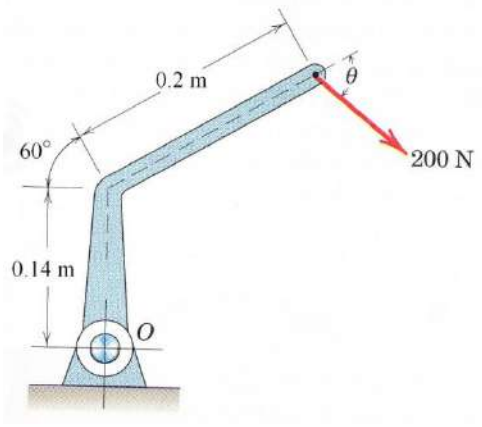
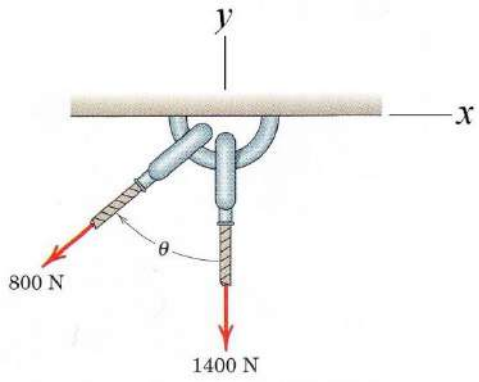
80 Problems in Engineering Mechanics

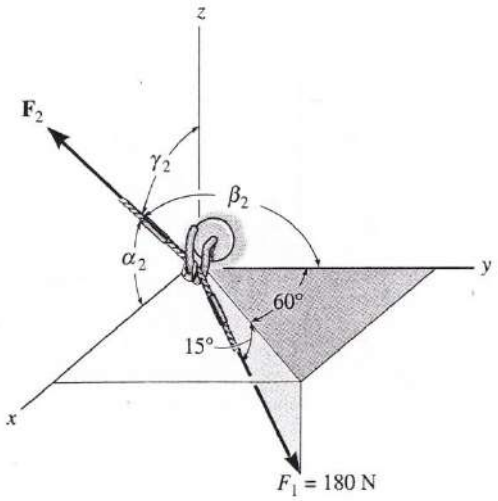
1- Determine the angle θ of the 200 N force shown in the figure so that it produces a maximum moment about point *O*. Also, compute this maximum moment.



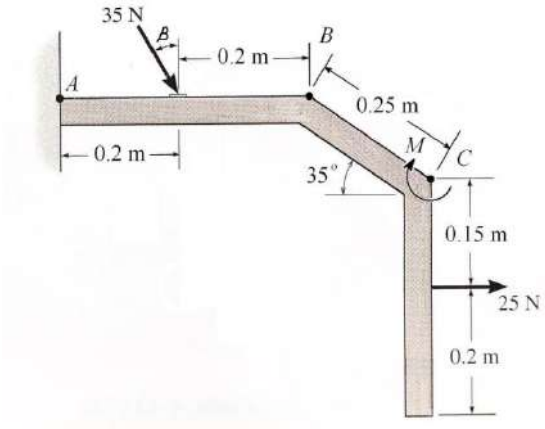
2- If the resultant of the two forces shown in the figure has a magnitude of 2000 N, Determine the angle θ and the direction of the resultant force measured counterclockwise from the positive *x* axis by using parallelogram law.



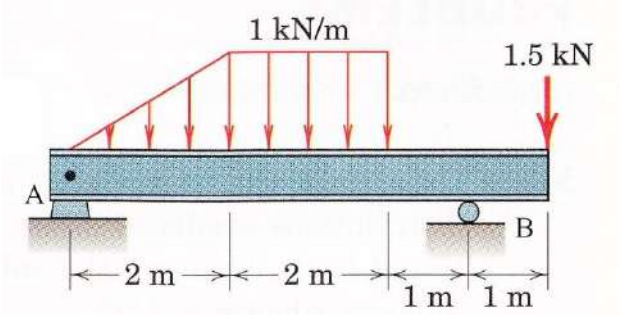
3- Determine the magnitude and coordinate direction angles of $\mathbf{F_2}$ shown in the figure so that the resultant of the two forces acts along the positive *x* axis and has a magnitude of 500 N.



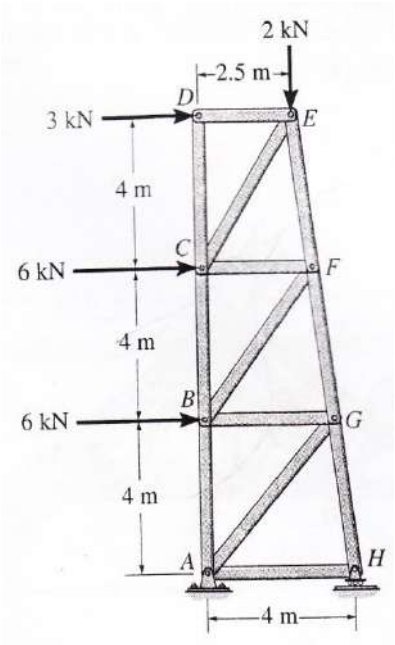
4- If the resultant of the two forces and couple moment is 53 N and passes through point *B*, determine the direction of the resultant force, the angle β and the magnitude of the couple moment *M*.



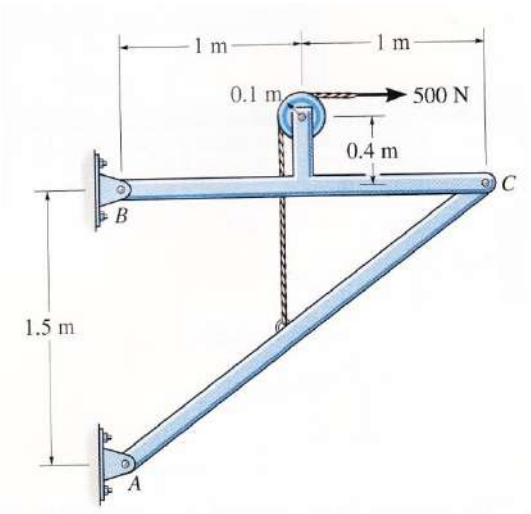
5- Determine the magnitude of the reactions at the pin A and the roller B of the Beam shown.



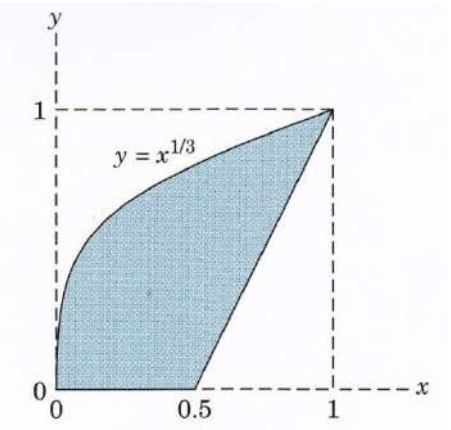
6- The tower truss is subjected to the loads shown. Determine the force in member CF, and state if the member is in tension or compression. The left side ABCD stands vertical.



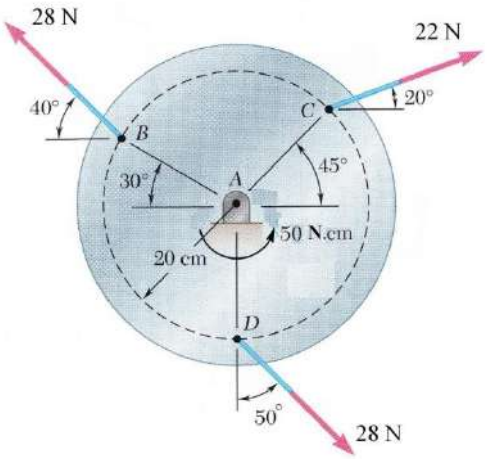
7- Determine the horizontal and vertical components of force that the pins at A and B exert on their connecting members in the frame.



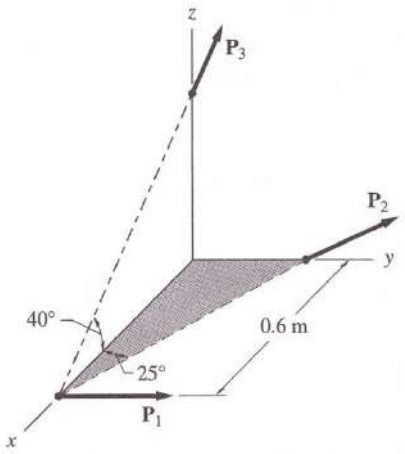
8- Locate the centroid y of the shaded area.



