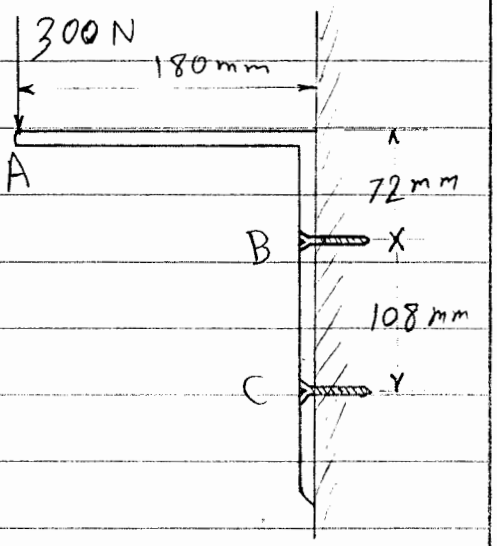
CE 201-9 (061)
Solution of HW # 6

Problem # 1



Given: The system shown in the figure.

Required: a) replace the 300-N force by an equivalent force-couple system at B;

b) find the two horizontal forces at B & C which are equivalent to the couple obtained in part (a)

Solution

a) The force 300 N can be replaced by the same force 300 & couple

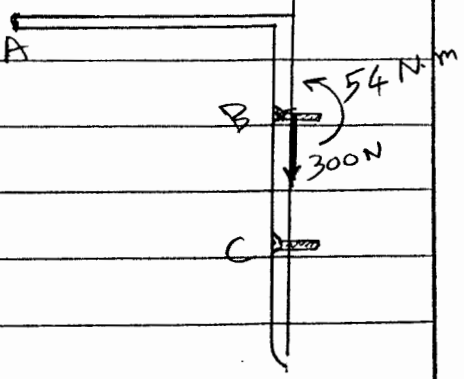
$\curvearrowleft + M = 300 \times 0.18 = 54$ N.m as shown in the figure below.

b) The horizontal forces at B & C are

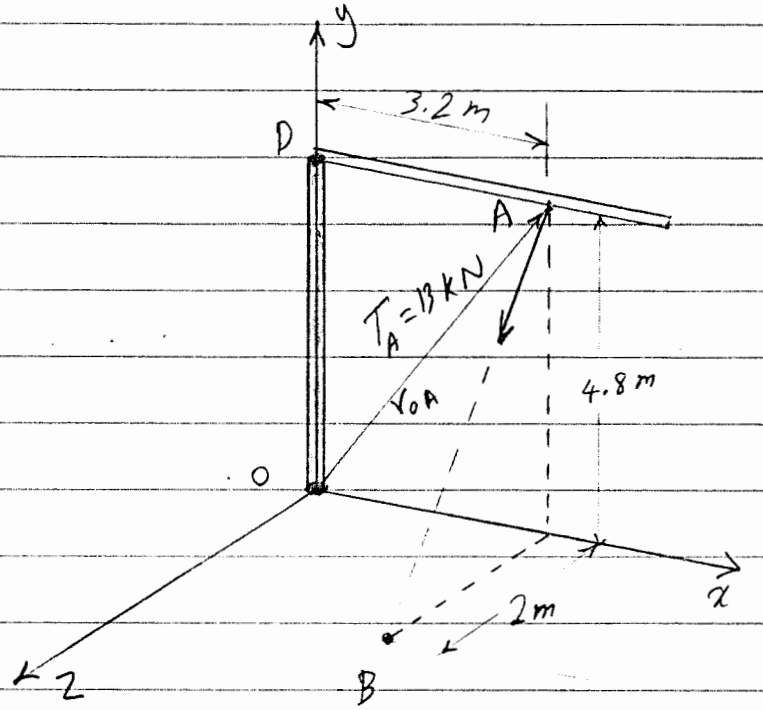
$F_B \times 0.108 = M \Rightarrow F_B \times 0.108 = 54$

$\Rightarrow F_B = 500$ N ←

& $F_C = 500$ N →



Problem # 2



Given:

The system shown in the figure

Required: Replace the force exerted by the cable at A by an equivalent force-couple system at O

Solution:

$$\vec{AB} = -4.8\vec{j} + 2\vec{k} \quad \{ \|AB\| = 5.2 \text{ m}$$

$$\vec{u}_{AB} = -\frac{4.8}{5.2}\vec{j} + \frac{2}{5.2}\vec{k}$$

$$\therefore \vec{T}_A = 13\left(-\frac{4.8}{5.2}\vec{j} + \frac{2}{5.2}\vec{k}\right) = -12\vec{j} + 5\vec{k} \ (\text{kN})$$

$$r_{OA} = 3.2\vec{i} + 4.8\vec{j}$$

$$\therefore \vec{M}_O = \vec{r}_{OA} \times \vec{T}_A = \begin{vmatrix} i & j & k \\ 3.2 & 4.8 & 0 \\ 0 & -12 & 5 \end{vmatrix}$$

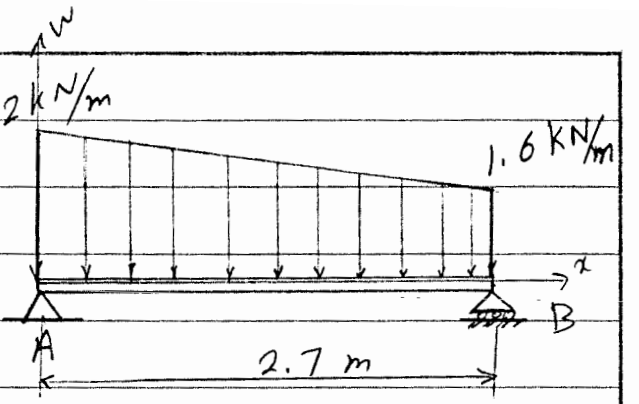
$$\vec{M}_O = 24\vec{i} - 16\vec{j} - 38.4\vec{k}$$

∴ The equivalent force-couple at O are

$$\vec{F} = -12\vec{j} + 5\vec{k}$$

& $\vec{M} = 24\vec{i} - 16\vec{j} - 38.4\vec{k}$ //

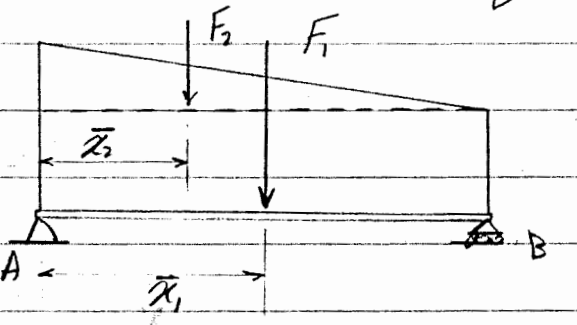
Problem # 3



Given: The system shown in the figure.

Required: The magnitude and location of the resultant of the distributed load shown in the fig.

Solution:



$F_1 = 2.7 \times 1.6 = 4.32$ kN

$F_2 = \frac{1}{2} 0.4 \times 2.7 = 0.54$ kN

$\therefore F_R = \Sigma F = F_1 + F_2 = 4.86$ kN

$\Sigma M = \bar{x} F_R$

$\bar{x}_1 F_1 + \bar{x}_2 F_2 = \bar{x} F_R$

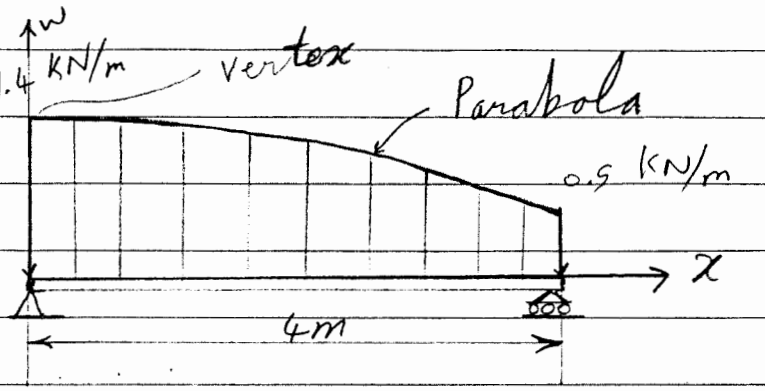
$1.35 \times 4.32 + 0.9 \times 0.54 = \bar{x} \times 4.86$

$\therefore \bar{x} = 1.3$ m

$\therefore$ **$F_R = 4.86$ kN**

$\bar{x} = 1.3$ m

Problem # 4



Given:

The system shown in the figure.

Required:

The magnitude and location of the resultant of the distributed load.

