Homework Problem Statements
ME 270 – Collection FSp IV

Homework H1.A

***Given*:** When a certain linear spring has a stretched length of $L = 180$ mm, the spring carries a *tensile* load of $F = 150$ N. When the same spring has a stretched length of $L = 160$ mm, the spring carries a *compressive* load of $F = 100$ N. The stiffness and unstretched length of the spring are represented by k and L_0, respectively.

Find: For this problem:

a) Determine k and L_0 of this spring in SI units.

b) Determine k and L_0 of this spring in British gravitational units.

Homework Problem H1.B

***Given*:** The speed v of a small propelled vehicle is given in terms of the vehicle's position $x > 0$ by the following equation:

$$v = ax^2 \, ln\left(b\sqrt{x}\right)$$

where x is in feet (ft) and v is in feet/second (ft/s). When the vehicle is at $x = 4$ ft, its speed is 15 miles per hour (mph), and when $x = 16$ ft, its speed is 60 mph.

Find: For this problem:

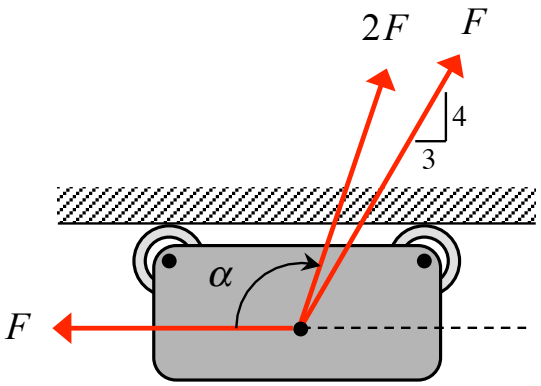
a) Determine the numerical values for the parameters a and b in terms of British gravitational units.

b) What is the speed of the vehicle when $x = 10$ ft?

Homework H2.A

Given: Three forces act on the roller guide shown.

Find: Determine the angle α for which the resultant of the three applied forces has a zero horizontal component.



Homework H2.B

Given: Pre-tensioned cables AB and AD, having tensions of $2T$ and T, respectively, are attached to end A of the L-shaped bracket and exert forces of $\vec{F}_{AB}$ and $\vec{F}_{AD}$, respectively, on the bracket due to these tensions.

Find:

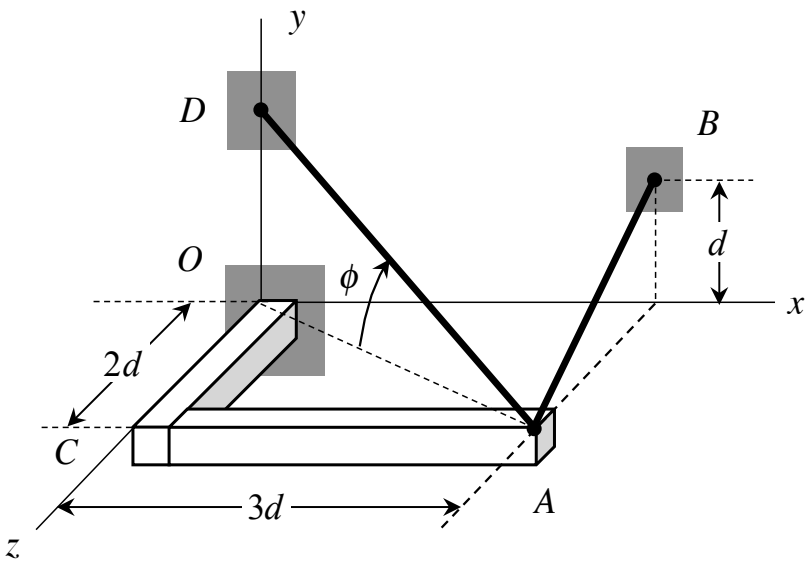
a) Determine the unit vector and force vector for $\vec{F}_{AB}$.

b) Determine the unit vector and force vector for $\vec{F}_{AD}$.

c) Calculate the direction cosines and direction angles for $\vec{F}_{AD}$.

d) Determine the resultant of $\vec{F}_{AB}$ and $\vec{F}_{AD}$.

Use the following parameter value in your analysis: $\phi = 36.87°$.