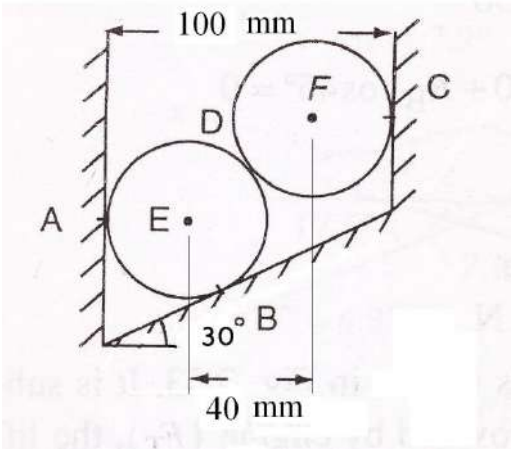
9- Three cables attached to a disk exert on it the forces shown. Determine the magnitude and direction of the resultant force and specify where its line of action intersects a line drawn through points *A* and *D*.



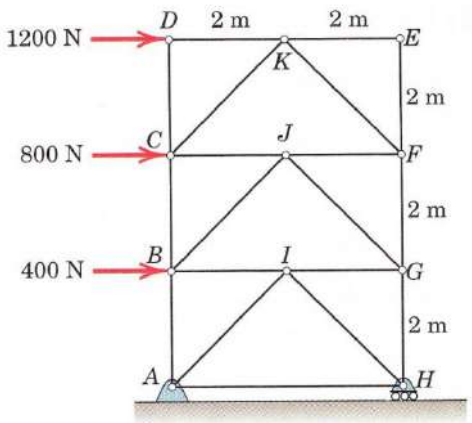
10- Let **R** refer to the resultant of the three forces shown. Given that **R**={-1320.5**i** + 867.2**j** + 430.4**k**}N. Determine the magnitudes of the three forces $\boldsymbol{P_1}$, $\boldsymbol{P_2}$ and $\boldsymbol{P_3}$.



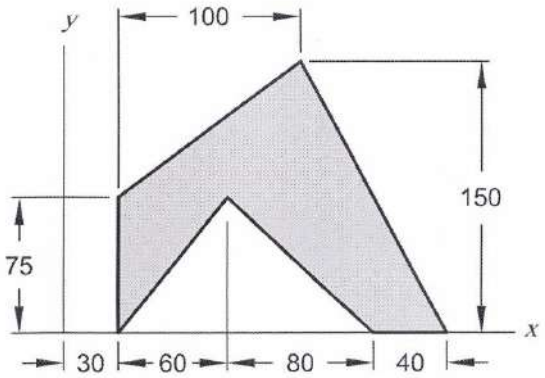
11- Two cylinders of diameters 60 mm are placed as shown in the figure. The weight of each cylinder is 160 N. Assuming that all the contact surfaces to be smooth, find the reactions at A, B and C.



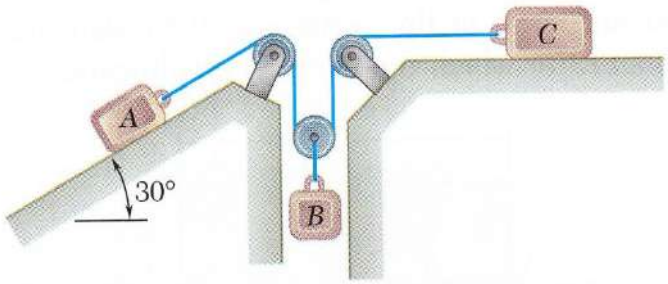
12- Determine the force in member FG of the loaded truss and state if this member is in tension or compression.



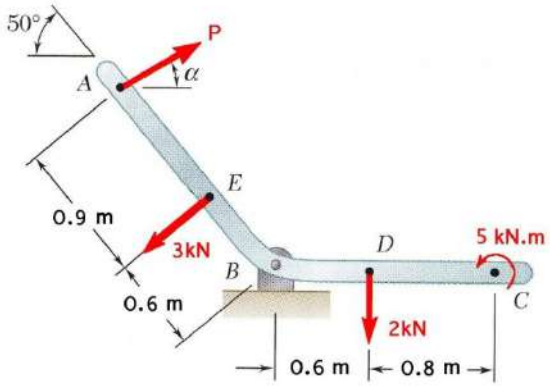
13- For the shaded area shown:
   1- Locate the centroid $\bar{y}$.
   2- Determine radius of gyration k_x.
   Note: The dimensions are in mm.



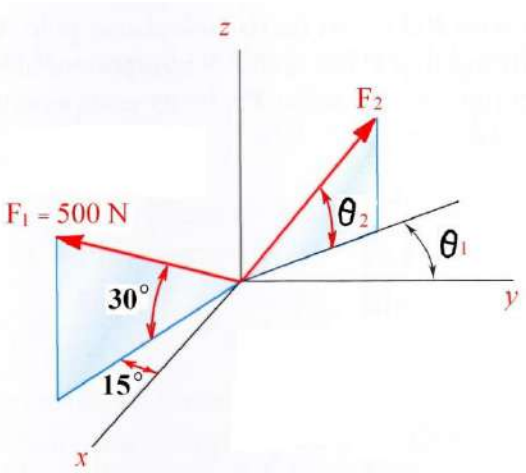
14- The mass of blocks A and C are 2.4 kg and 6 kg, respectively. Knowing that $\mu_s = 0.5$ between block A and the incline surface and $\mu_s = 0.3$ between block C and the horizontal surface. Determine the largest value of the mass of block B for which the blocks are in equilibrium.



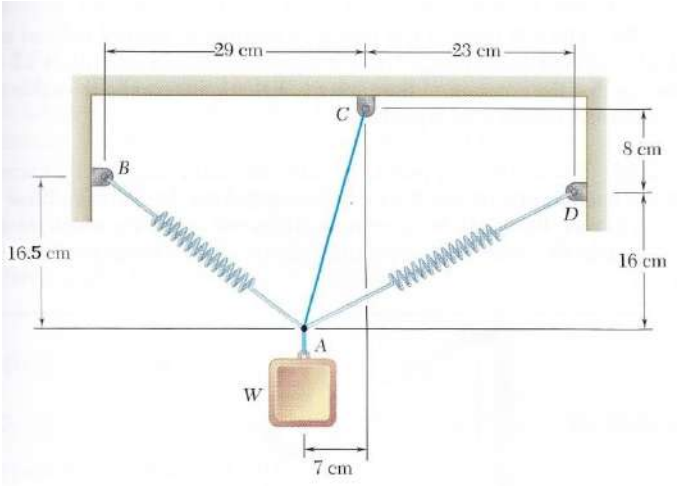
15- Three forces and a couple act on crank ABC. The magnitude and direction of the resultant force is 1.47 kN and Θ=55.6° measured counter clockwise from the positive x-axis. Find the magnitude of the force P and the angle α. Locate the point where the line of action of the resultant force intersects a line drawn through points B and C.



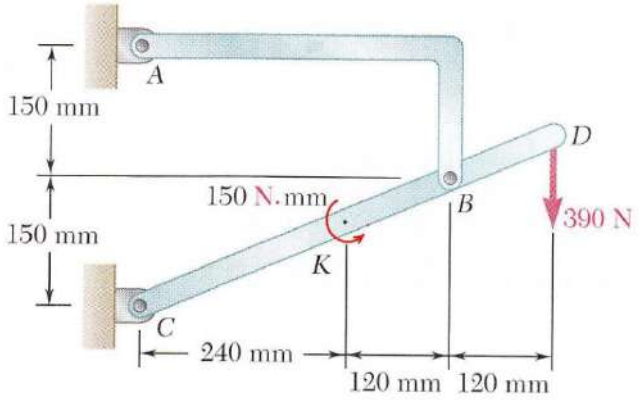
16- The resultant of the two forces F_1 and F_2 is **R**={260.5**i** + 320.3**j** + 635.7**k**}N. Determine the magnitudes of F_2, θ_1 and θ_2.



17- A block of weight W is suspended from a cord AC and two springs of which the unstretched lengths are 22.5 cm. knowing that kAB= 9 N/cm and kAD= 3 N/cm. Determine the tension force in the cord and the weight of the block.

