

H/W # 5

4-101

$$\sum F_x = -60 \cos 30^\circ = -51.96 \text{ N}$$

$$\sum F_y = -60 \sin 30^\circ - 140 = -170$$

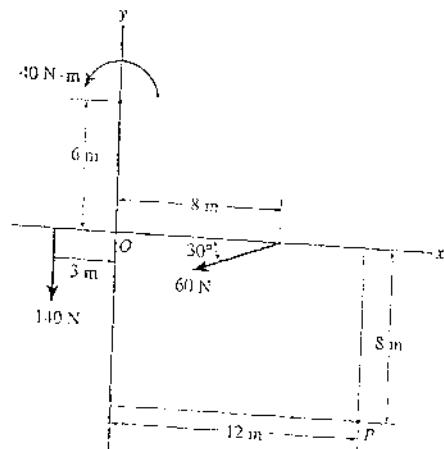
$$F_R = \sqrt{(-51.96)^2 + (-170)^2} = 177.76 \text{ N}$$

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

$$= 2635 \text{ N}\cdot\text{m}$$

$$M_P = 2.68 \text{ kN}\cdot\text{m}$$

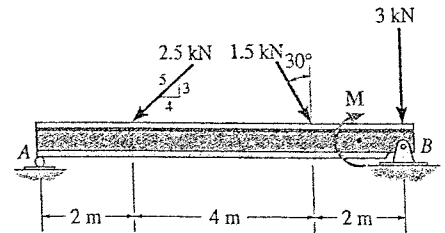
4-101. Replace the force and couple moment system by an equivalent force and couple moment acting at point P.



H. W. # 5

4-110

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



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

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

$$= [0.75i - 1.3j] \text{ kN}$$

$$F_3 = [-3j] \text{ kN}$$

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

$$= [-1.25i - 5.8j] \text{ kN}$$

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

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

$$M_{\text{couple}}^A = -M - 3(8) - 1.5 \cos 30^\circ (6) - 2.5\left(\frac{3}{5}\right)(2)$$

