Roll no:- 2150.

Modern College of Engineering

Shivajinagar, Pune 5.

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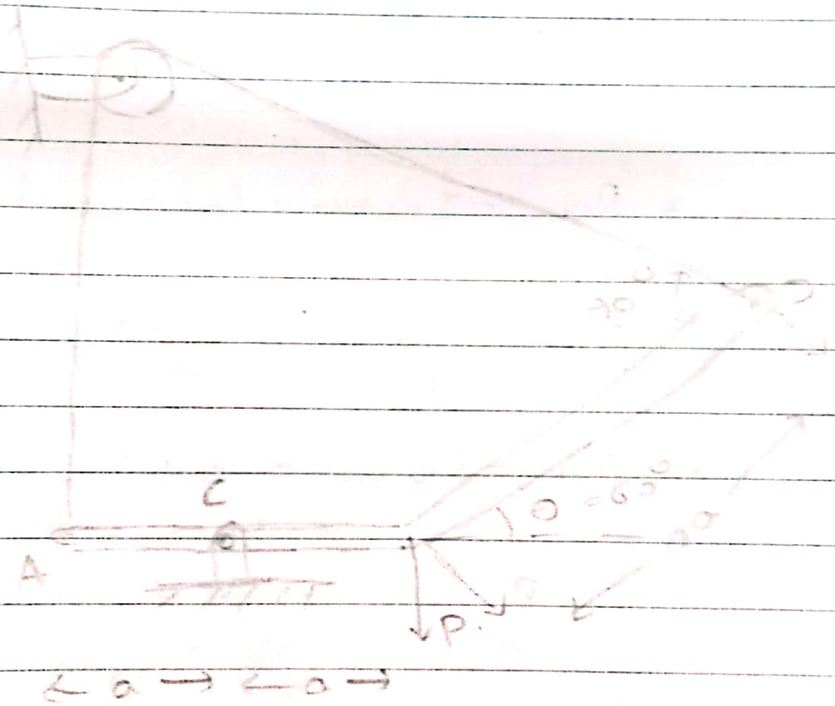
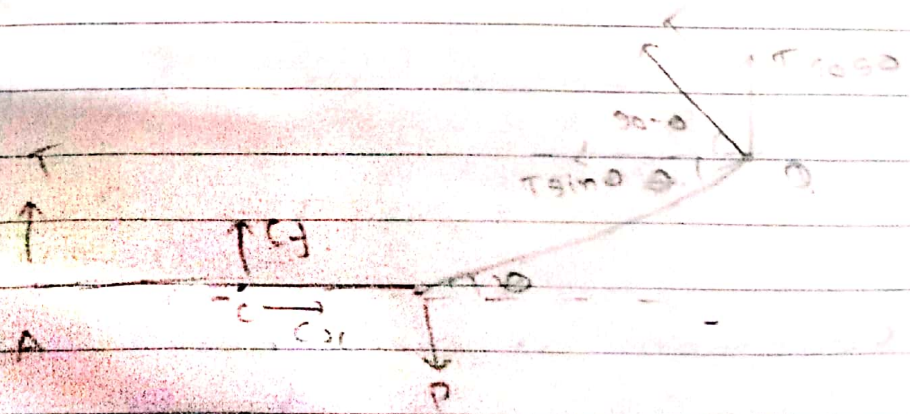
Assignment - 3.

1] Neglecting friction, determine the tension in cable ABD and the reaction at C when $\theta = 60^\circ$.



Soln.