Homework H3.A

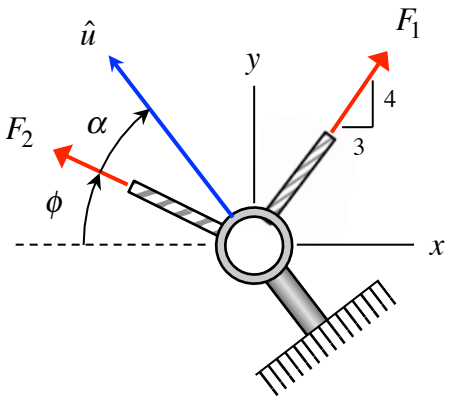
Given: Cable forces $\vec{F}_1$ and $\vec{F}_2$ act concurrently on the ring shown. Let $\vec{R} = \vec{F}_1 + \vec{F}_2$ represent the resultant of these two cable forces, and let $\vec{R}_u$ represent the vector projection of $\vec{R}$ onto the direction defined by the unit vector $\vec{u}$ shown.

Find:

a) Determine the vector $\vec{R}_u$ by directly projecting $\vec{R}$ onto $\vec{u}$.

b) Determine the vector $\vec{R}_u$ by individually projecting $\vec{F}_1$ and $\vec{F}_2$ onto $\vec{u}$ and adding together these vector projections.

Use the following parameter value in your analysis: F_1 = 2 kN, F_2 = 3 kN, ϕ = 20° and α = 30°.



Homework H3.B

Given: Cables BD and CD are attached to corners B and C, respectively, of a hinged door and exert forces of $\vec{F}_{BD}$ and $\vec{F}_{CD}$, respectively, on the door due to their tensions. The tensions in cables BD and CD are known to be T and $2T$, respectively. The door hinges are locked so that these cable loads on the door result from pre-tensioning.

Find:

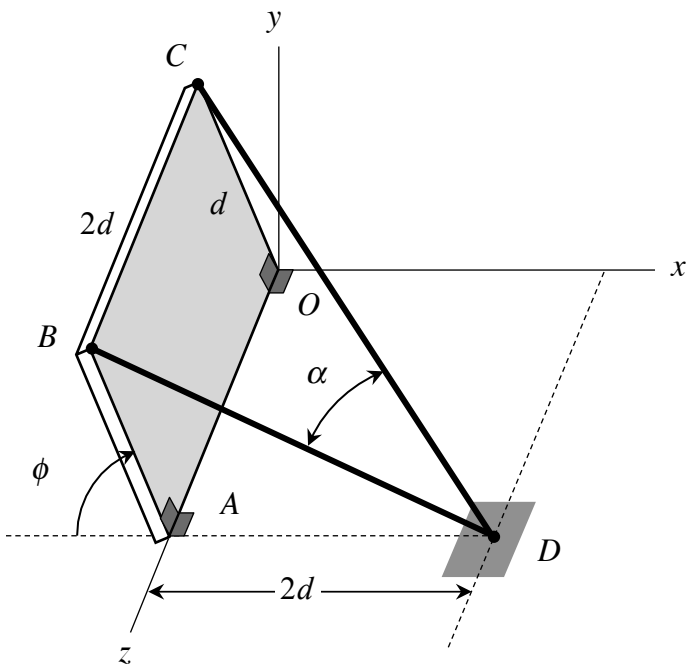
a) Write out the force vectors $\vec{F}_{BD}$ and $\vec{F}_{CD}$ in terms of their Cartesian components.

b) Determine the vector projection of $\vec{F}_{BD}$ onto cable CD.

c) Determine the vector projection of $\vec{F}_{CD}$ onto cable BD.

d) Determine the angle α that exists between cables BD and CD.

Use the following parameter value in your analysis: $\phi = 53.13°$.



