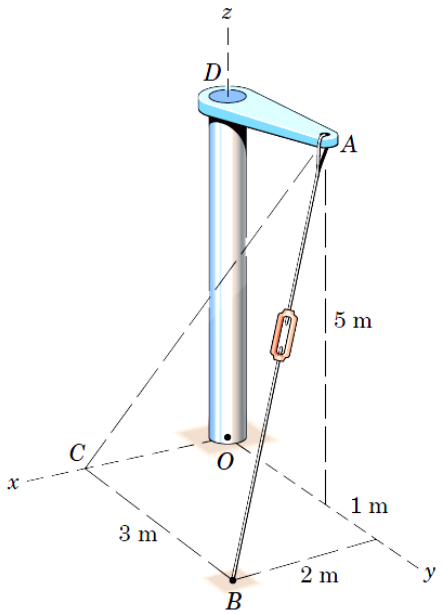
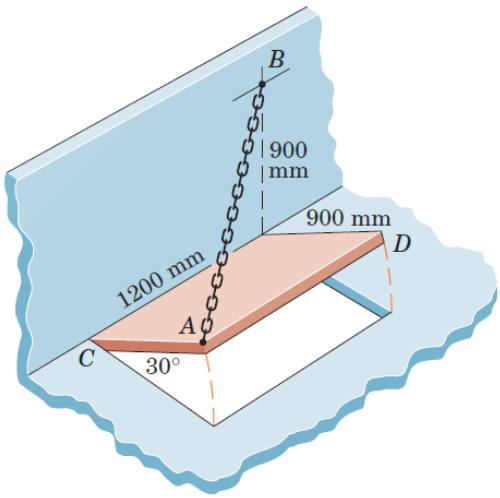
Q1

The turnbuckle is tightened until the tension in the cable *AB* equals 2.4 kN. Determine the vector expression for the tension **T** as a force acting on member *AD*. Also find the magnitude of the projection of **T** along the line *AC*.



Q2

The access door is held in the 30° open position by the chain *AB*. If the tension in the chain is 100 N, determine the projection of the tension force onto the diagonal axis *CD* of the door.



Q3

The shaft *S* exerts three force components on the die *D*. Find the magnitude and direction of the resultant force. Force $\mathbf{F}_2$ acts within the octant shown.

$F_1 = 400$ N

$F_2 = 300$ N

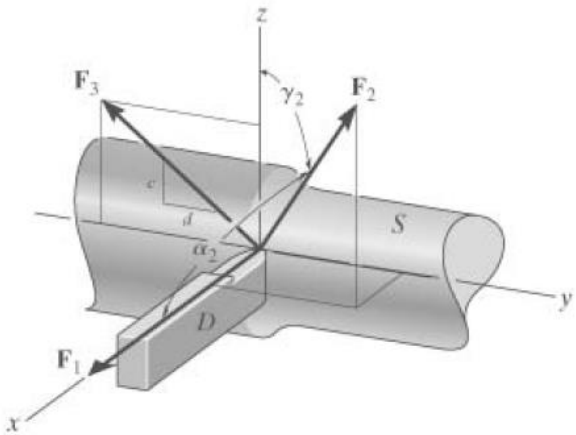
$F_3 = 200$ N

$\alpha_2 = 60$ deg

$\gamma_2 = 60$ deg

$c = 3$

$d = 4$



Q4

The positions of point A on the building and point B on the antenna have been measured relative to the electronic distance meter (EDM) at O. Determine the distance between A and B. *Hint:* Formulate a position vector directed from A to B; then determine its magnitude.

$a = 460$ m

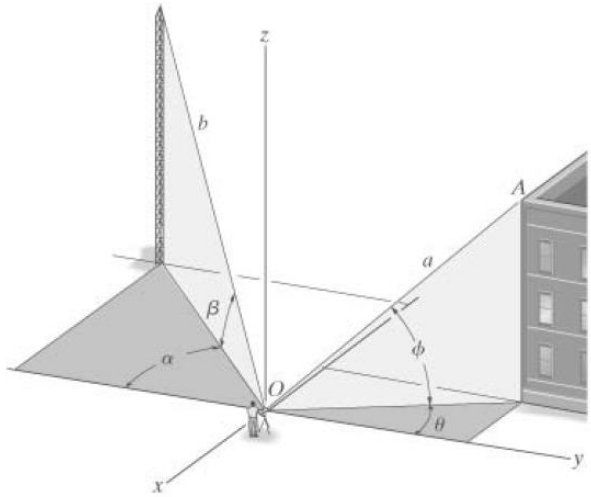
$b = 653$ m

$\alpha = 60$ deg

$\beta = 55$ deg

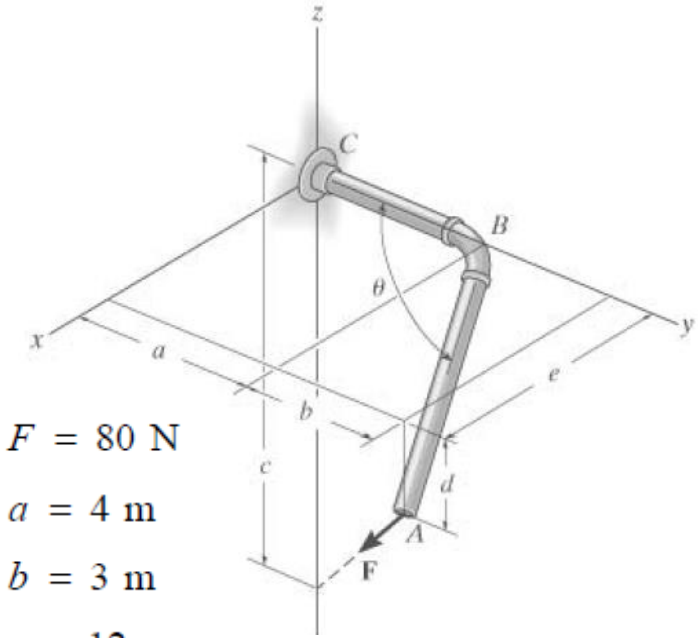
$\theta = 30$ deg

$\phi = 40$ deg



Q5

Determine the projected component of the force **F** acting along the axis AB of the pipe.



$F = 80$ N

$a = 4$ m

$b = 3$ m

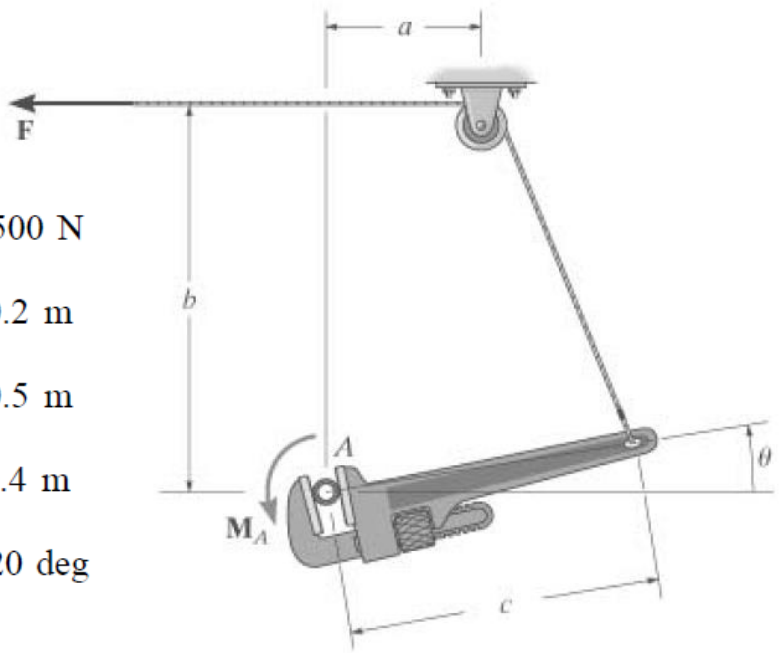
$c = 12$ m

$d = 2$ m

$e = 6$ m

Q6

The pipe wrench is activated by pulling on the cable segment with a horizantal force **F**. Determine the moment M_A produced by the wrench on the pipe at θ.]



$F = 500$ N

$a = 0.2$ m

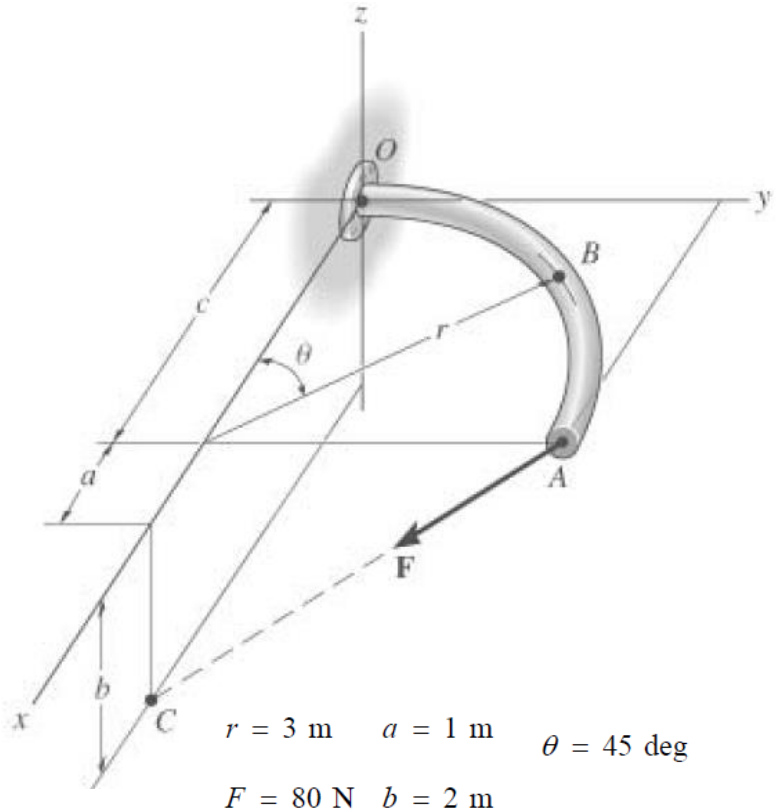
$b = 0.5$ m

$c = 0.4$ m

$\theta = 20$ deg

Q7

The curved rod lies in the x-y plane and has radius r. If a force **F** acts at its end as shown, determine the moment of this force about point O.



$r = 3$ m $\quad a = 1$ m $\quad \theta = 45$ deg

$F = 80$ N $\quad b = 2$ m

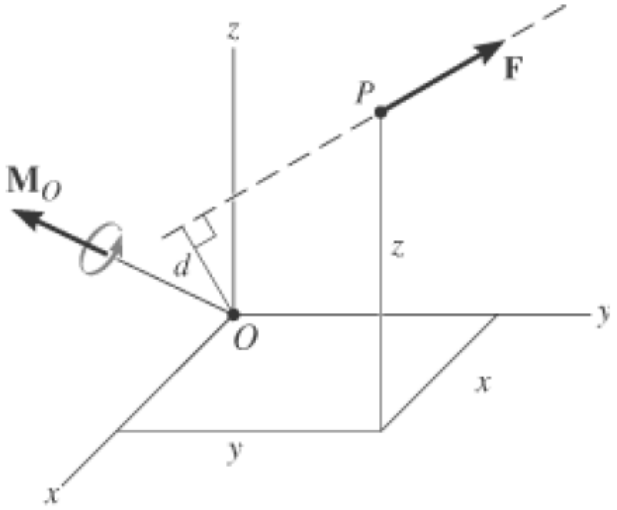
Q8

The force $\mathbf{F}$ creates a moment about point O of $\mathbf{M}_O$. If the force passes through a point having the given x coordinate, determine the y and z coordinates of the point. Also, realizing that $M_O = Fd$, determine the perpendicular distance d from point O to the line of action of $\mathbf{F}$.

$$\mathbf{F} = \begin{pmatrix} 6 \\ 8 \\ 10 \end{pmatrix} \text{ N}$$

$$\mathbf{M_O} = \begin{pmatrix} -14 \\ 8 \\ 2 \end{pmatrix} \text{ N·m}$$

$x = 1$ m



Q9

Determine the magnitude of the moment of the force $\mathbf{F}$ about the base line CA of the tripod.

$a = 4$ m

$b = 2.5$ m

$c = 1$ m

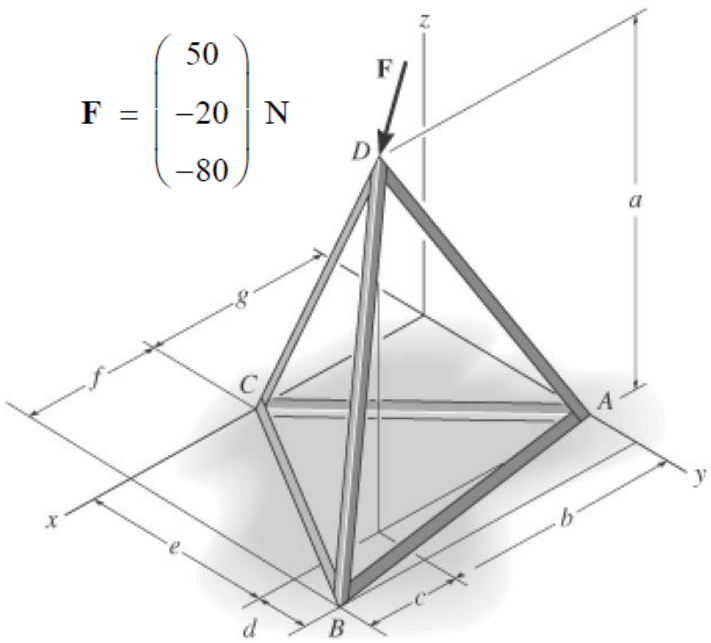
$d = 0.5$ m

$e = 2$ m

$f = 1.5$ m

$g = 2$ m

$$\mathbf{F} = \begin{pmatrix} 50 \\ -20 \\ -80 \end{pmatrix} \text{ N}$$



Q10

The ends of the triangular plate are subjected to three couples. Determine the magnitude of the force **F** so that the resultant couple moment is M clockwise.

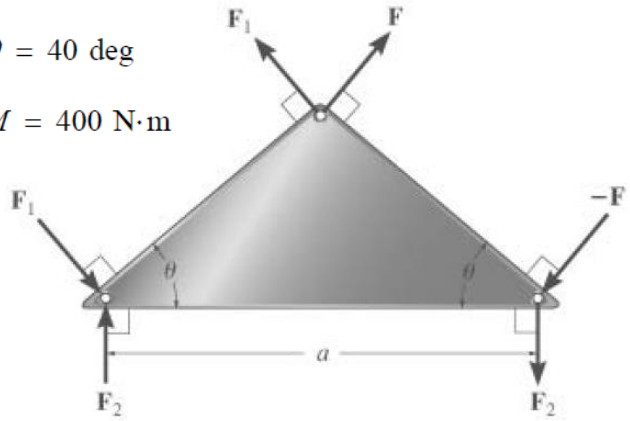
$F_1 = 600$ N

$F_2 = 250$ N

$a = 1$ m

$\theta = 40$ deg

$M = 400$ N·m



Q11

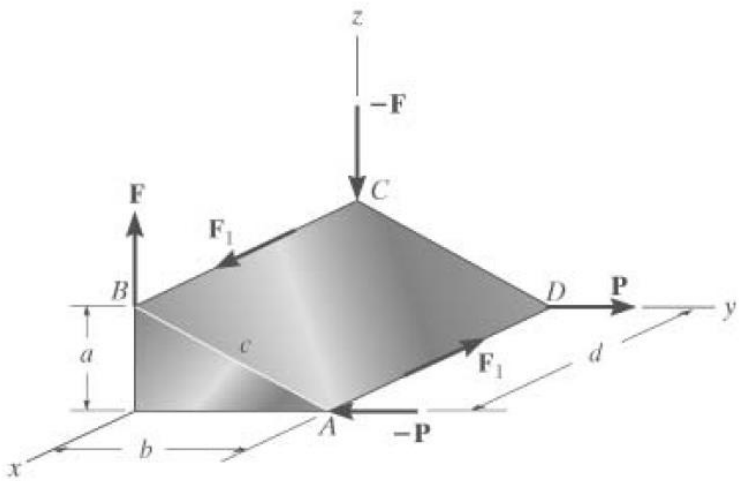
If the resultant couple of the three couples acting on the triangular block is to be zero, determine the magnitude of forces **F** and **P**.

$F_1 = 150$ N

$a = 300$ mm

$b = 400$ mm

$d = 600$ mm



Q12

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.

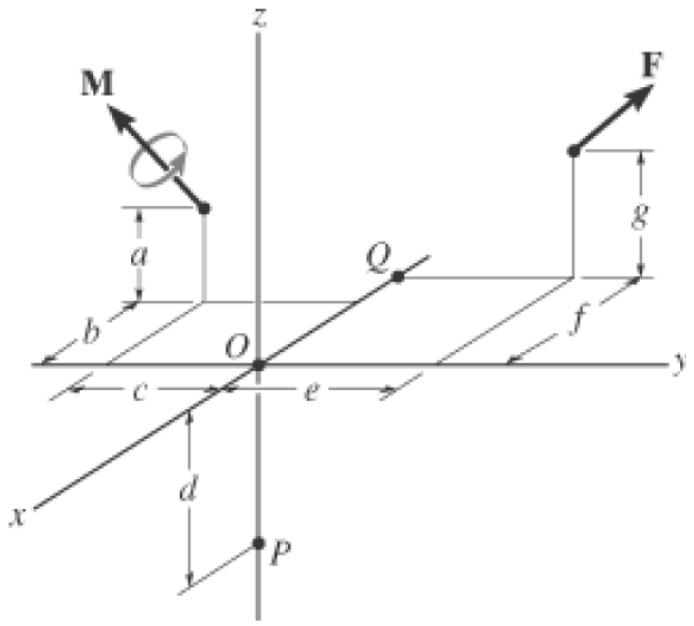
$$\mathbf{F} = \begin{pmatrix} 8 \\ 6 \\ 8 \end{pmatrix} \text{ kN}$$