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$$\Sigma M_C = 0.$$

$$Ta + Pa - T\sin 30 \times 2a - T\cos 30 \times 2a\sin 60 = 0$$

$$\cancel{T}a + Pa - \cancel{T}a - T \times \frac{\sqrt{3}}{2} \times \cancel{2}a \times \frac{\sqrt{3}}{\cancel{2}} = 0$$

$$Pa - \frac{3Ta}{2} = 0$$

$$\therefore Pa = 3$$

$$Ta + Pa - T\cos\theta \times (a + 2a\cos\theta) - T\sin\theta \times 2a\sin\theta = 0.$$

$$Ta + Pa - Ta\cos\theta - 2Ta\cos^2\theta - 2Ta\sin^2\theta = 0$$

$$Ta + Pa - Ta\cos\theta - 2Ta \times 1 = 0$$

$$P\cancel{a} = T\cancel{a}\cos\theta + 2T\cancel{a} - T\cancel{a}$$

$$\therefore P = T(\cos\theta + 2 - 1)$$

$$\therefore P = T(\cos\theta + 1)$$

$$\therefore T = \frac{P}{(\cos\theta + 1)}$$

$\therefore$ tension in cable ABD is

$$T = \frac{P}{(\cos\theta + 1)}$$

Reaction at C, when $\theta = 60^\circ$ is

$$T = \frac{2P}{3}$$

$\therefore \quad \Sigma F_x = 0.$

$-T\sin\theta + C_x = 0.$

$\therefore \quad C_x = T\sin 60$

$= T\frac{\sqrt{3}}{2}.$

but, $T = \frac{2P}{3}$

$\therefore \quad C_x = \frac{\cancel{2}P}{3} \times \frac{\sqrt{3}}{\cancel{2}}$

$= \frac{P}{\sqrt{3}}$

$\Sigma F_y = 0$

$\therefore \quad T + \frac{T}{2} + C_y - P = 0$

$\frac{3T}{2} + C_y = P$

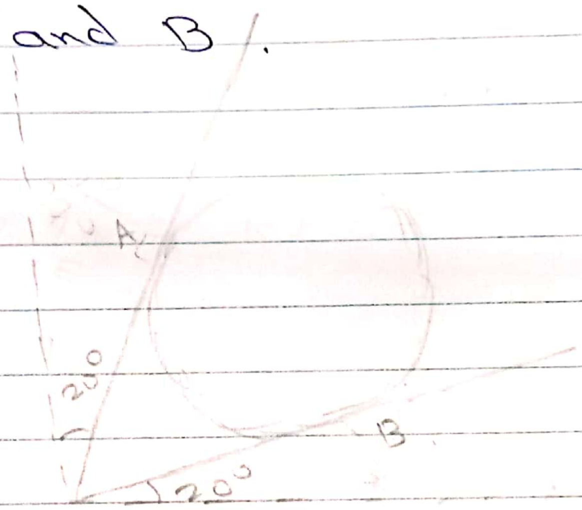
$\frac{\cancel{3}}{2_1} \times \frac{\cancel{2}P}{\cancel{3}} + C_y. = P$

$\therefore \quad C_y = P - P$

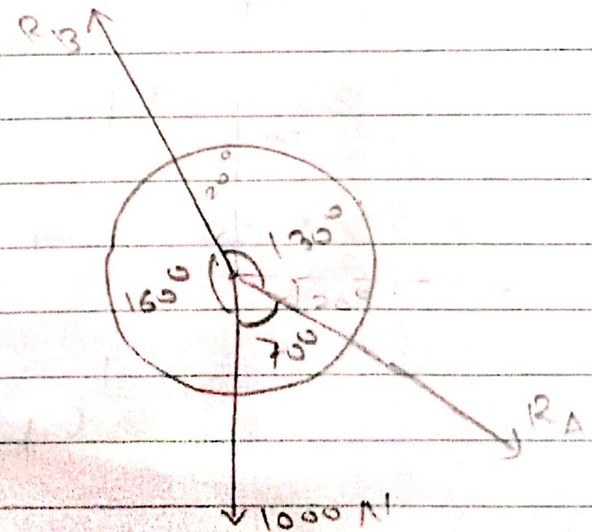
$\therefore \quad C_y = 0.$

$\therefore$ Reaction at C, when $\theta = 60^\circ$ is, $\frac{P}{\sqrt{3}}$.

2) A Cylinder of mass 100 kg rest between the inclined plane as shown in fig. Determine the normal reaction at A and B.



Soln.