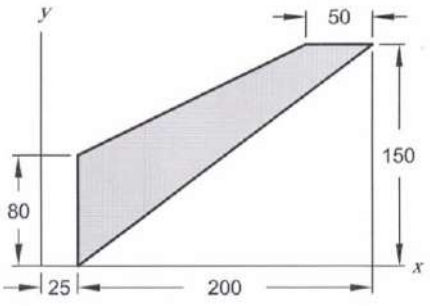


18- For the frame shown in the figure determine the support reactions at A and C.

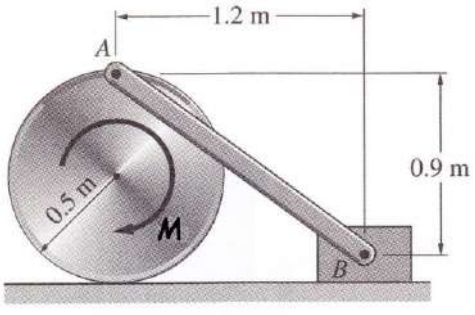


19- For the shaded area shown:
1- Locate the centroid (x , y).
2- Determine moment of inertia I_x about x axis.

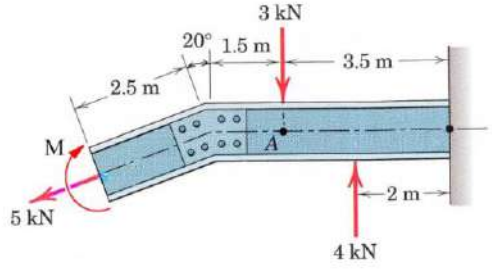
Note: The dimensions are in mm.



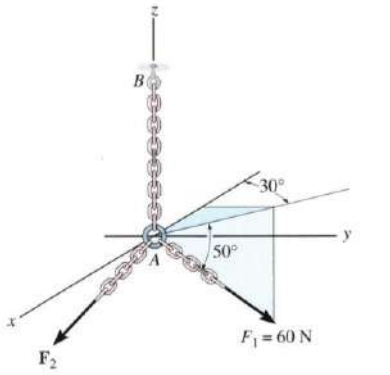
20- The 50 kg uniform cylinder and the 30 kg block are connected by the bar *AB*. The coefficient of static friction is 0.2 under both the cylinder and the block. Determine the smallest clockwise couple ***M*** which will cause motion to impend. Neglect the weight of the bar



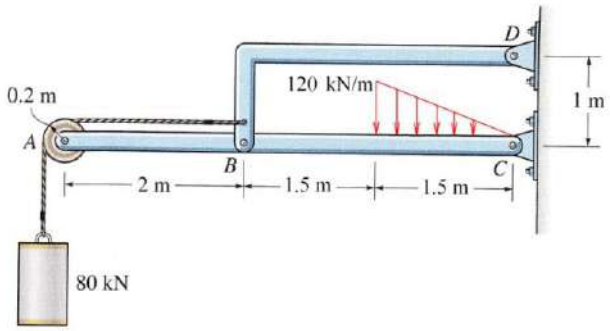
21- If the resultant of the two forces and couple *M* shown in the figure is passes through point *A*, determine the magnitude and direction of the resultant force and the couple *M*.



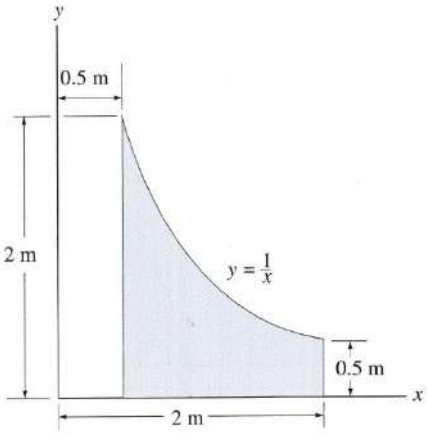
22- The two forces $\mathbf{F_1}$ and $\mathbf{F_2}$ acting at *A* have a resultant force of $\mathbf{F_R} = \{-100\ \mathbf{k}\}$ N. Determine the magnitude and coordinate direction angles of $\mathbf{F_2}$.



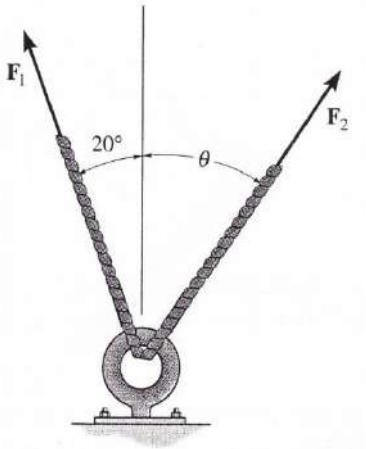
23- For the frame shown in the figure, determine the horizontal and vertical components of force for the pins at *B* and *C*.



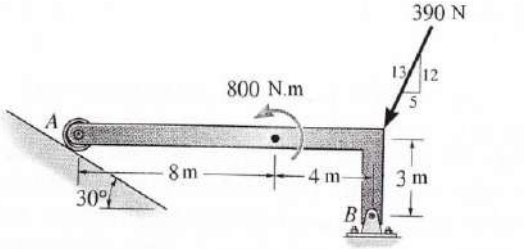
24- Locate the centroid x of the shaded area shown in the figure.



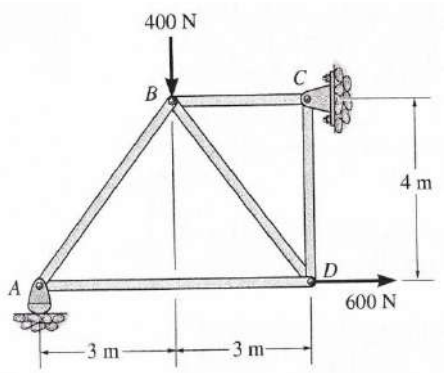
25- The ring shown in the figure is subjected to two forces F_1 and F_2. If it is required that the resultant force have a magnitude of 1500 N and be directed vertically upward, determine the magnitude of F_1 and F_2 if F_2 is to be a minimum.



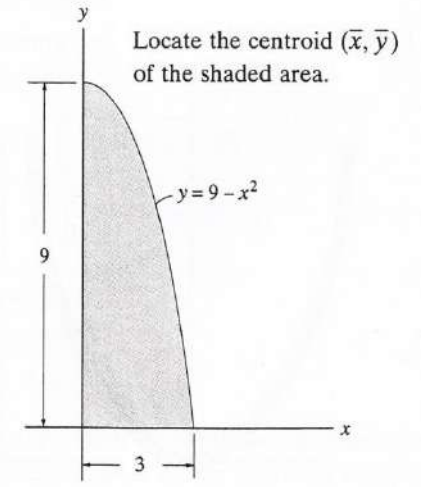
26- Determine the support reactions at A and B.



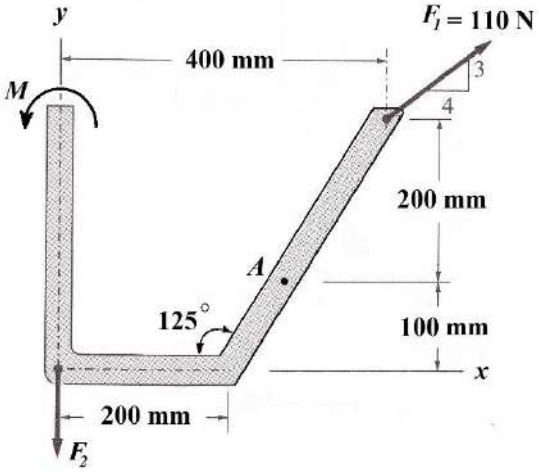
27- Determine the force in member *BD* of the truss shown. Indicate whether the member is in tension or compression.



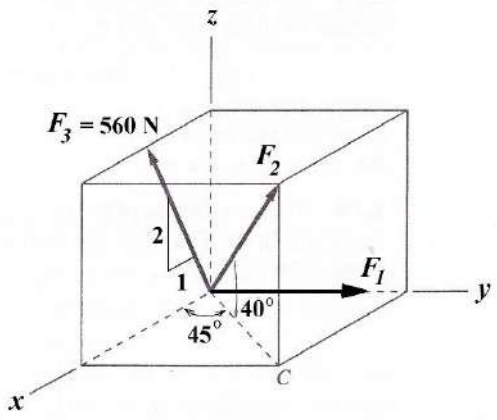
28- Locate the centroid (x,y) of the shaded area.



