos 15^\circ) + 8 \cos 20^\circ \times (4 \sin 30^\circ - 3 \sin 15^\circ) \\ &= -17.40 + 9.17 \\ &= -8.23 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_A &= -8 \sin 20^\circ \times 3 \cos 15^\circ - 8 \cos 20^\circ \times 3 \sin 15^\circ \\ &= -7.93 - 5.84 \\ &= -13.76 \text{ kNm} \end{aligned}$$

$$\frac{dM_0}{d\theta} = 0 \Rightarrow \text{Maximum} \quad M_0 = 0 \Rightarrow \text{Minimum}$$

$$\begin{aligned} M_0 &= -8 \sin (\theta - 15^\circ) \times (4 \cos 30^\circ + 3 \cos 15^\circ) + \\ &\quad 8 \cos (\theta - 15^\circ) \times (4 \sin 30^\circ - 3 \sin 15^\circ) \\ &= -8(\sin \theta \cos 15^\circ - \cos \theta \sin 15^\circ) \times 6.36 + 8(\cos \theta \cos 15^\circ + \sin \theta \sin 15^\circ) \end{aligned}$$

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$$0 = -50.88(0.97 \sin \theta - 0.26 \cos \theta) + \\ 9.76(0.97 \cos \theta + 0.26 \sin \theta)$$

$$0 = -49.35 \sin \theta + 13.23 \cos \theta + 9.46 \cos \theta + 2.54 \sin \theta$$

$$0 = -46.81 \sin \theta + 22.69 \cos \theta$$

$$\frac{\sin \theta}{\cos \theta} = \frac{22.69}{46.81}$$

$$\tan \theta = 0.48$$

$$\theta = 25.86^\circ$$

$$\therefore M_{0\text{ min}} = -8 \sin(25.86 - 15) \times 6.36 + 8 \cos(25.86 - 15) \times 1.22$$

$$= -1.51 \times 6.36 + 7.86 \times 1.22$$

$$= -9.59 + 9.58$$

$$\therefore 0$$

For M_0 to be max force

$$\theta = 90^\circ + 25.86 \quad \text{or} \quad 270 + 25.86$$

$$= 115.86 \quad \text{or} \quad 295.86$$

$$\therefore M_{0\text{ max}} = -8 \sin(115.86 - 15) \times 6.36 + \\ 8 \cos(115.86 - 15) \times 1.22 \\ = -49.97 + (-1.84) \\ = -51.81 \text{ kN-m}$$

$$M_{0\text{ max}} = -8 \sin(295.86 - 15) \times 6.36 + \\ 8 \cos(295.86 - 15) \times 1.22 \\ = +49.97 + 1.84 \\ = +51.81 \text{ kN-m}$$

$$M_0 = -50.88 \sin(\theta - 15) + 9.76 \cos(\theta - 15)$$

$$0 = dM_0 = -50.88 \cos(\theta - 15) + 9.76(-\sin(\theta - 15)) \\ d\theta$$

$$= -50.88(\cos \theta \cos 15 + \sin \theta \sin 15) \\ - 9.76(\sin \theta \cos 15 - \cos \theta \sin 15)$$

$$= -49.15 \cos \theta - 13.17 \sin \theta - 9.43 \sin \theta + 2.53 \cos \theta$$

$$0 = -46.63 \cos \theta - 22.61 \sin \theta$$

$$\frac{\sin \theta}{\cos \theta} = -46.63/22.61 = -2.06 \Rightarrow \theta = \tan^{-1}(-2.06) = -64.10^\circ$$