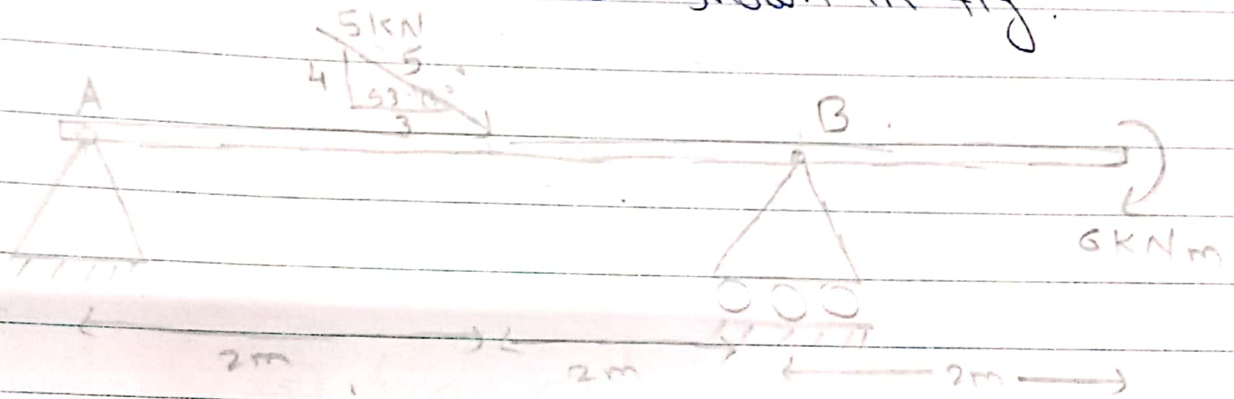
∴ By sine rule.

$$\frac{R_B}{\sin 70^\circ} = \frac{R_A}{\sin(160^\circ)} = \frac{1000}{\sin(130^\circ)} = 1305.407$$

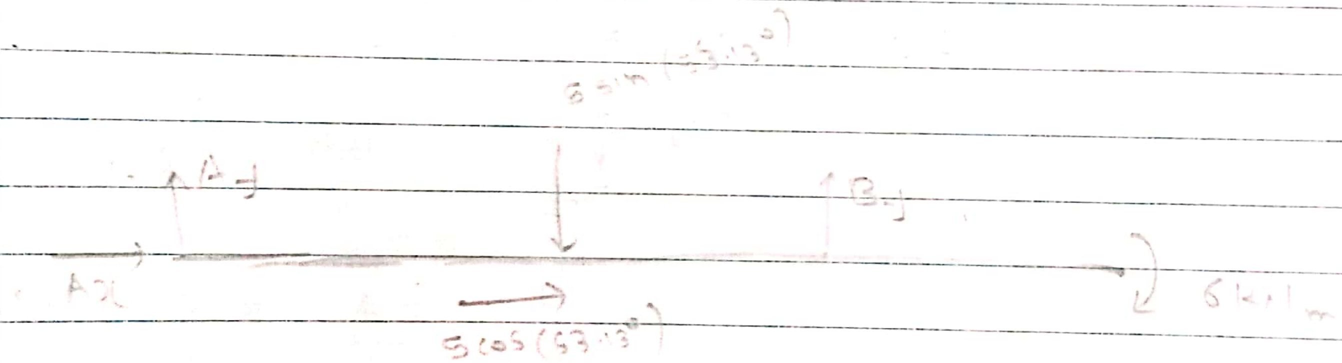
∴ $R_B = \sin 70^\circ \times 1305.407$, and $R_A = \sin 160^\circ \times 1305.407$

$= 1226.681\ N$ $\quad R_A = 446.475 N$

3] Determine the horizontal and vertical components of reaction at the supports for the beam as shown in fig.



Soln.



