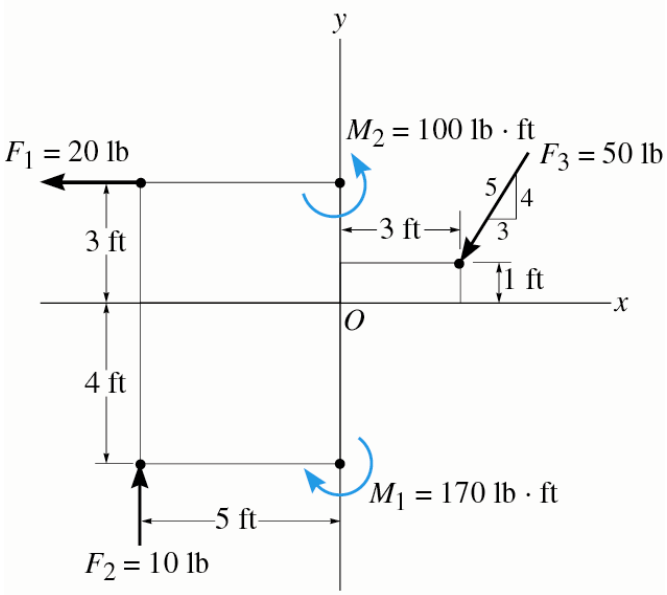
Moment 6:

Problem 1:

Replace the force and couple-moment system by an equivalent resultant force and specify its coordinate point of application (x, 0) on the x axis.



Solution:

$$\xrightarrow{+} \sum F_{R_x} = \sum F_x$$

$$\Rightarrow F_{R_x} = -50\left(\frac{3}{5}\right) - 20 = -50 \text{ lb}$$

$$+\uparrow \sum F_{R_y} = \sum F_y$$

$$\Rightarrow F_{R_y} = -50\left(\frac{4}{5}\right) + 10 = -30 \text{ lb}$$

$$F_R = \sqrt{F_{R_x}^2 + F_{R_y}^2}$$

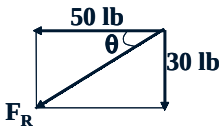
$$\Rightarrow F_R = \sqrt{(-50)^2 + (-30)^2} = 58.3 \text{ lb}$$

$$\theta = \tan^{-1}\left(\frac{-30}{-50}\right) = 31.0°$$

$$F_{R_x} = -50 \text{ lb}$$

$$F_{R_y} = -30 \text{ lb}$$

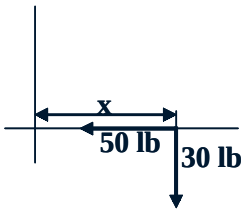
$$F_R = 58.3 \text{ lb}$$



$$(+M_{R_O} = \sum M_O$$

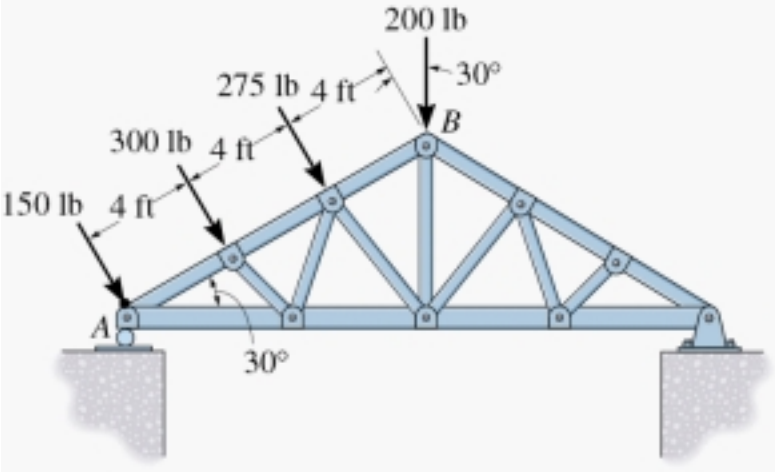
$$\Rightarrow (-30)(x) = -50\left(\frac{4}{5}\right)(3) + 50\left(\frac{3}{5}\right)(1) + (20)(3) + 100 - 170 - 10(5)$$

$$\Rightarrow x = 5.00 \text{ ft}$$



Problem 2:

The system of four forces acts on the roof truss. Determine the equivalent resultant force and specify its location along AB, measured from point A.



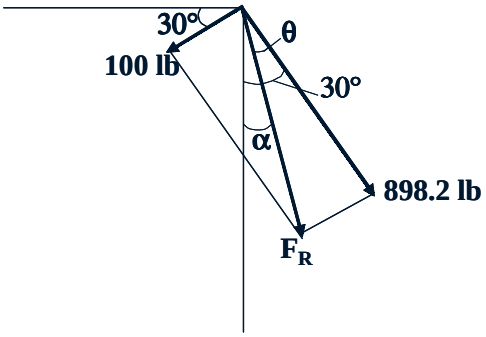
Solution:

$$\stackrel{+}{\rightarrow}\sum F_{R_x}=\sum F_x$$

$$\Rightarrow F_{R_x}=200\sin 30°=100\text{ lb}$$

$$+\downarrow\sum F_{R_y}=\sum F_y$$

$$\Rightarrow F_{R_y}=150+300+275+200\cos 30°=898.2\text{ lb}$$



$$F_R=\sqrt{F_{R_x}^2+F_{R_y}^2}$$

$$\Rightarrow F_R=\sqrt{(100)^2+(898.2)^2}=904\text{ lb}$$

$$\theta=\tan^{-1}\left(\frac{100}{898.2}\right)=6.35°$$

$$\Rightarrow\alpha=30°-6.35°=23.6°$$

$$F_{R_x}=100\text{ lb}$$

$$F_{R_y}=898.2\text{ lb}$$

$$F_R=904\text{ lb}$$

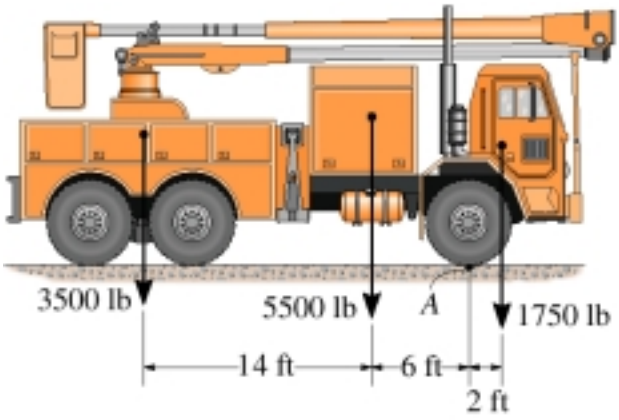
$$\circlearrowleft+M_{R_A}=\sum M_A$$

$$\Rightarrow(-898.2)(d)=-4(300)-8(275)$$
$$-12\cos 30°(200)$$

$$\Rightarrow d=6.10\text{ ft}$$

Problem 3:

The weights of the various components of the truck are shown. Replace this system of forces by an equivalent resultant force and specify its location measured from point A.

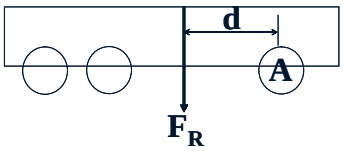


Solution:

$$+\uparrow F_R = \sum F_y$$

$$\Rightarrow F_R = -1750 - 5500 - 3500$$

$$\Rightarrow F_R = -10750 \text{ lb} = 10.75 \text{ kip} \downarrow$$



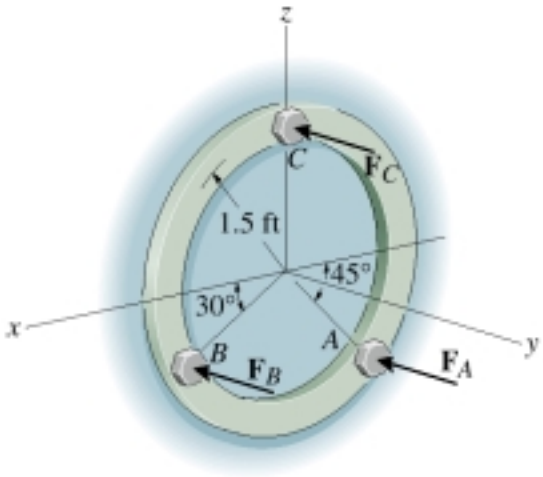
$$(+M_{R_A} = \sum M_A$$

$$\Rightarrow (10750)(d) = 3500(20) + 5500(6) - 1750(2)$$

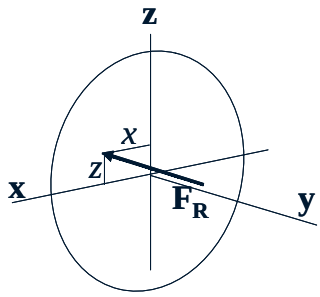
$$\Rightarrow d = 9.26 \text{ ft}$$

Problem 4:

Three parallel bolting forces act on the circular plate. Determine the resultant force, and specify its location (x, z) on the plate. FA = 200 lb, FB = 100 lb, and FC = 400 lb.



Solution:



$$F_R = \sum F_y$$

$$\Rightarrow -F_R = -400 - 200 - 100 = -700$$

$$\Rightarrow F_R = 700 \text{ lb into the plate}$$

$$M_{R_x} = \sum M_x$$

$$\Rightarrow (700)(z) = 400(1.5) - 200(1.5 \sin 45°) - 100(1.5 \sin 30°)$$

$$\Rightarrow z = 0.447 \text{ ft}$$

$$M_{R_z} = \sum M_z$$

$$\Rightarrow -(700)(x) = 200(1.5 \cos 45°) - 100(1.5 \cos 30°)$$

$$\Rightarrow x = -0.117 \text{ ft}$$