$$\mathbf{M} = \begin{pmatrix} -20 \\ -70 \\ 20 \end{pmatrix} \text{ kN·m}$$

$a = 3$ m

$b = 3$ m $\quad e = 5$ m

$c = 4$ m $\quad f = 6$ m



Q13

Handle forces $\mathbf{F}_1$ and $\mathbf{F}_2$ are applied to the electric drill. Replace this system by an equivalent resultant force and couple moment acting at point O. Express the results in Cartesian vector form.

Given:

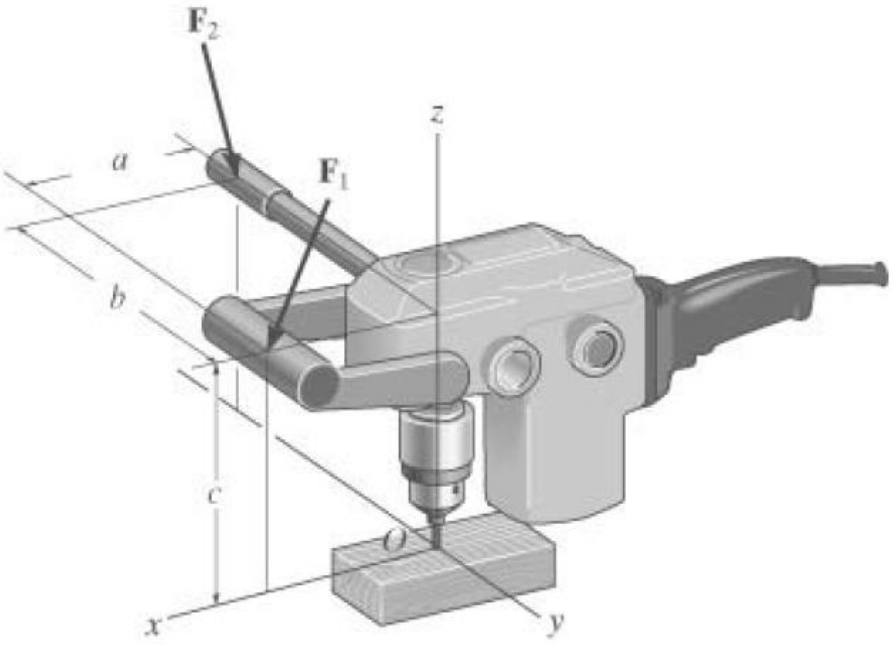
$a = 0.15$ m

$b = 0.25$ m

$c = 0.3$ m

$$\mathbf{F_1} = \begin{pmatrix} 6 \\ -3 \\ -10 \end{pmatrix} \text{ N}$$

$$\mathbf{F_2} = \begin{pmatrix} 0 \\ 2 \\ -4 \end{pmatrix} \text{ N}$$



Q14

The building slab is subjected to four parallel column loadings.Determine the equivalent resultant force and specify its location (x, y) on the slab.

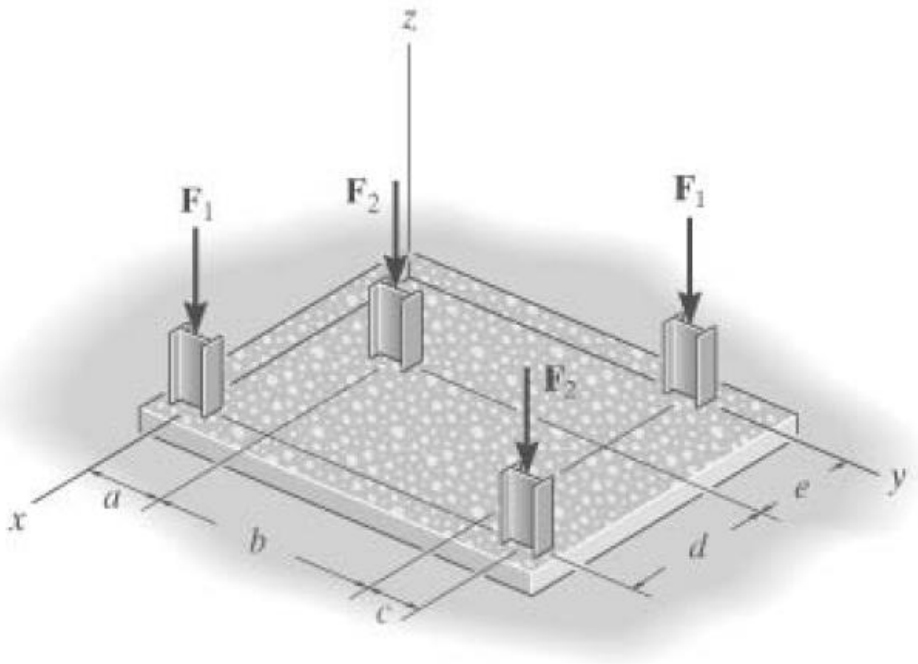
$F_1 = 30$ kN $\quad a = 3$ m

$F_2 = 40$ kN $\quad b = 8$ m

$F_3 = 20$ kN $\quad c = 2$ m

$F_4 = 50$ kN $\quad d = 6$ m

$e = 4$ m



Q15

Replace the loading on the frame by a single resultant force. Specify where its line of action intersects member CD, measured from end C.

$F_1 = 500$ N $\quad a = 3$ m

$b = 2$ m

$F_2 = 300$ N

$c = 1$ m

$F_3 = 250$ N

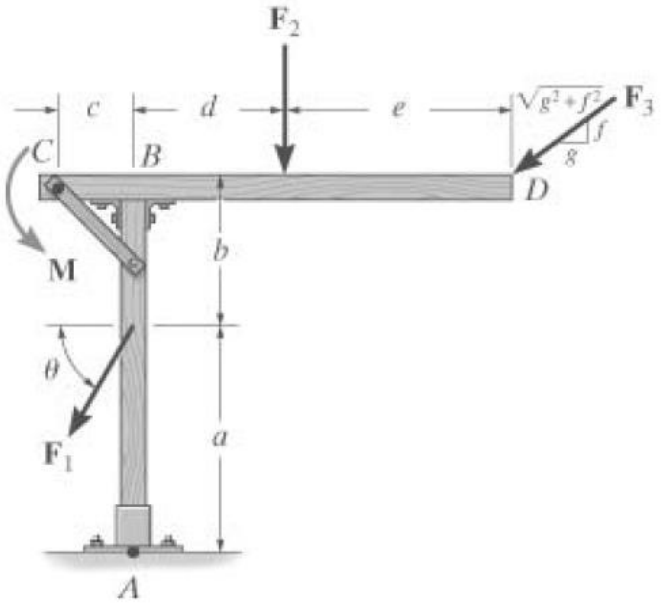
$d = 2$ m

$M = 400$ N·m

$e = 3$ m

$\theta = 60$ deg $\quad f = 3$

$g = 4$



Q16

Replace the distributed loading by an equivalent resultant force and specify where its line of action intersects member BC, measured from C.

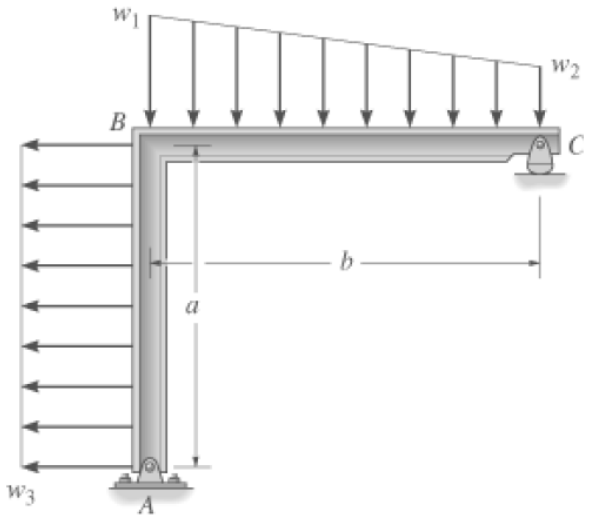
$w_1 = 200 \frac{\text{N}}{\text{m}}$

$w_2 = 100 \frac{\text{N}}{\text{m}}$

$w_3 = 200 \frac{\text{N}}{\text{m}}$

$a = 5$ m

$b = 6$ m



Q17

The shelf supports the electric motor which has mass m_1 and mass center at G_m. The platform upon which it rests has mass m_2 and mass center at G_p. Assuming that a single bolt B holds the shelf up and the bracket bears against the smooth wall at A, determine this normal force at A and the horizontal and vertical components of reaction of the bolt B on the bracket.