$\Sigma F_x = 0.$

$\therefore A_x + 5\cos(53.13^\circ) = 0.$

$\therefore \underline{A_x} = -3\ kN.$

$\Sigma F_y = 0.$

$\therefore A_y - 5\sin(53.13^\circ) + B_y = 0. \quad -(1)$

$\therefore$

$\Sigma M_c = 0.$

$\therefore A_y 6 - 5\sin(53.13^\circ)\times 4 + 2B_y + 6 = 0$

$\therefore 6A_y - 16 + 6 + 2B_y = 0$

$\therefore 6A_y + 2B_y - 10 = 0$

$\therefore 3A_y + B_y - 5 = 0$

$\therefore B_y = 5 - 3A_y$ — (2)

from (1) and (2)

$A_y - 4 + 5 - 3A_y = 0.$

$-2A_y + 1 = 0.$

$\frac{1}{2} = A_y.$

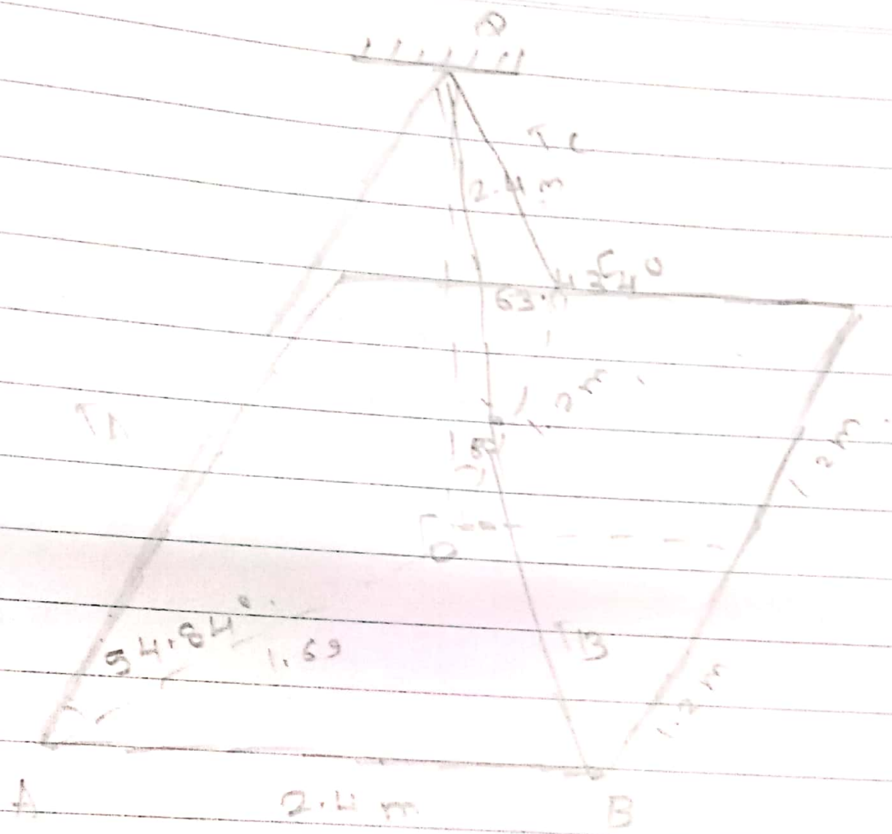
$\therefore \underline{A_y} = 0.5 \text{ KN}.$

$\therefore \underline{B_y} = 5 - 3\times 0.5$

$= 5 - 1.5$

$\therefore \underline{B_y} = 3.5 \text{ KN}$

4]. The square steel plate has a mass of 1800 kg with mass center G as shown in Fig. Determine the tension in each cable so that the plate remains horizontal.