$$= -M - 24 - 7.794 - 3$$

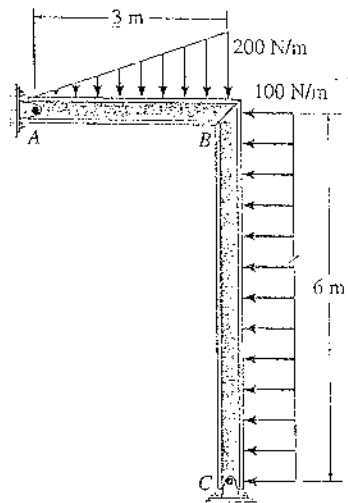
$$= -34.794 \text{ kN-m}$$

$$\boxed{M_{\text{couple}}^A = +34.794 \text{ kN-m}}$$

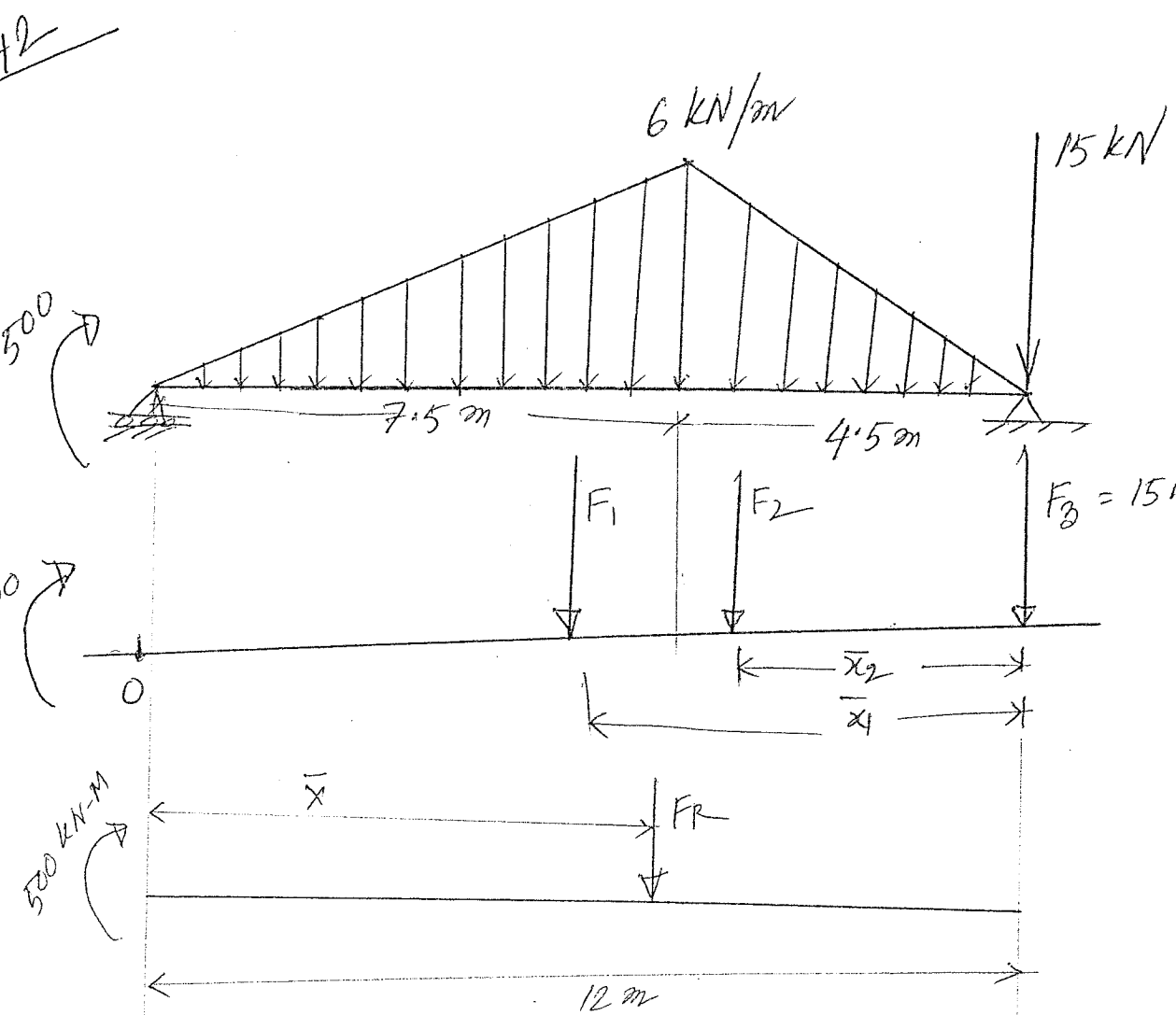
HW#5

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

$$\begin{aligned}
 &= -\frac{1}{2} \times 3 \times 200 = -300 \text{ N} \\
 &= -100 \times 6 = -600 \text{ N} \\
 &= \sqrt{(-300)^2 + (-600)^2} = 670.82 \\
 &= \tan^{-1} \left(\frac{-300}{-600} \right) = 26.6^\circ \\
 &= -300 \times \frac{2}{3} \times 3 - 600 \times 3
 \end{aligned}$$



2000 N-m



Here

$$F_1 = \frac{1}{2} \times 7.5 \times 6 = 22.5 \text{ kN}$$

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

$$F_3 = 15 \text{ kN}$$

$$F_R = F_1 + F_2 + F_3 \Rightarrow F_R = 22.5 + 13.5 + 15 \quad \boxed{F_R = 50}$$

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

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

Now Taking Moment about "O" ($M_x = \sum M_0$)

$$\Rightarrow F_R(\bar{x}) = F_1(12-7) + F_2(12-3) + F_3(12) + 500$$

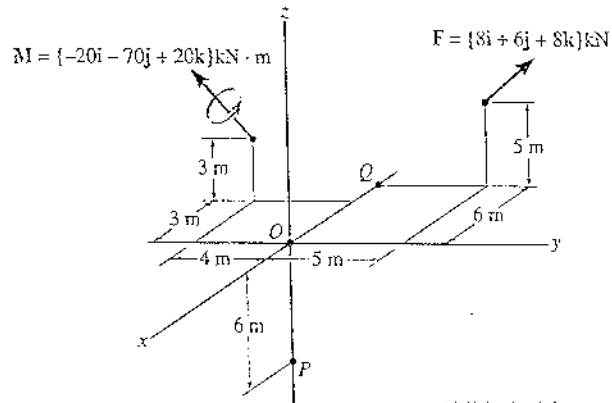
$$\Rightarrow F_R(\bar{x}) = F_1 \times 5 + F_2 \times 9 + F_3 \times 12 + 500$$

$$\therefore F_R(\bar{x}) = 22.5 \times 5 + 13.5 \times 9 + 15 \times 12 + 500$$

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

HW # 5

340
4-126. Replace the force and couple-moment system by an equivalent resultant force and couple moment at point P. Express the results in Cartesian vector form.



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

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

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

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

Ans: