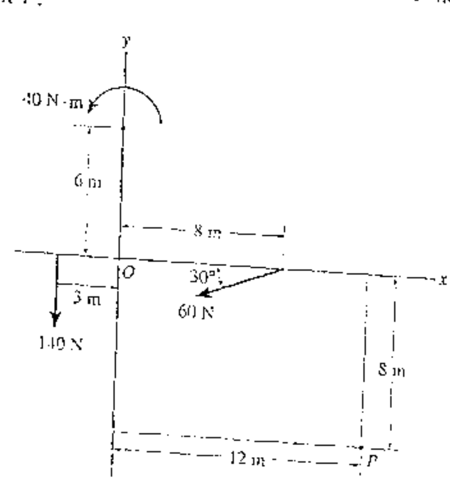
HW # 5

4-101

4-101. Replace the force and couple moment system by an equivalent force and couple moment acting at point P.



$\Sigma F_x = -60 \times \cos 30^\circ = -51.96\ N$

$\Sigma F_y = -60 \times \sin 30 - 140 = -170$

$\therefore F_R = \sqrt{(-51.96)^2 + (-170)^2} = 177.76\ N$

$M_P = 60 \cos 30 \times 8 + 60 \sin 30 \times 4$
$\quad + 140 \times 15$

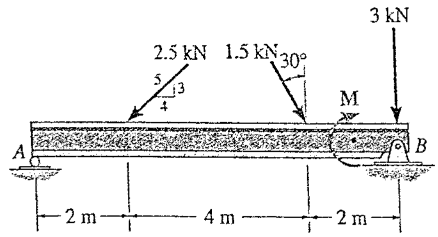
$= 2635\ N\text{-}M$

$\boxed{M_P = 2.68\ kN\text{-}M}$

H. W. # 5

4-110

4-110. Replace the force system acting on the beam t an equivalent force and couple moment at point *A*.



$$\vec{F}_1 = -2.5(4/5)i - 2.5(3/5)j \Rightarrow \vec{F}_1 = [-2i - 1.5j]\ kN$$

$$F_2 = \{1.5 \sin 30 i - 1.5 \cos 30 j\}\ kN$$

$$= [0.75 i - 1.3 j]\ kN$$

$$F_3 = [-3j]\ kN$$

$$\vec{F}_R = F_1 + F_2 + F_3 = [-2i - 1.5j] + [0.75i - 1.3j] + [-3j]$$

$$= [-1.25 i - 5.8 j]\ kN$$

$$\therefore |\vec{F}_R| = \sqrt{(-1.25)^2 + (-5.8)^2} \Rightarrow \boxed{F_R = 5.93\ kN}$$

$$\tan\theta_x = \frac{-5.8}{-1.25} \Rightarrow \boxed{\theta = 77.83^\circ}$$

$$M^A_{couple} = -M - 3(8) - 1.5\cos 30^\circ(6) - 2.5(3/5)2$$

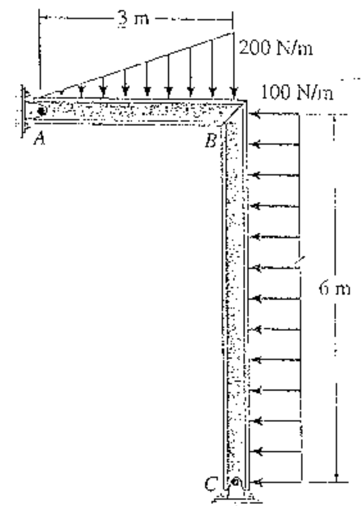
$$= -0 - 24 - 7.794 - 3$$

$$= -34.794\ kN\text{-}m$$

$$\therefore \boxed{M^A_{couple} = +34.794\ kN\text{-}m}$$

HW#5

4-148. Replace the distributed loading by an equivalent resultant force and couple moment at point A.