Sol^n:

$T_A = T_B$ [by symmetry]

$\Sigma F_x = 0.$

$2T_A \cos(54.84^\circ)\cos(45^\circ) = T_C \cos(63.434^\circ)$

$T_A = T_C\, 0.5491$

$\Sigma F_y = 0.$

$2T_A \sin 54.84^\circ + T_C \sin(63.434^\circ) = 16000$

$\therefore 2T_C\, 0.5491 + T_C\, 0.894 = 16000.$

$T_C\, 1.9922 = 16000$

$\therefore T_C = 9035.2374\ N$

$= 9.035\ kN$

$\therefore T_A = 9.035 \times 0.5491$

$= 4.9611\ kN.$

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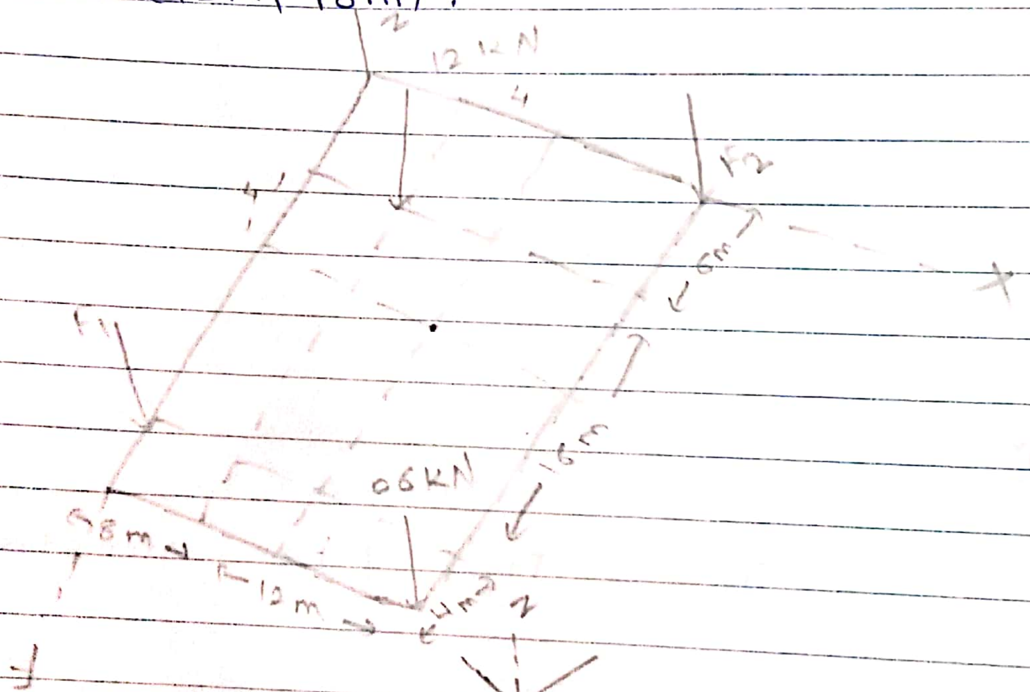
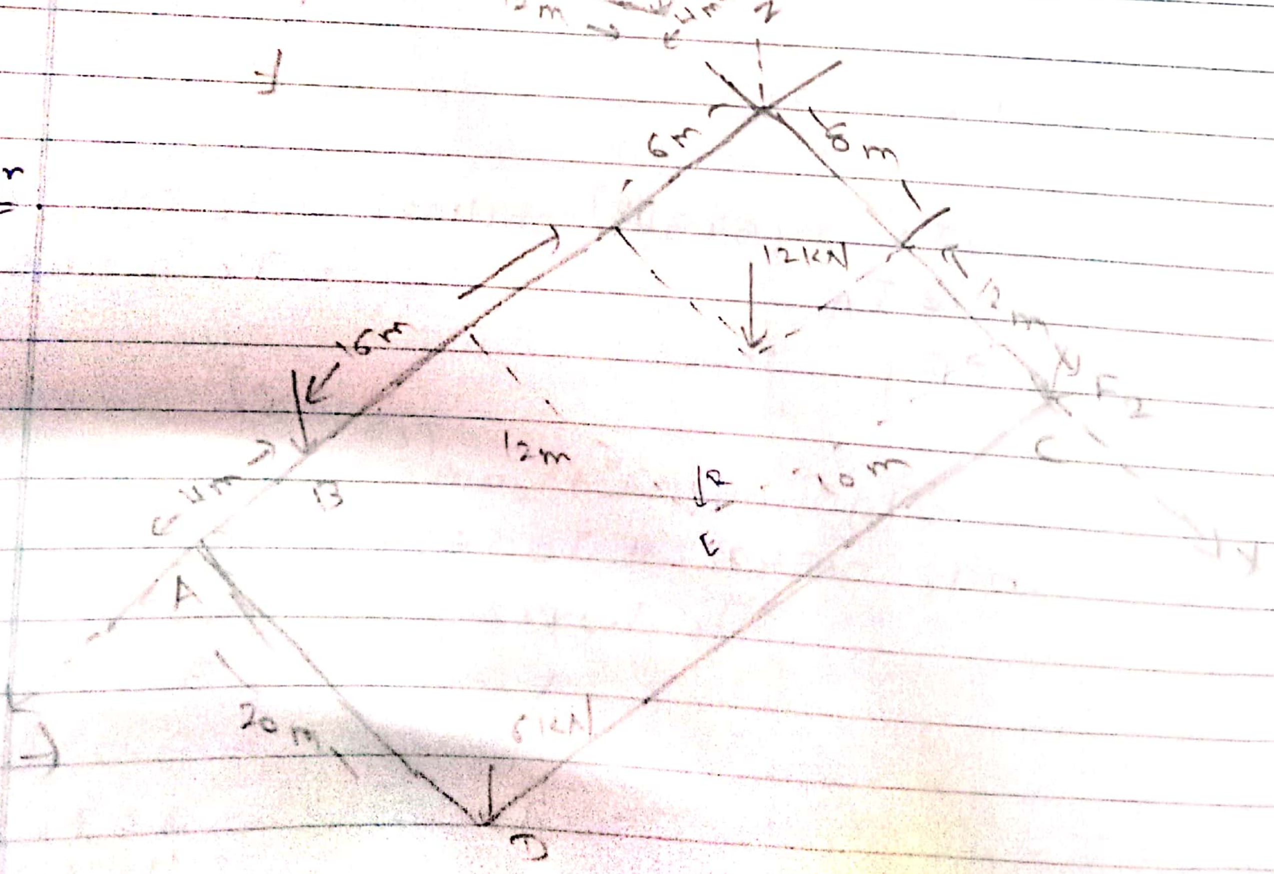
5. The building slab is subjected to four parallel column loading shown in Fig. Determine F_1 and F_2 if the result force acts through point (12m, 10m).