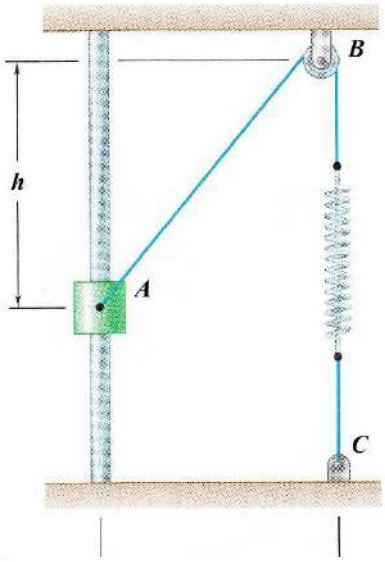
29- The resultant of the force system shown passes through point *A*. The magnitude of the resultant force is equal to 95 N. Determine the magnitudes of the force F_2 , the couple moment *M* and the direction of the resultant force.



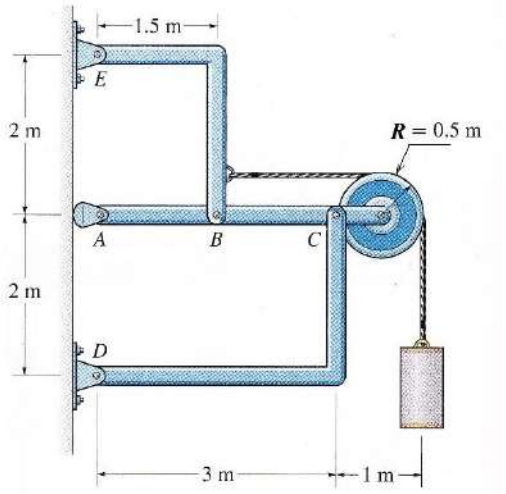
30- The three concurrent forces $\boldsymbol{F_1}$, $\boldsymbol{F_2}$ and $\boldsymbol{F_3}$ have a resultant force of $\mathbf{F}_R=\{660\mathbf{i} + 710\mathbf{j} + F_{RZ}\mathbf{k}\}$N. Determine the magnitudes of the forces $\boldsymbol{F_1}$, $\boldsymbol{F_2}$ and F_{RZ}.



31- The collar A shown in the figure can slide on a frictionless vertical rod and is attached as shown to a spring. The constant of the spring is $k = 660$ N/m, and the spring is unstretched when $h = 300$ mm. Knowing that the system is in equilibrium when $h = 400$ mm, determine the weight of the collar.



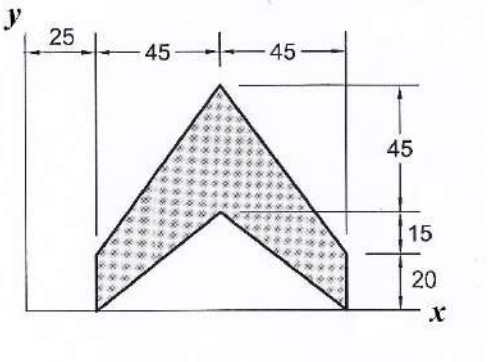
32- Determine the support reactions at E, A and D. The suspended cylinder has a weight of 82 kg.



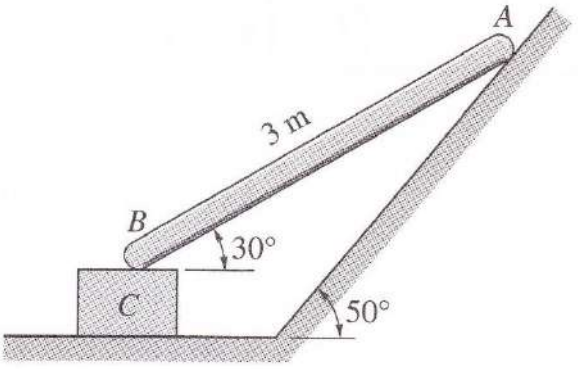
33- For the shaded area shown:

1- Locate the centroid (x , y).
2- Determine I_x and I_{xy}.

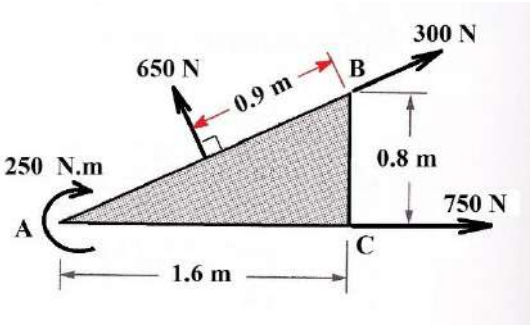
Note: The dimensions are in mm.



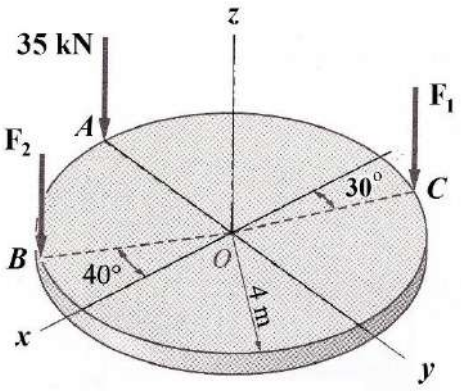
34- The uniform bar AB weighs 225 kg, and the weight of block C is 135 kg. The contact surface at A is smooth, and the coefficient of static friction is μ_s = 0.4 at the other two contact surfaces. Are the system in static equilibrium?



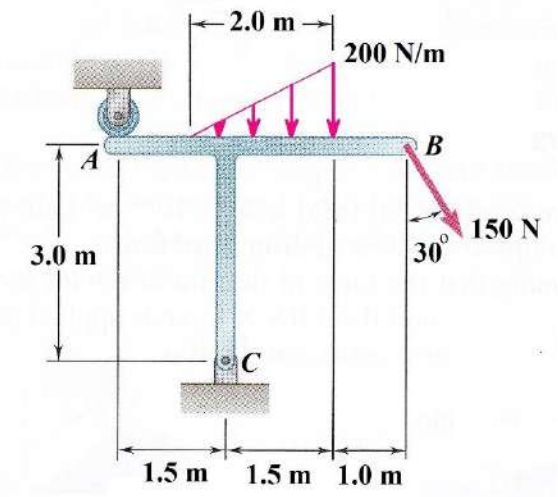
35- Replace the loading on the triangle by a single resultant force. Specify where its line of action intersects the side AC, measured from C.



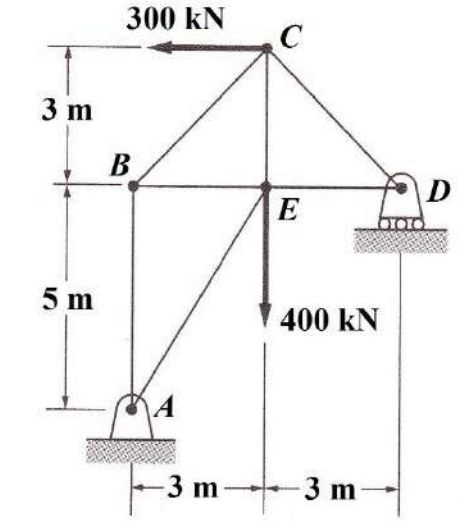
36- The circular plate is acted on by three parallel forces. If the line of action of the resultant force intersects the plate at x = -0.62 m and y = -1.24 m, determine the magnitudes of the forces F_1 and F_2.



37- A T-shaped bracket supports a concentrated and distributed load as shown. Determine the reactions at *A* and *C*.



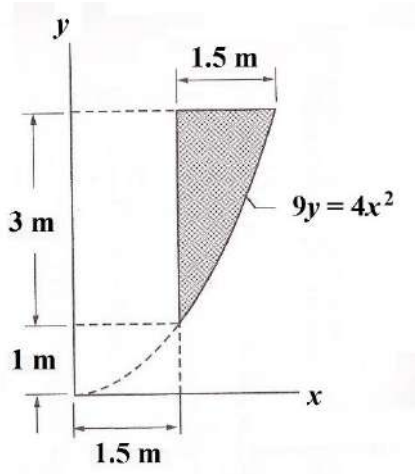
38- Determine the force in member *BE* of the truss shown in the figure and state if the member is in tension or compression.



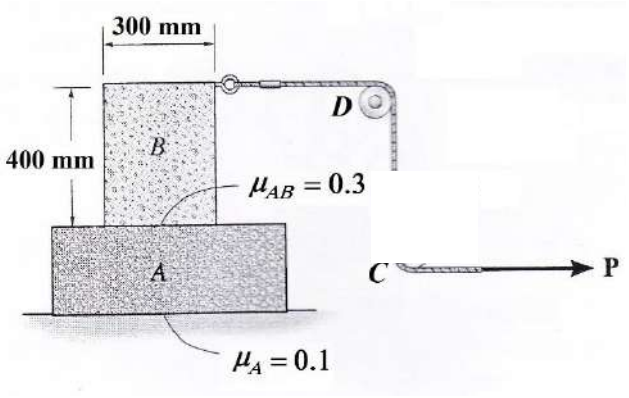
39- For the shaded area shown:

1- Locate the centroid (x , y).

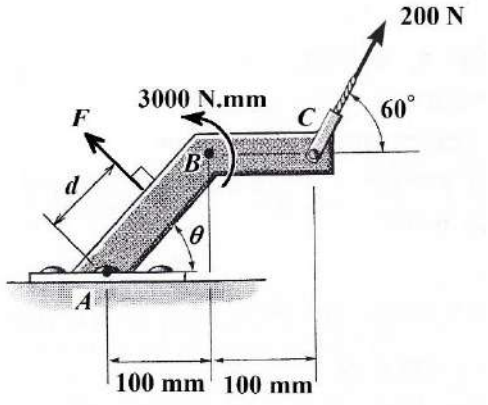
2- Determine I_y and I_{xy}.



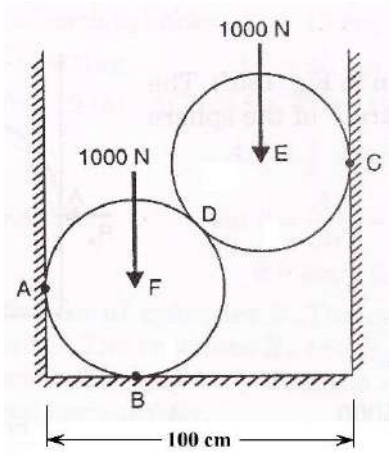
40- Blocks A and B have a mass of 7 kg and 10 kg,respectively. Using the coefficient of static friction indicated, determine the largest force P which can be applied to the cord without causing motion. There are pulleys at C and D.



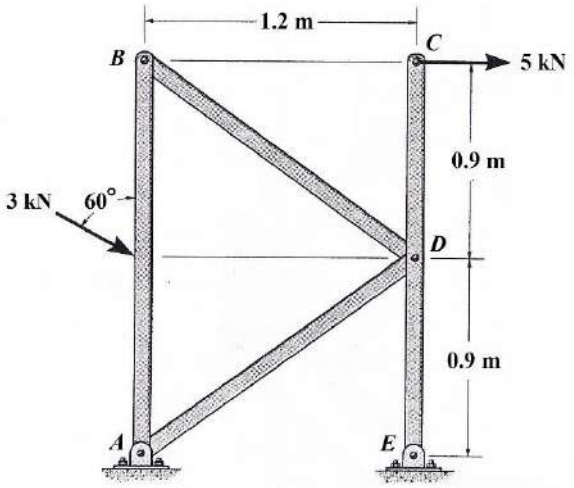
41- In the bracket shown in the figure, if the resultant of force-couple system is vertically upward at a distance 45 mm right of B and has a magnitude of 280 N. Determine the magnitudes of the force F, the angle Θ and the distance d.



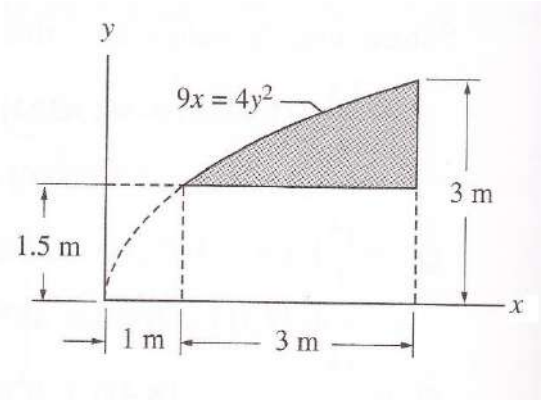
42- Two spheres, each of weight 1000 N and of radius 30 cm rest in a horizontal channel of width 100 cm. Assuming that all the contact surfaces to be smooth, find the reaction on the points of contact A, B and C.



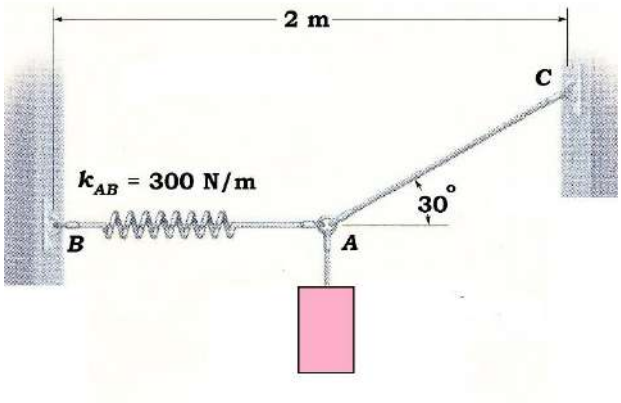
43- For the frame shown, determine the support reactions at A and E.



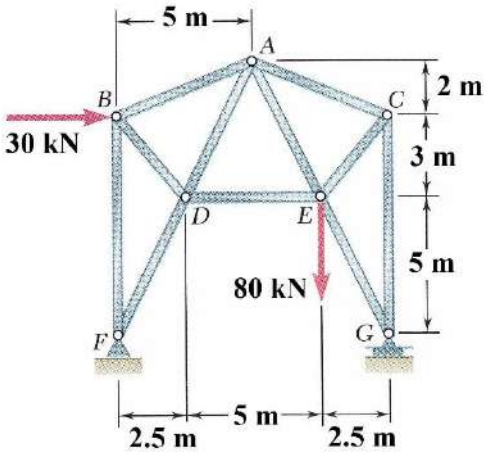
44- Determine the coordinates of the centroid (x, y) of the shaded area.



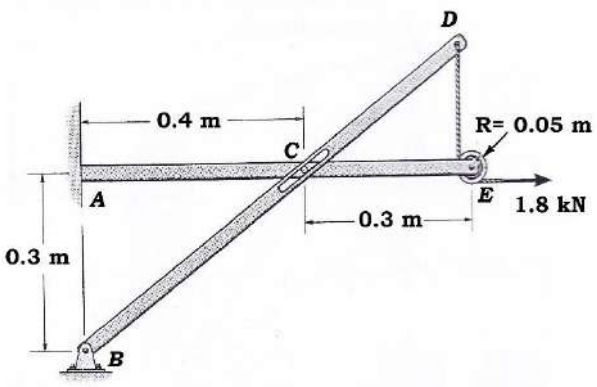
45- Determine the required length of cord AC so that the 8 kg block is suspended in the position shown. The undeformed length of spring AB is equal to 0.4 m.



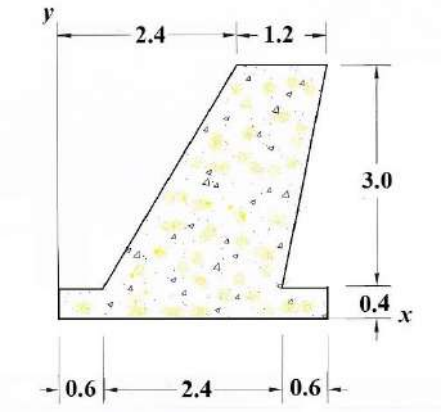
46- Determine the force in members DE and AE of the truss. State if these members are in tension or compression.



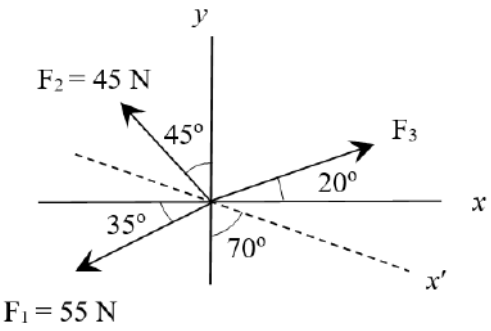
47- In the frame shown the pin attached to member AE, passes through a smooth slot in member BD. Determine the horizontal and vertical components of reaction at B.



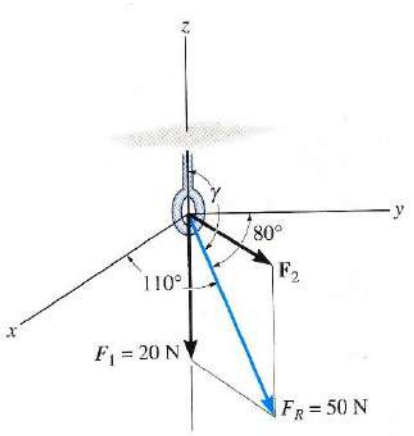
48- The gravity wall is made of concrete. Determine the location of the centroid *x*.



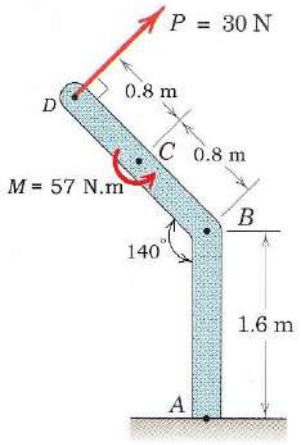
49- In the concurrent coplanar force system, determine the magnitudes of the resultant force and F_3 so that the resultant force is directed along negative x'-axis.



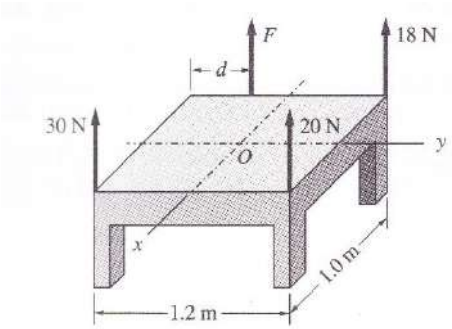
50- Two forces $\mathbf{F_1}$ and $\mathbf{F_2}$ act on the bolt. If the resultant force $\mathbf{F_R}$ has a magnitude of 50 N and coordinate direction angles as shown in the figure, determine the magnitude of $\mathbf{F_2}$ and its coordinate direction angles.



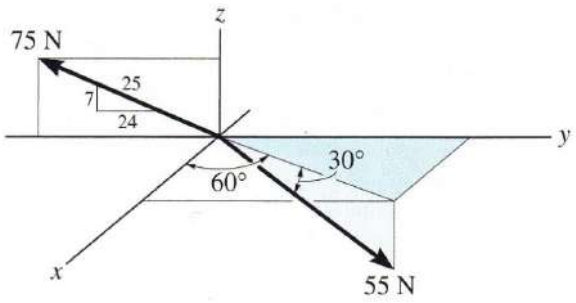
51- Replace the loading on the bent bar by a single resultant force. Specify where its line of action intersects the portion AB, measured from A.



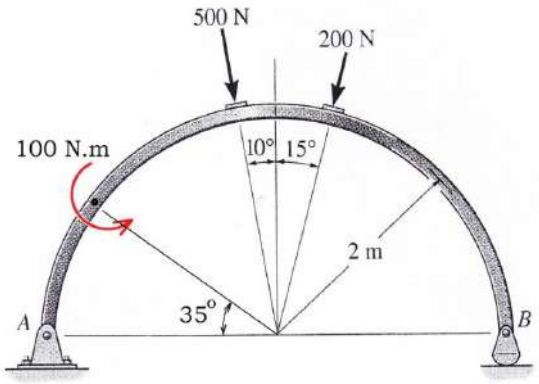
52- If the resultant of the parallel force system passes through point O (point O is the center of the table), determine the magnitude of the force F and the distance d.



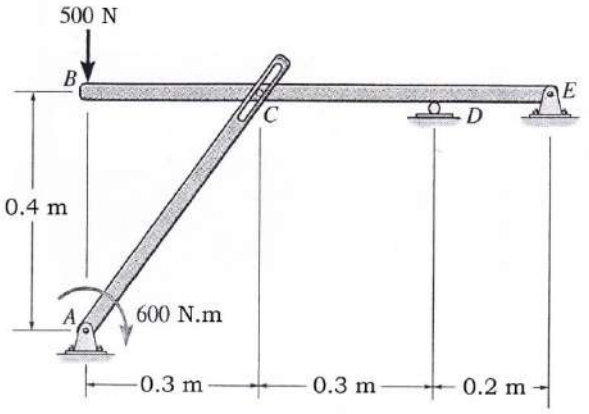
53- Determine the magnitude and coordinate direction angles of the resultant force.



54- Determine the horizontal and vertical components of force at the pin A and the reaction at the rocker B of the curved beam.



55- The two-member structure is connected at C by a pin, which is fixed to BDE and passes through the smooth slot in member AC. Determine the horizontal and vertical components of reaction at supports.



56- Resolve the force shown in the figure into components acting along members *AB* and *AC*, and determine the magnitude of each component.

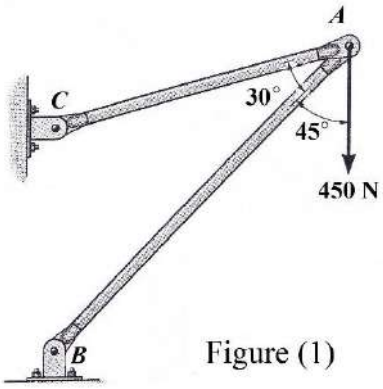


Figure (1)

57- The bracket in the figure (2) is subjected to the two forces $\mathbf{F_1}$ and $\mathbf{F_2}$. If the resultant force $\mathbf{F_R}$={ F_{Rx} i + 468 j + 56.6 k}N, determine the magnitude of the resultant force .

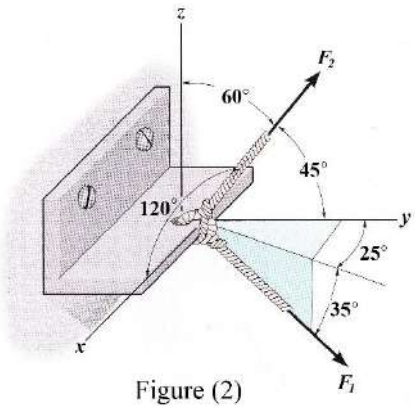


Figure (2)

58- The two forces and couple moment shown in the figure (3) can be replaced by an equivalent resultant force F_R that has a line of action passing through point *A*. Determine the magnitude of F_R and the distance *d*.

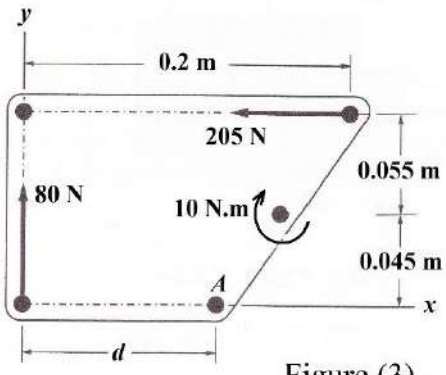


Figure (3)

59- Determine the resultant of the parallel force system that acts on the quarter-circular plate, as shown in the figure (4). Specify the location of the resultant force.

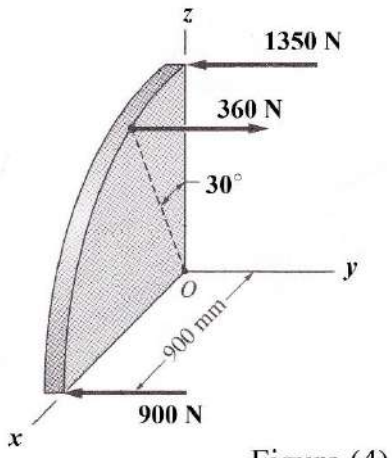
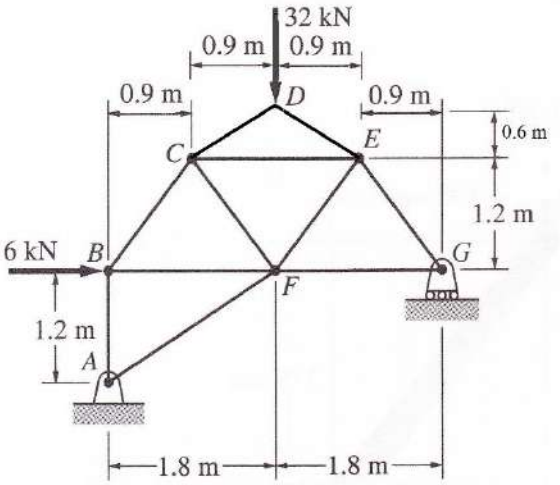
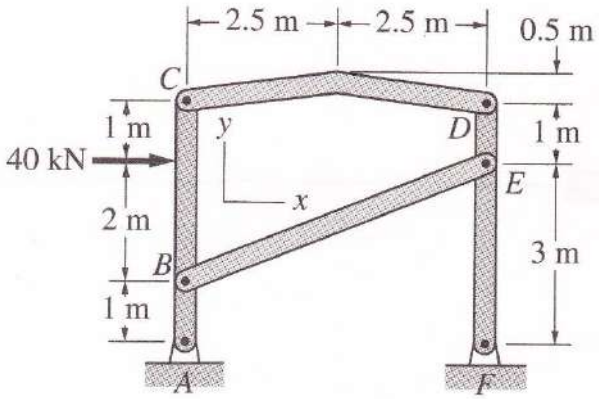