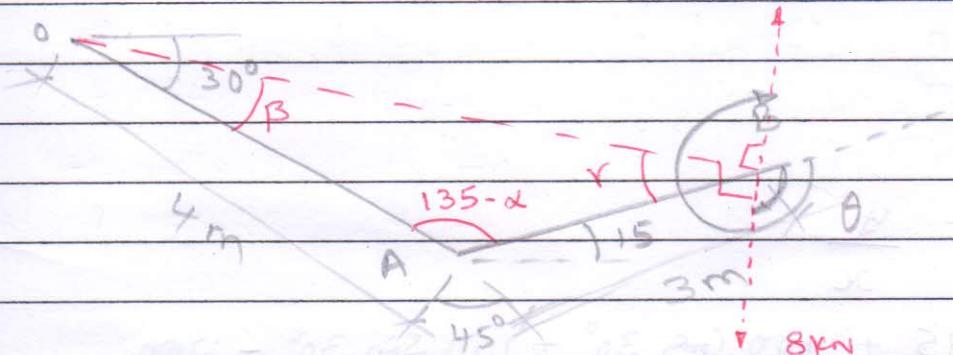
$$\theta = 360 - 64.10 = 295.89^\circ$$

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$$\therefore \theta = 295.89^\circ \text{ or } \theta = 295.89^\circ - 180 = 115.89^\circ$$

$$\begin{aligned}\therefore M_{\text{max}} &= -50.88 (\sin(115.89 - 15)) \\ &\quad + 9.76 (\cos(115.89 - 15)) \\ &= -49.96 + (-1.84) \\ &= -51.8 \text{ kN-m}\end{aligned}$$

$$\begin{aligned}M_{\text{max}} &= -50.88 \times \sin(295.89 - 15) \\ &\quad + 9.76 \times \cos(295.89 - 15) \\ &= +49.96 + 1.84 \\ &= +51.81 \text{ kN-m}\end{aligned}$$



Cosine rule

$$\begin{aligned}OB^2 &= OA^2 + AB^2 - 2 \cdot OA \cdot AB \cos \alpha \\ &= 4^2 + 3^2 - 2 \times 4 \times 3 \times \cos 135^\circ \\ &= 41.97\end{aligned}$$

$$OB = 6.48 \text{ m}$$

Sin rule

$$\frac{OA}{\sin r} = \frac{OB}{\sin \alpha}$$

$$\sin r = \frac{OA \sin \alpha}{OB}$$

$$= \frac{4 \times \sin 135^\circ}{6.48}$$

$$\sin r = 0.436$$

$$r = 25.88^\circ$$

$$\theta = 180 - (90 - r)$$

$$\begin{aligned}&= 180 - (90 - 25.88^\circ) \\ &= 115.88^\circ\end{aligned}$$

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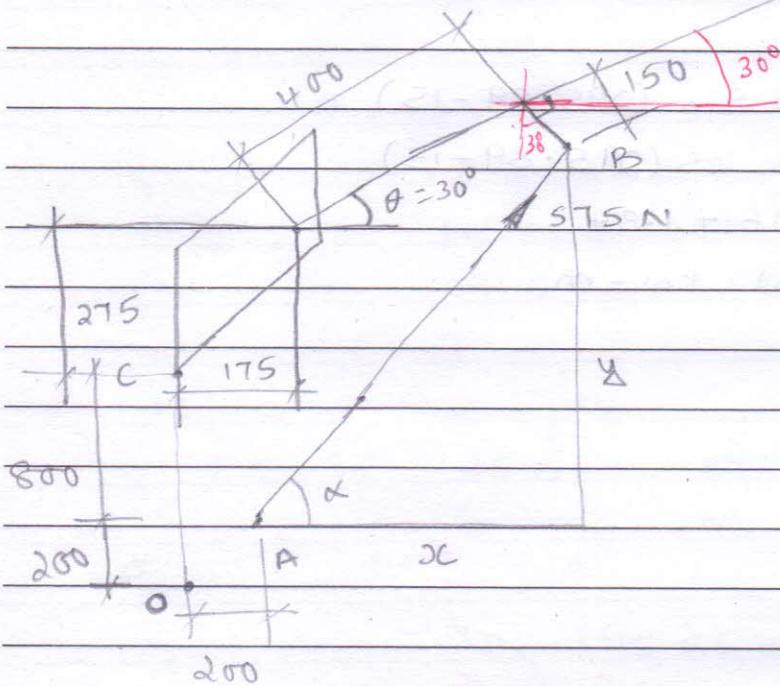
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$$C = 575 \text{ N}$$