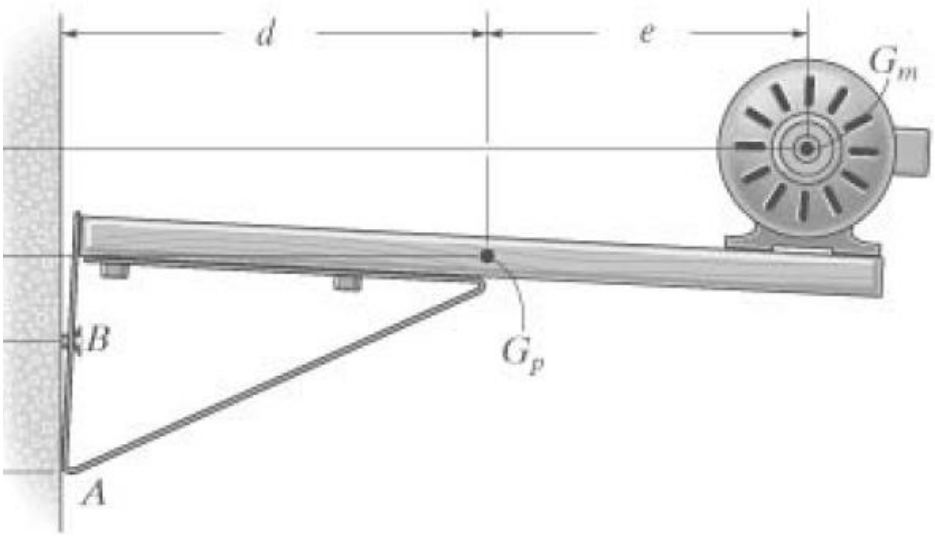
$m_1 = 15$ kg $\quad c = 50$ mm

$m_2 = 4$ kg $\quad d = 200$ mm

$a = 60$ mm $\quad e = 150$ mm

$b = 40$ mm

$g = 9.81 \frac{\text{m}}{\text{s}^2}$



Q18

Replace the loading by a single resultant force, and specify the location of the force on the beam measured from point *O*.