Figure (4)

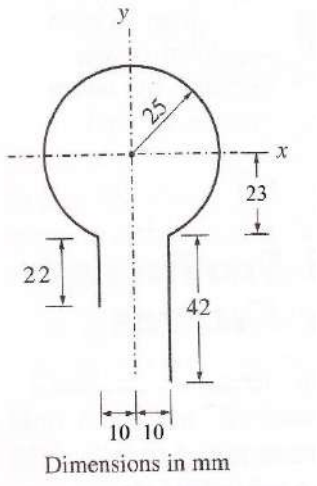
60- Determine the force in member *CF* of the truss shown. Indicate whether the member is in tension or compression.



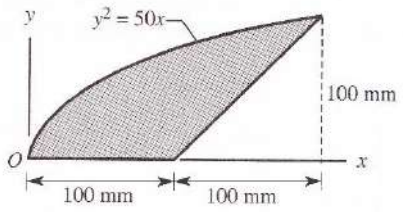
61- Determine all forces acting on members *DEF* of the frame shown.



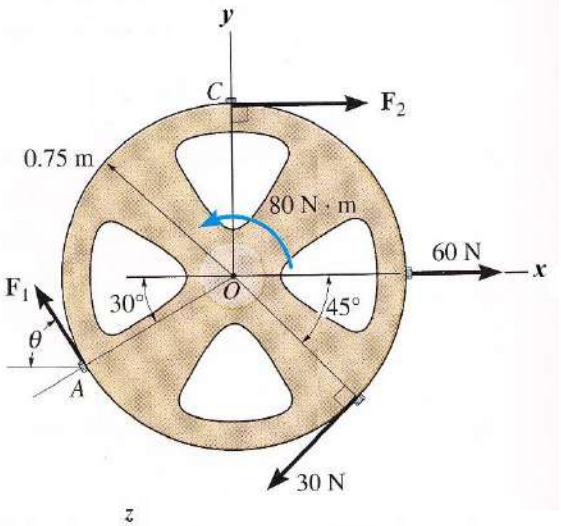
62- Locate the centroid *x* of the curve shown.



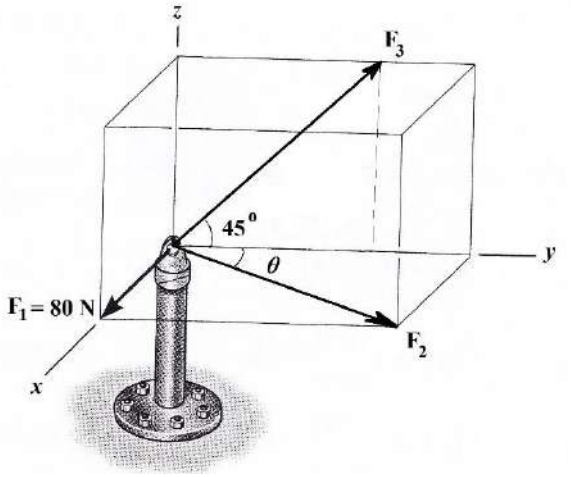
63- Determine the moment of inertia of the shaded area about the *x* axis.



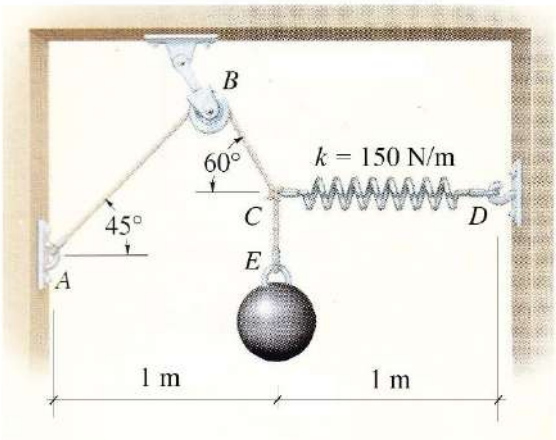
64- The resultant of the force system shown passes through point *O*. The magnitude and direction of the resultant force is 20 N and 30° measured counter clockwise with positive x-axis. Determine the magnitudes of the force F_1, F_2 and the angle θ.



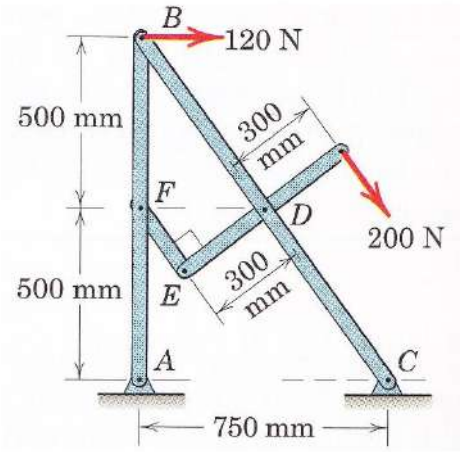
65- The three concurrent forces $\boldsymbol{F_1}$, $\boldsymbol{F_2}$ and $\boldsymbol{F_3}$ have a resultant force of $\mathbf{F}_R=\{148\mathbf{i} + 308\mathbf{j} + 120\mathbf{k}\}$N. Determine the magnitudes of the forces $\boldsymbol{F_2}$, $\boldsymbol{F_3}$ and the angle θ**.**



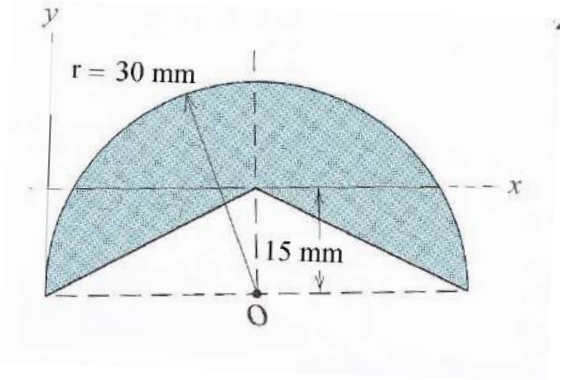
66- The sphere has a mass of 6 kg and is suspended in the position shown. Determine the unstretched length of the spring.



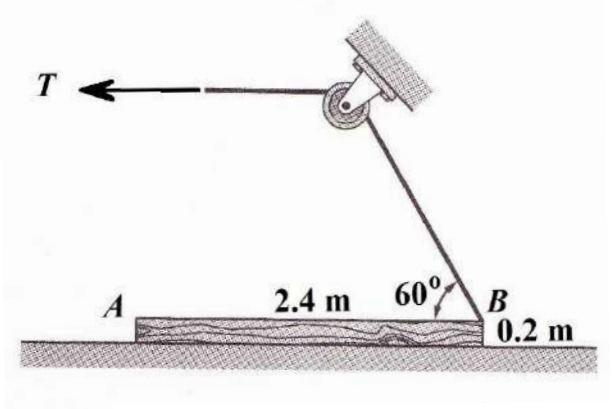
67- Determine the horizontal and vertical components of force at pins *B*, *D,* and *C*.



68- For the shaded area shown:
1- Locate the centroid *y*.
2- Determine I_x and I_{xy}.



69- The uniform log *AB* weighs 135 kg. Determinethe largest tension in the cable for which the log remains at rest. The coefficient of static friction between the log and the plane is $\mu_s = 0.4$.



70- In the force system shown, if the magnitude and direction of the resultant force is 66 N and 40° measured counter clockwise from positive x-axis. Determine the magnitude of the force F, the angle β and specify where the resultant's line of action intersects member *BC*, measured from point *B*.