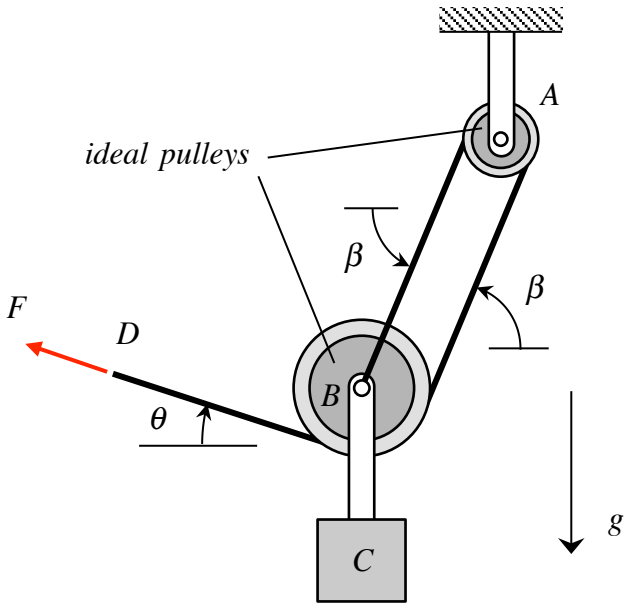
Homework H4.A

Given: Block C, having a weight of W_C, is supported by the cable-pulley system shown below. The cable-pulley system is made up of a single cable DAB, with the cable being wrapped around two ideal pulleys, one end of the cable attached to the pulley center at B, and a force F acting at the free end D of the cable.

Find:

a) If $\beta = 80°$, determine the force F and the angle θ required to hold block C in place. Leave your answer for F in terms of W_C.

b) What is the smallest possible angle β for which C can be held in equilibrium by the force F? Provide an explanation for your answer.

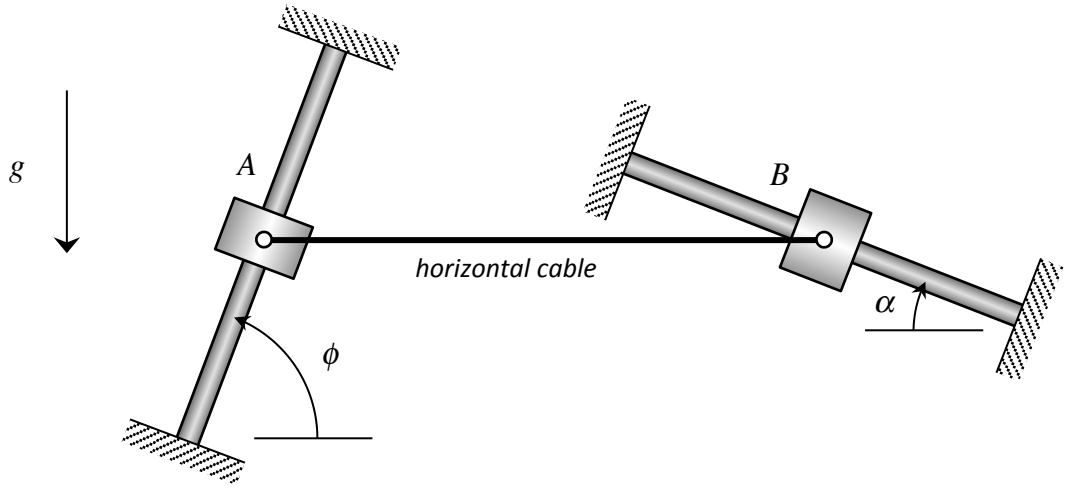


Homework H4.B

Given: Blocks A and B are at rest on a pair of smooth guides, as shown in the figure, where m_A and m_B are the masses for A and B, respectively. A horizontal cable connects the two blocks.

Find: Determine the mass ratio m_A/m_B required for equilibrium.

Use the following parameters in your analysis: $\phi = 75°$ and $\alpha = 25°$.



Homework H5.A

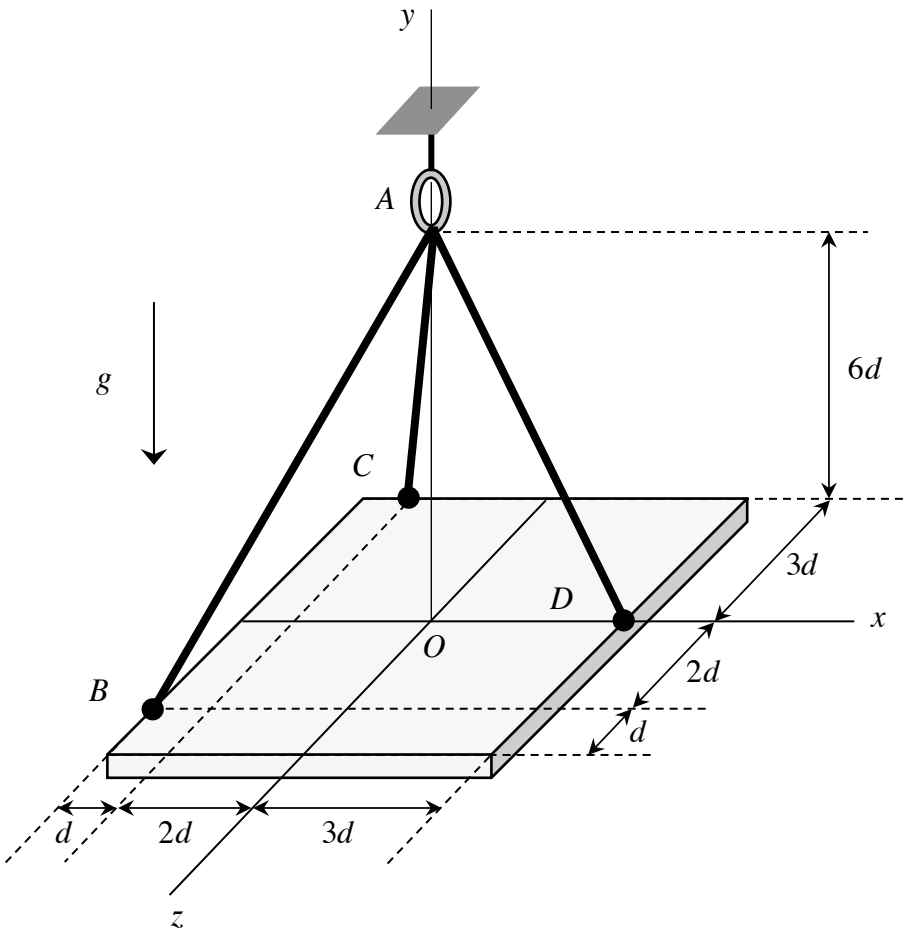
Given: A homogenous plate, having weight of W and its center of mass at point O, is supported by three cables: AB, AC and AD. The plate center of mass O is directly below the support ring A. Each cable is capable of carrying a maximum tensile load of T_{max} without failure.

Find:

a) Determine the tension in each cable in terms of the plate weight W.

b) Which cable carries the largest tension?

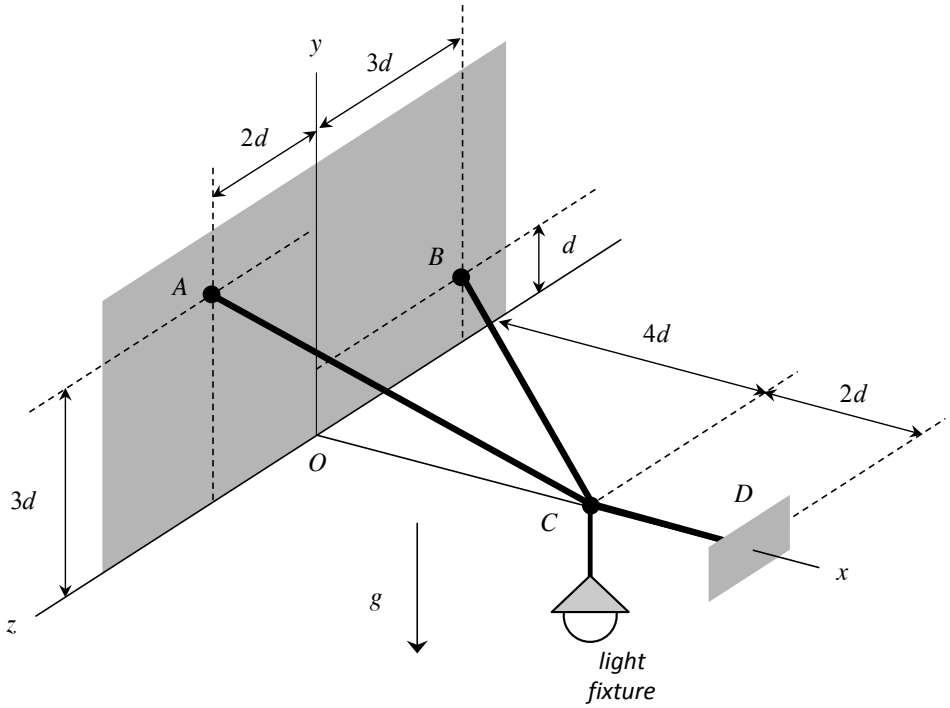
c) Determine the numerical value of the maximum plate weight that can be supported without failure. Express your answer in terms of T_{max}.



Homework H5.B

Given: A light fixture, having weight of *W*, is supported by three cables: AC, BC and DC.

Find: Determine the tension in each cable. Leave your answers in terms of the light fixture weight *W*.



Homework H6.A

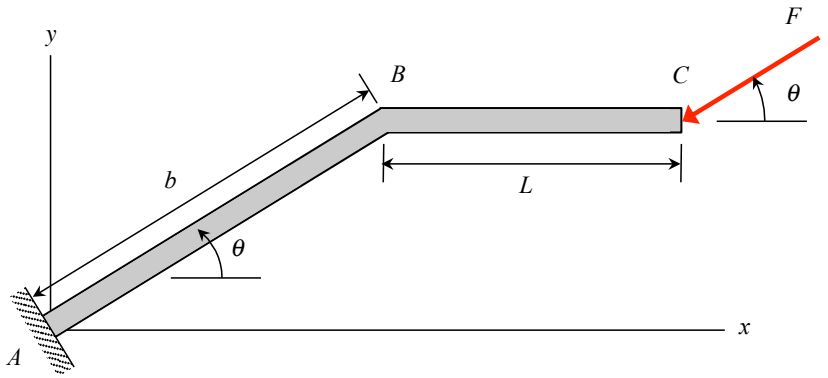
Given: A force $\vec{F}$ acts at end C of the bent bar shown below.

Find:

a) Determine the moment arm d of $\vec{F}$ about point A.

b) Using the moment arm d found above, determine the moment about point A, $\vec{M}_A$, due to the force $\vec{F}$. Write your answer as a vector in terms of, at most: b, L and θ and F.

c) Using the cross product $\vec{r}_{AC} \times \vec{F}$, determine the moment about point A, $\vec{M}_A$, due to the force $\vec{F}$. Write your answer as a vector in terms of, at most: b, L, θ and F. Compare this answer with what you found in part b) above.



Homework H6.B

Given: A pre-tensioned cable DE is attached between ground E and end D of the pipe structure shown. The tension in cable DE is T_{DE}. Let $\vec{F}_{DE}$ represent the force vector on the structure at D due to the cable.

Find:

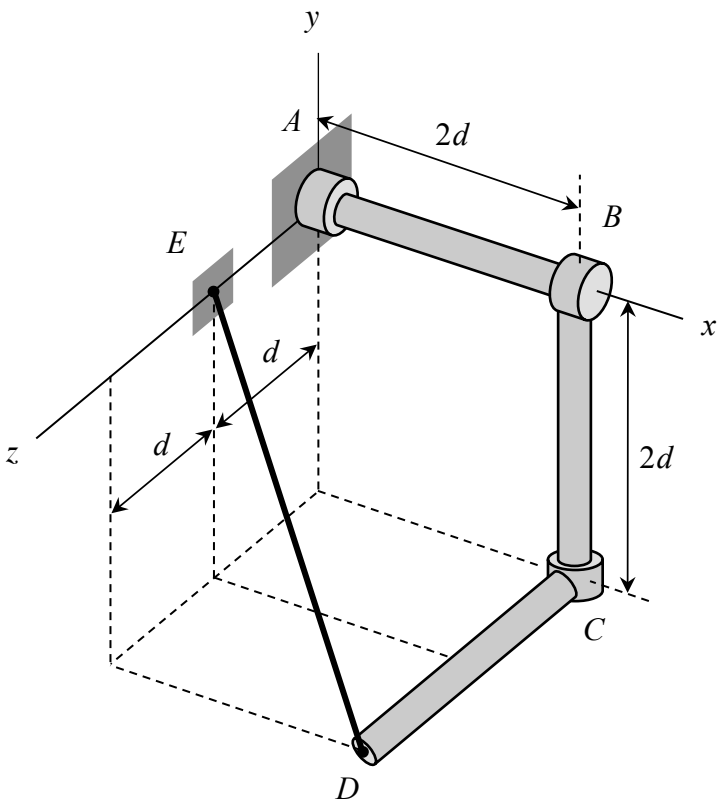
a) Write out $\vec{F}_{DE}$ in terms of its Cartesian components.

b) Determine the moment about point A due to $\vec{F}_{DE}$ using $\vec{r}_{AD} \times \vec{F}_{DE}$.

c) Determine the moment about point A due to $\vec{F}_{DE}$ using $\vec{r}_{AE} \times \vec{F}_{DE}$. Compare your answer with what you found in part a) above.

d) Determine the moment about point C due to $\vec{F}_{DE}$.