$$\theta = 30^\circ$$

$$M_B = ?$$

$$M_C = ?$$



$$\tan \alpha = \frac{y}{x}$$

$$x = 175 + 400 \cos 30^\circ + 150 \sin 30^\circ - 200 \\ = 396.41 \text{ mm}$$

$$y = 800 + 275 + 400 \sin 30^\circ - 150 \cos 30^\circ \\ = 1145.10 \text{ mm}$$

$$\therefore \alpha = \tan^{-1} \frac{1145.10}{396.41} \\ = 70.90^\circ$$

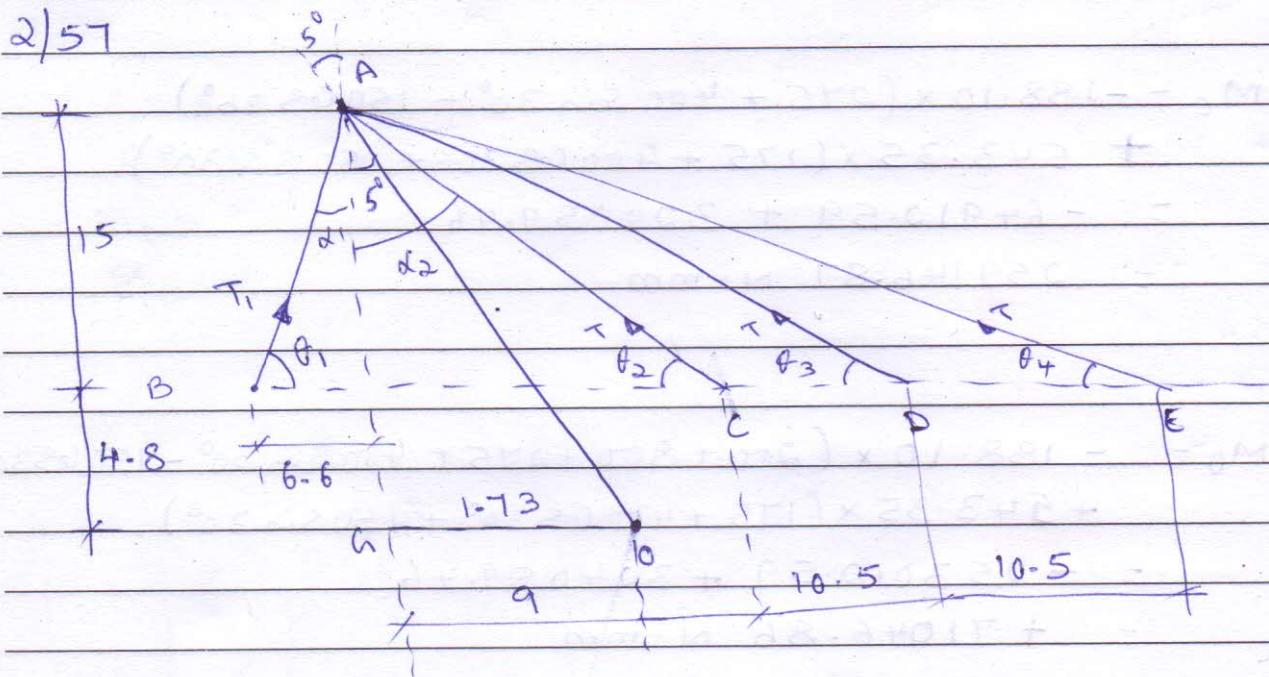
$$F_x = 575 \times \cos 70.90 \\ = 188.10 \text{ N}$$

$$F_y = 575 \times \sin 70.90 \\ = 543.35 \text{ N}$$

$$\begin{aligned}M_c &= -188.10 \times (275 + 400 \sin 30^\circ - 150 \cos 30^\circ) \\&\quad + 543.35 \times (175 + 400 \cos 30^\circ + 150 \sin 30^\circ) \\&= -64912.59 + 324059.46 \\&= 259146.87 \text{ N-mm}\end{aligned}$$

$$\begin{aligned}M_0 &= -188.10 \times (200 + 800 + 275 + 400 \sin 30^\circ - 150 \cos 30^\circ) \\&\quad + 543.35 \times (175 + 400 \cos 30^\circ + 150 \sin 30^\circ) \\&= -253012.59 + 324059.46 \\&= +71046.86 \text{ N-mm}\end{aligned}$$