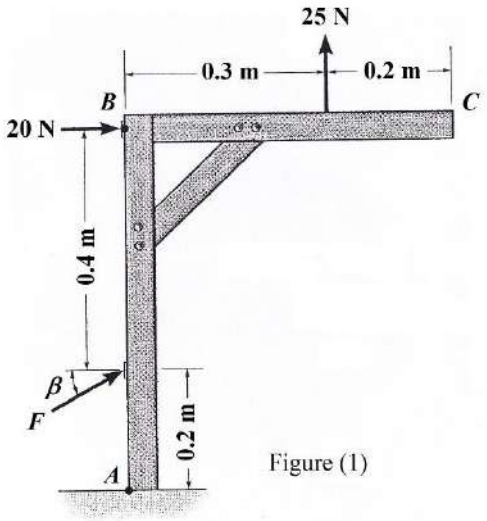


Figure (1)

71- The plate is acted on by four parallel forces. If the resultant force is 250 N vertically upward and its line of action intersects the plate at x = 0.3 m and y = 3.6 m. Determine the magnitude of the force F and specify its location.

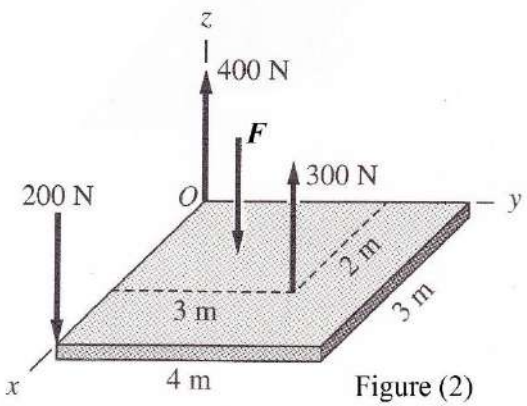
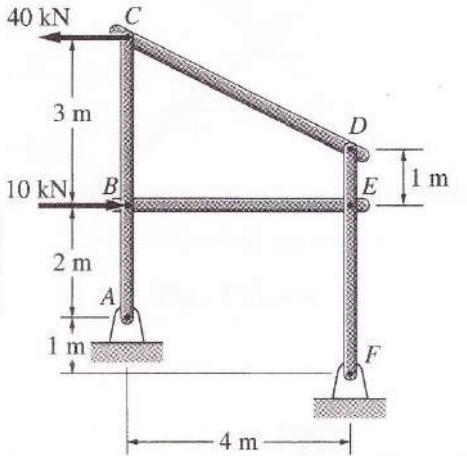
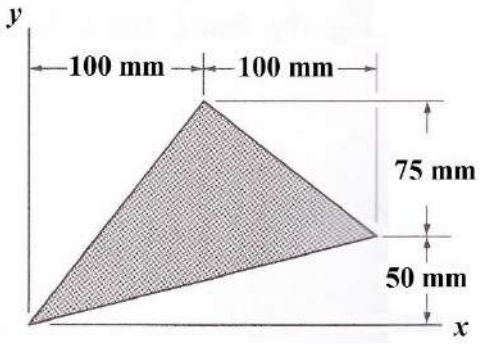


Figure (2)

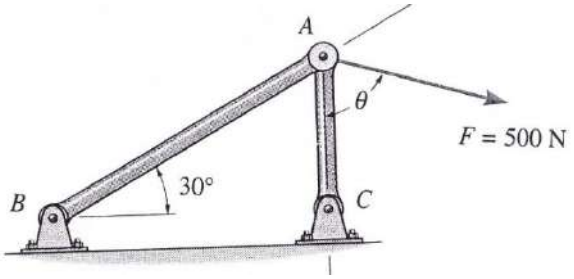
72- Determine the support reactions for the frame shown in the figure.



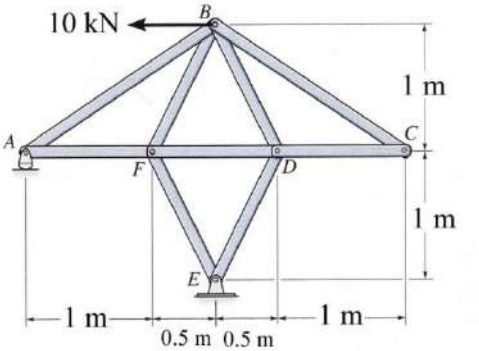
73- For the shaded area shown in the figure (4) determine the centroid *y* and the moment of inertia about *x* - axis.



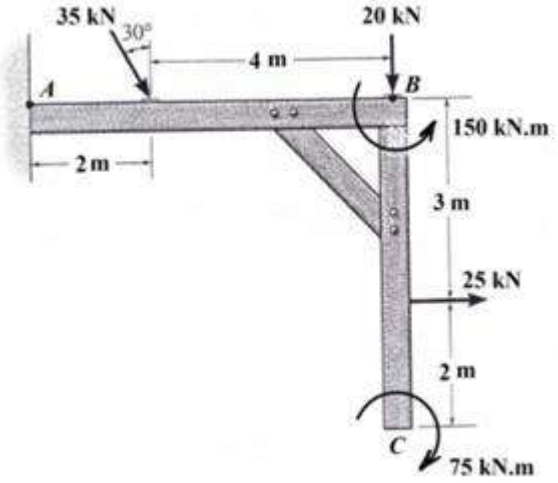
74- The Force F acting on the frame shown has a magnitude of 500 N and is to be resolved into two components acting along members AB and AC. Determine the angle θ, so that the component F_{AC} is directed from A toward C and has a magnitude of 400 N.



75- Determine the force in member DF of the truss and state if the member is in tension or compression.



76- Replace the force and couple moment system acting on the frame by an equivalent resultant force and specify where the resultant's line of action intersects member AB, measured from point A.



77- A disabled automobile is pulled by two tension forces. The resultant force is inclined by an angle 12° measured counter clockwise from positive *x*-axis. Determine the magnitude of the resultant force if F_2 to be a minimum.

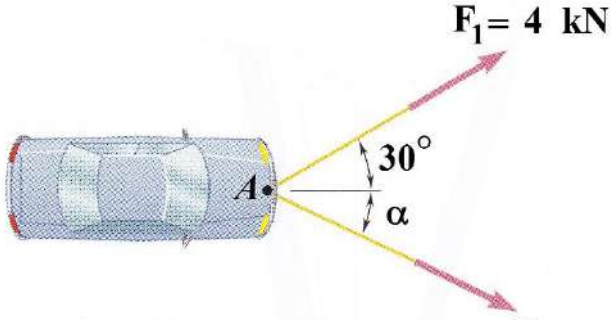


Figure (1)

78- Replace the force and couple system by an equivalent resultant force and specify where the resultant's line of action intersects line *AC* measured from *A*.

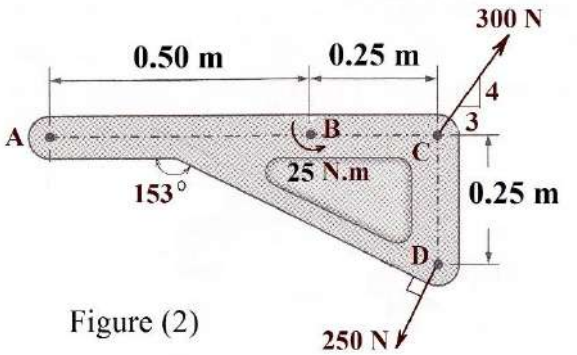
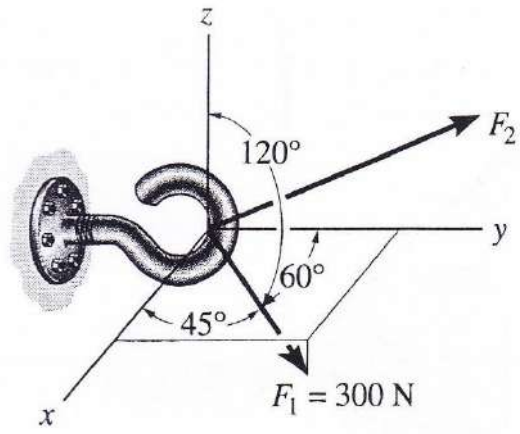


Figure (2)

79- The two forces act on the hook. Determine the magnitude of the force F_2 so that the resultant force $\mathbf{F_R}$ acts along the positive *y* axis and has a magnitude of 800 N.



80- The 1200 kg car shown in the figure (4) is being lowered slowly on to the dock using the hoist *A* and winch *C*. Determine the forces in cables *BA* and *BC* for the position shown.