$= -\frac{1}{2} * 3 * 200 = -300 N$

$= -100 * 6 = -600 N$

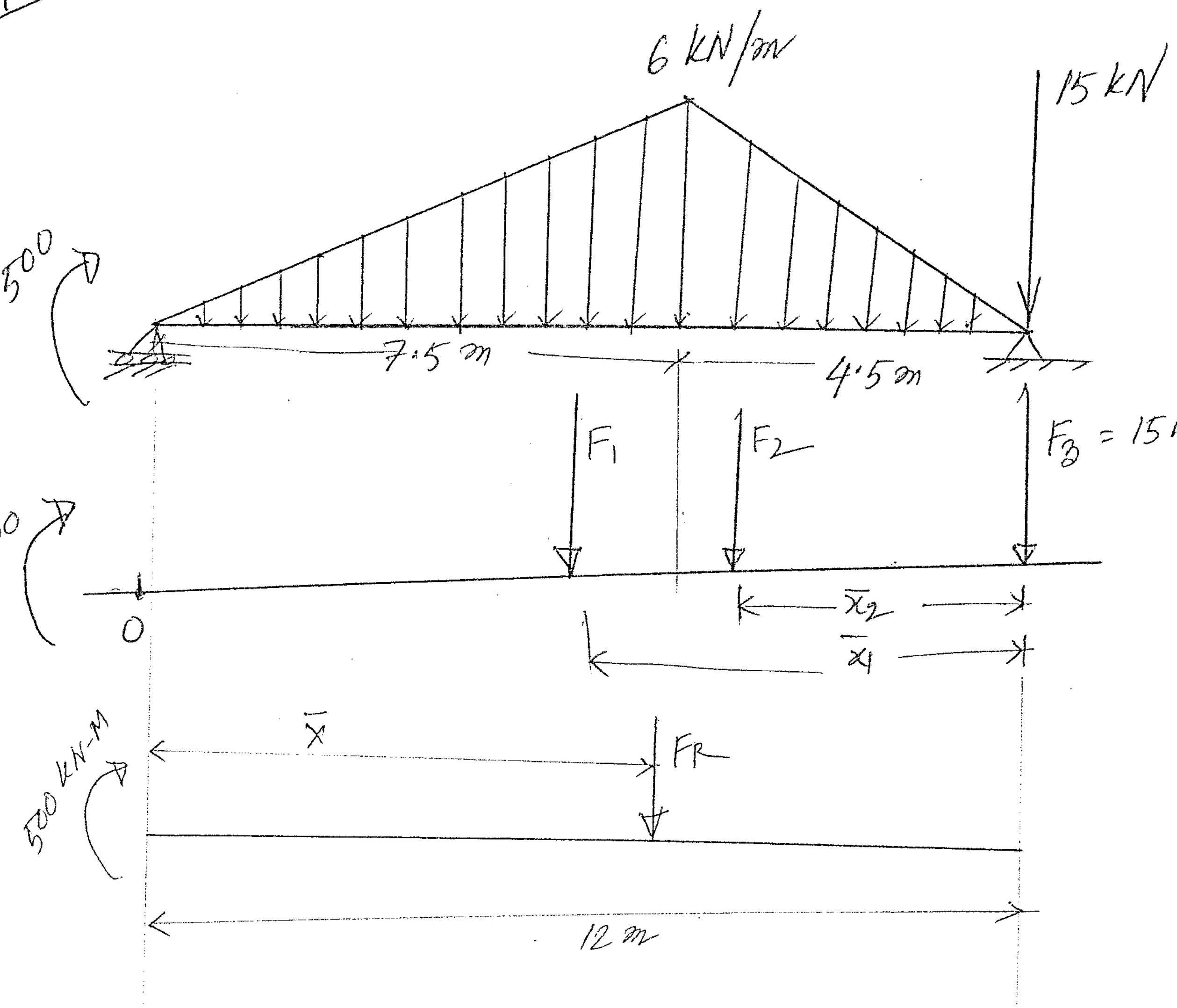
$= \sqrt{(-300)^2 + (-600)^2} = 670.82$

$= \tan^{-1}\left(\frac{-300}{-600}\right) = 26.6^\circ$

$= -300 * \frac{2}{3} * 3 - 600 * 3$

$= -2400 N \cdot m$

+2



Here $F_1 = \frac{1}{2} * 7.5 * 6 = 22.5$ kN

$F_2 = \frac{1}{2} * 4.5 * 6 = 13.5$ kN

$F_3 = 15$ kN

$F_R = F_1 + F_2 + F_3 \Rightarrow F_R = 22.5 + 13.5 + 15$ $\therefore \boxed{F_R = 5}$

$\bar{x}_1 = 4.5 + \frac{1}{3}(7.5) = 7.0$ m

$\bar{x}_2 = 2/3(4.5) = 3.0$ m

Now Taking Moment about "O" $M_R = \Sigma M_O$

$\Rightarrow F_R(\bar{x}) = F_1(12-7) + F_2(12-3) + F_3(12) + 5$

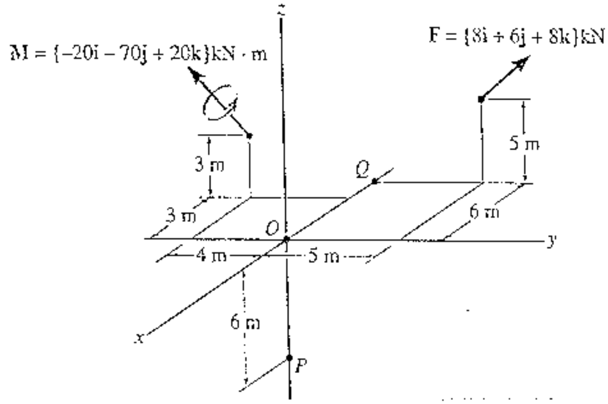
$\Rightarrow F_R(\bar{x}) = F_1 * 5 + F_2 * 9 + F_3 * 12 + 500$

$\therefore F_R(\bar{x}) = 22.5 * 5 + 13.5 * 9 + 15 * 12 +$

$\boxed{\bar{x} = 17.92 \text{ m}}$

HW#5

4-126. Replace the force and couple-moment system by an equivalent resultant force and couple moment at poin P. Express the results in Cartesian vector form.



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$$F_R = \{8i + 6j + 8k\}\ kN$$

$$M_{RP} = \Sigma M_P = \{-20i - 70j + 20k\} + \begin{vmatrix} i & j & k \\ -6 & 5 & 11 \\ 8 & 6 & 8 \end{vmatrix}$$

$$M_{RP} = \left[-20i - 70j + 20k + i(40-66) - j(-48-88) + k(-36-40)\right]\ kN\text{-}m$$

$$M_{RP} = \left[-46i + 66j - 56k\right]\ kN\text{-}m$$

Ans.