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$$\tan 5^\circ = \frac{h_0}{AC}$$

$$\begin{aligned} h_0 &= AC \times \tan 5^\circ \\ &= 19.8 \times \tan 5^\circ \\ &= 1.73 \text{ m} \end{aligned}$$

$$\tan \theta_1 = \frac{15}{6.6}$$

$$\theta_1 = 66.25^\circ$$

$$\tan \theta_2 = \frac{15}{9}$$

$$\theta_2 = 59.04^\circ$$

$$\tan \theta_3 = \frac{15}{(9+10.5)}$$

$$\theta_3 = 37.56^\circ$$

$$\tan \theta_4 = \frac{15}{(9+10.5+10.5)}$$

$$\theta_4 = 26.57^\circ$$

$$M_0 = 0$$

$$+ T_1 \sin \theta_1 (6.6 + 1.73) + T_1 \cos \theta_1 (4.8) = \\ T \sin \theta_2 (9 - 1.73) + T \cos \theta_2 \times 4.8 + \\ T \sin \theta_3 (9 - 1.73 + 10.5) + T \cos \theta_3 \times 4.8 + \\ T \sin \theta_4 (9 - 1.73 + 10.5 + 10.5) + T \cos \theta_4 \times 4.8$$

$$\Rightarrow T_1 (8.33 \times \sin 66.25 + 4.8 \times \cos 66.25) = \\ T [7.27 \times \sin 59.04 + 4.8 \times \cos 59.04 + \\ 17.27 \times \sin 37.56 + 4.8 \times \cos 37.56 + \\ 28.27 \times \sin 26.57 + 4.8 \times \cos 26.57]$$

$$9.56 T_1 = 39.97 T$$

$$T_1 = \frac{39.97 T}{9.56}$$

$$T_1 = 4.18 T \quad (4.21 T)$$

compression P

$$\alpha_1 = 90 - \theta_1 = 90 - 66.25 = 23.75$$

$$\alpha_2 = 90 - 59.04 = 30.96$$

$$\alpha_3 = 90 - 37.56 = 52.44$$

$$\alpha_4 = 90 - 26.57 = 63.43$$

$$P = T_1 \cos (\alpha_1 + 5^\circ) + T \cos (\alpha_2 - 5) + T \cos (\alpha_3 - 5) + T \cos (\alpha_4 - 5) \\ = 4.18 T \cos (23.75 + 5) + T [\cos (30.96 - 5) + \cos (52.44 - 5) + \\ \cos (63.43 - 5)] \\ = 3.66 T + T [2.099]$$

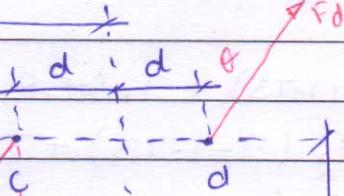
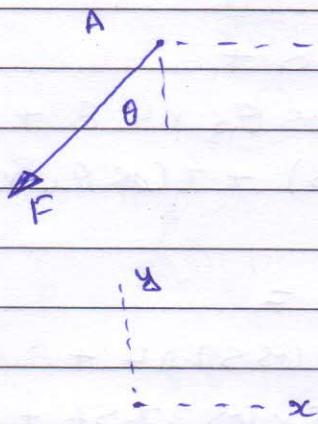
$$= 5.76 T \quad (5.79 T)$$