Sol^n



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II) $\overline{F_A} = -12\hat{k}$

$\overline{F_B} = -F_1\hat{k}$.

$\overline{F_C} = -F_2\hat{k}$.

$\overline{F_D} = -6\hat{k}$.

III) As R is acting at point

$\therefore \Sigma M_E = 0$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -4 & -4 & 0 \\ 0 & 0 & -12 \end{vmatrix}_A + \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -12 & 12 & 0 \\ 0 & 0 & -F_1 \end{vmatrix}_B +$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & -10 & 0 \\ 0 & 0 & -F_2 \end{vmatrix}_C + \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & 16 & 0 \\ 0 & 0 & -6 \end{vmatrix}_D = 0$$

iv) ($\hat{i}$ - comp)

$48 - 12F_1 + 10F_2 - 96 = 0$

$-12F_1 + 10F_2 = 48$ -- (1)

($\hat{j}$ - comp)

$\therefore 48 + 12F_1 - 8F_2 - 48 = 0$

$\therefore -12F_1 - 8F_2 = 0$ -- (2)

v) $-12F_1 + 10F_2 = 48$ - (1)

$-1 \quad -12F_1 - 8F_2 = 0$ (2)

$+ \qquad \quad 18F_2 = 48$

$\therefore F_2 = \cancel{24}^{2.66} kN$

$\therefore F_1 = \cancel{16 kN} - \frac{8F_2}{12} = \frac{-8 \times 2.66}{12}$

$= -1.7733\ kN$

$$\therefore \boxed{\begin{array}{l} F_1 = \cancel{16kN}\ -1.7733\ kN \\ F_2 = \cancel{24kN}\ 2.66\ kN \end{array}}$$

— II —

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