Solution: The equation of the distributed load are of the form

$$w - a = bx^2$$

at $x = 0 \Rightarrow w = 1.4\ kN/m \Rightarrow a = 1.4$

at $x = 4\ m \Rightarrow w = 0.5\ kN/m \Rightarrow b = -0.05625$

$\therefore\ w = 1.4 - 0.05625\,x^2$

$$\therefore F_R = \Sigma F = \int_0^4 (1.4 - 0.05625x^2)\,dx$$

$$\therefore F_R = \left[1.4x - \frac{0.05625}{3}x^3\right]_0^4 = 4.4\ kN$$

The location of resultant

$$\bar{x} = \frac{\int_0^4 (1.4 - 0.05625x^2)\,x\,dx}{\int_0^4 (1.4 - 0.05x^2)\,dx} = \frac{\left[1.4\frac{x^2}{2} - \frac{1}{4}0.05625x^4\right]_0^4}{4.4}$$

$$\boxed{\bar{x} = 1.727\ m}$$

$$\boxed{F_R = 4.4\ kN}$$

Problem # 5

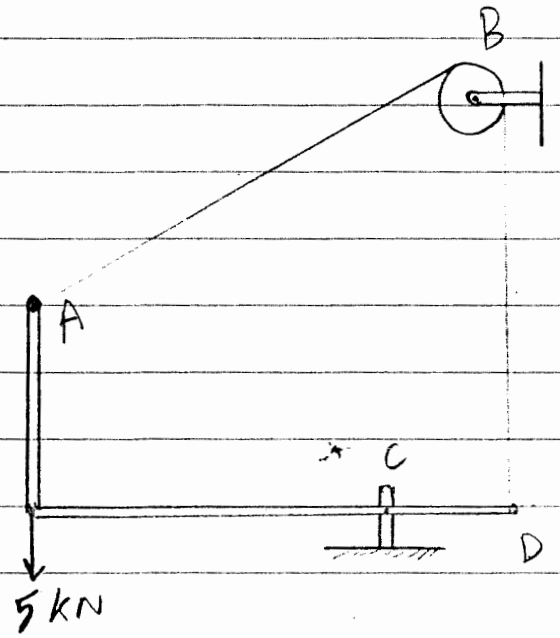


Fig. A

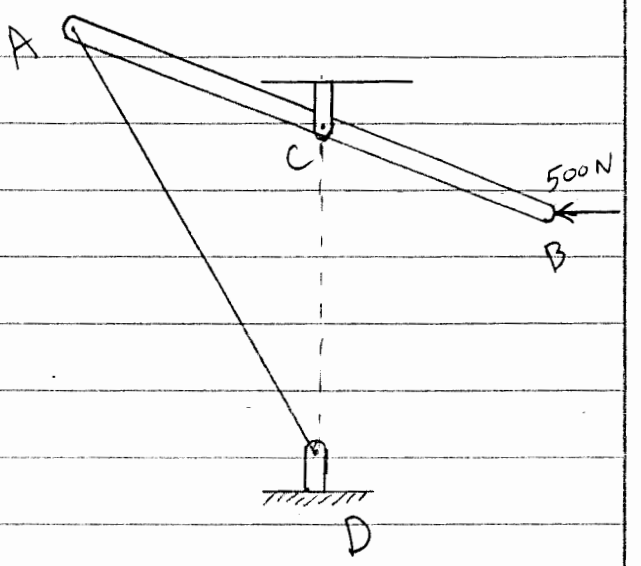


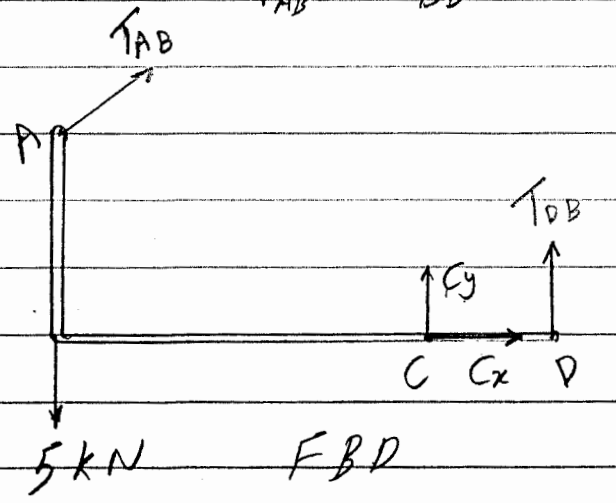
Fig. B

Given: The system shown on figures A & B

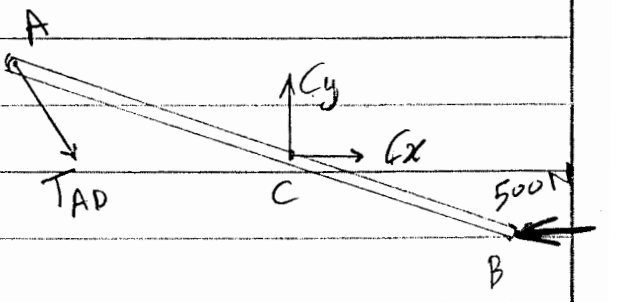
Required: Draw complete and clear free body diagrams for ACD in A and ACB in B

Solution:

$T_{AB} = T_{DB}$



FBD



FBD

with $T_{AB} = T_{DB}$ #