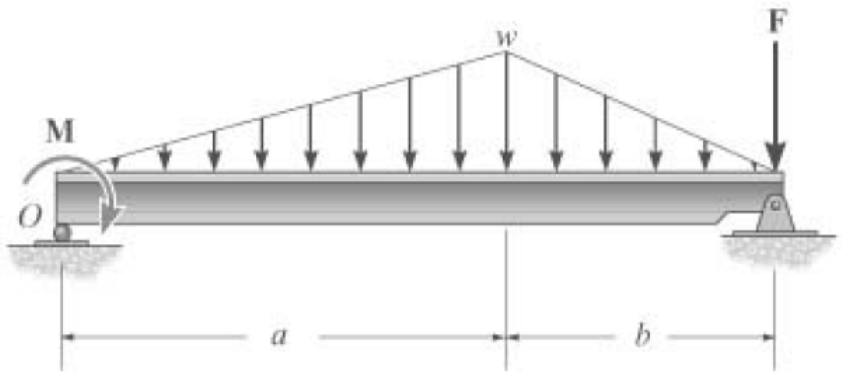
$w = 6 \dfrac{\text{kN}}{\text{m}}$

$F = 15$ kN

$M = 500$ kN·m

$a = 7.5$ m

$b = 4.5$ m

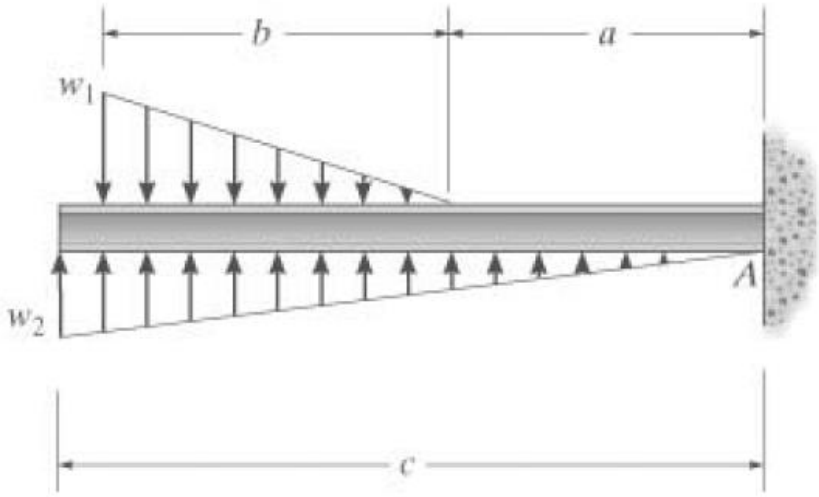


Q19

Determine the length *b* of the triangular load and its position *a* on the beam such that the equivalent resultant force is zero and the resultant couple moment is *M* clockwise.

$w_1 = 4 \dfrac{\text{kN}}{\text{m}}$ $\quad w_2 = 2.5 \dfrac{\text{kN}}{\text{m}}$

$M = 8$ kN·m $\quad c = 9$ m



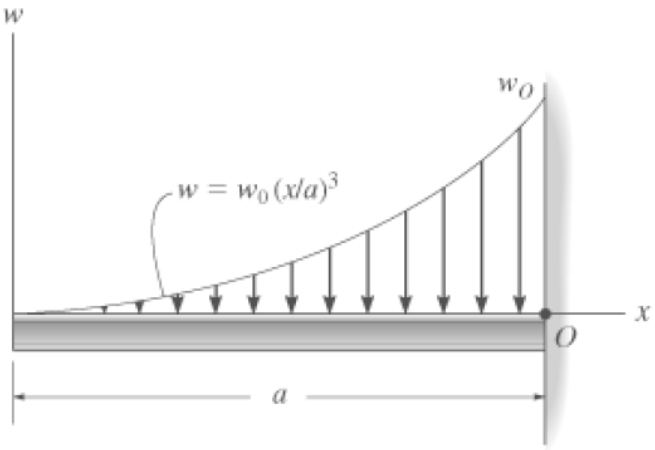
Q20

Determine the equivalent resultant force and couple moment at point *O*.

$a = 3$ m

$w_O = 3 \dfrac{\text{kN}}{\text{m}}$

$w(x) = w_O \left(\dfrac{x}{a}\right)^2$



Q21

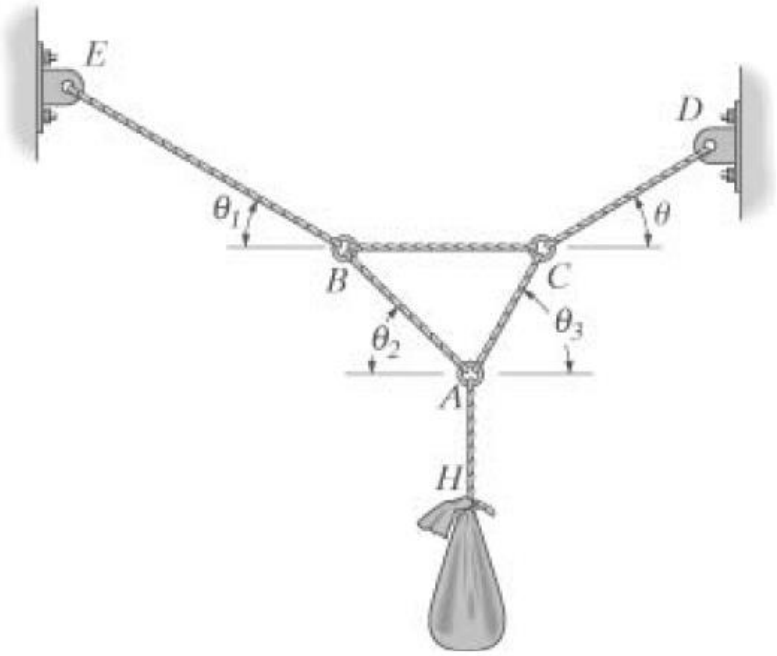
Each cord can sustain a maximum tension T. Determine the largest weight of the sack that can be supported. Also, determine θ of cord DC for equilibrium.

T=2000 N

$\theta_1 = 30$ deg

$\theta_2 = 45$ deg

$\theta_3 = 60$ deg



Q22

The members of a truss are connected to the gusset plate. If the forces are concurrent at point O, determine the magnitudes of **F** and **T** for equilibrium.

$F_1 = 8$ kN

$F_2 = 5$ kN

$\theta_1 = 45$ deg

$\theta = 30$ deg