DATE

2/68

+

b



$$F = 425 \text{ N}$$

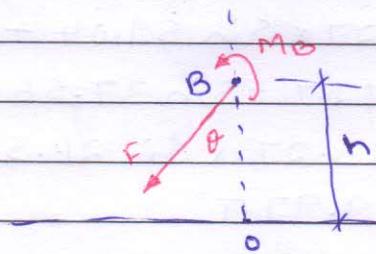
$$\theta = 30^\circ$$

$$b = 1.9 \text{ m}$$

$$d = 0.2 \text{ m}$$

$$l = 0.8 \text{ m}$$

$$h = 2.75 \text{ m}$$



$F_B = F \text{ @ } \theta \text{ from vertical cw below horizontal}$

$$M_B = F \cos \theta \times b + F \sin \theta \times (l - h)$$

$$= 425 \times \cos 30^\circ \times 1.9 + 425 \times \sin 30^\circ \times (2.75 - 0.8)$$

$$=$$

$$F_C - F_d = F$$

$$F_C = 425 + F_d \quad \text{--- (1)}$$

$$M_A = 0$$

$$-F_C \cos \theta (b-d) + F_d \cos \theta (b+d) = 0 \quad \text{--- (2)}$$

$$-(425 + F_d) \cos \theta (b-d) + F_d \cos \theta (b+d) = 0$$

$$-425 \cos \theta b + 425 \cos \theta d + F_d \cos \theta d - F_d \cos \theta b + F_d \cos \theta b + F_d \cos \theta d$$

$$-425 \cos 30^\circ \times 1.9 + 425 \cos 30^\circ \times 0.2 + F_d \cos 30^\circ \times 0.2$$

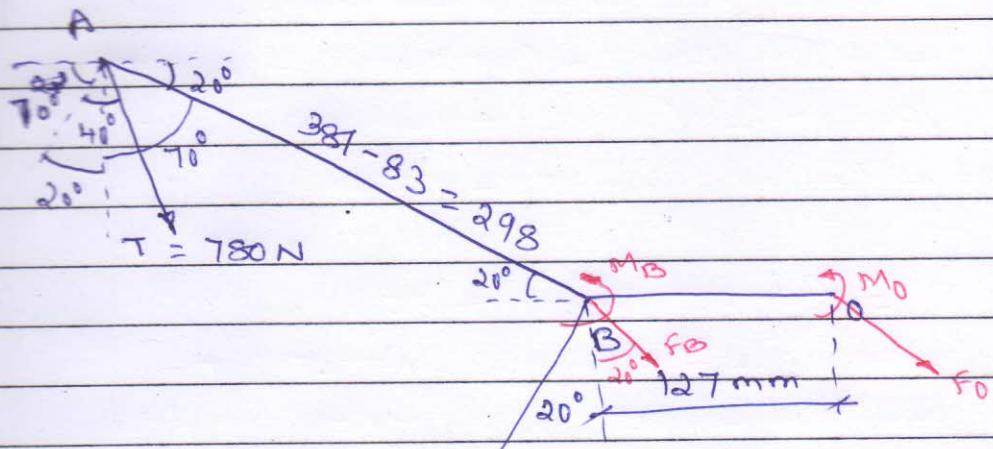
$$-F_d \cos 30^\circ \times 1.9 + F_d \cos 30^\circ \times 1.9 + F_d \cos 30^\circ \times 0.2$$

$$F_d \cos 30^\circ \times 0.2 \times 2 = 425 \cos 30^\circ (1.9 - 0.2)$$

$$F_d = \frac{425 \times 1.7}{0.4} = 1806.25 \text{ N}$$

$$F_C = 425 + 1806.25 = 2231.25 \text{ N}$$

2|70



$$F_B = 780 \text{ N} @ 240^\circ \text{ from positive } x\text{-axis}$$

$$\begin{aligned} M_B &= 780 \times \cos 40^\circ \times (381 - 83) \\ &= 178059.37 \text{ N-mm} \end{aligned}$$

$$F_O = 780 \text{ N} @ 240^\circ \text{ from positive } x\text{-axis}$$

$$\begin{aligned} M_O &= 780 \times \sin 70^\circ \times 127 + 178059.37 \\ &= 93085.95 \text{ N-mm} + 178059.37 \\ &= 271145.32 \text{ N-mm} \end{aligned}$$

2|72

$$F_B = 20 \text{ N} @ 25^\circ \text{ from positive } x\text{-axis}$$

$$\begin{aligned} M_B &= 20 \cos 25^\circ \times 102 + 20 \sin 25^\circ \times (154 - 102) \\ &= 1848.86 + 1081.90 \\ &= 2930.76 \text{ N-mm} \end{aligned}$$