Write your answers as vectors and in terms of, at most: T_{DE} and d.



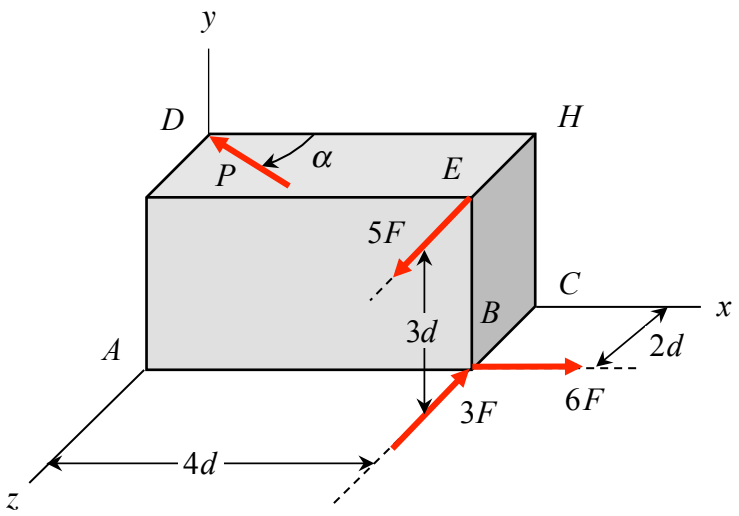
Homework H7.A

Given: A set of four forces act at corners of a parallelpiped block, as shown below.

Find:

a) Determine the value of the load P and the angle α such that this set of forces is equivalent to a single couple $\vec{M}$. Express your answer for P in terms of F.

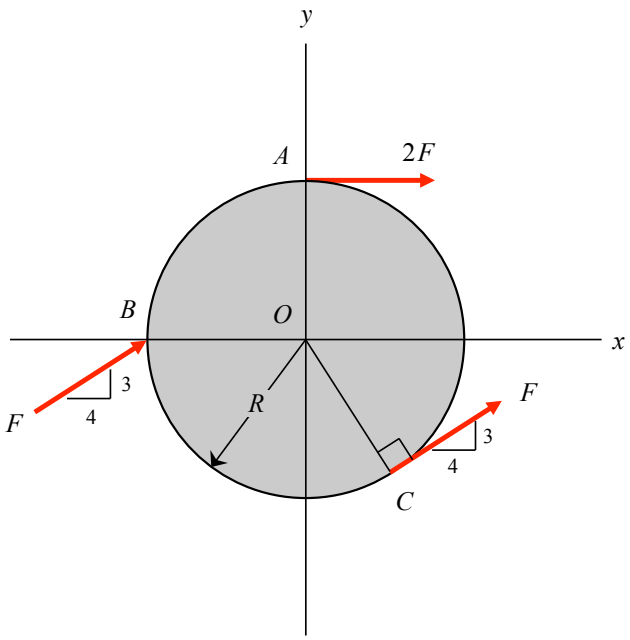
b) Determine the value of the equivalent couple $\vec{M}$. Express your answer in terms of F and d.



Homework H7.B

Given: A set of three forces act on the perimeter of a circular disk, as shown.

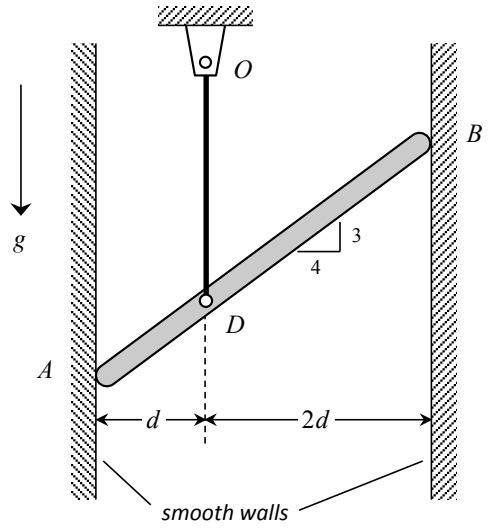
Find: Determine the equivalent force-couple system at the circle's center O. Express your answers in terms of F and R.



Homework H8.A

Given: A homogeneous bar of weight *W* is supported by a vertical cable at point D, and by smooth, vertical walls at ends A and B.

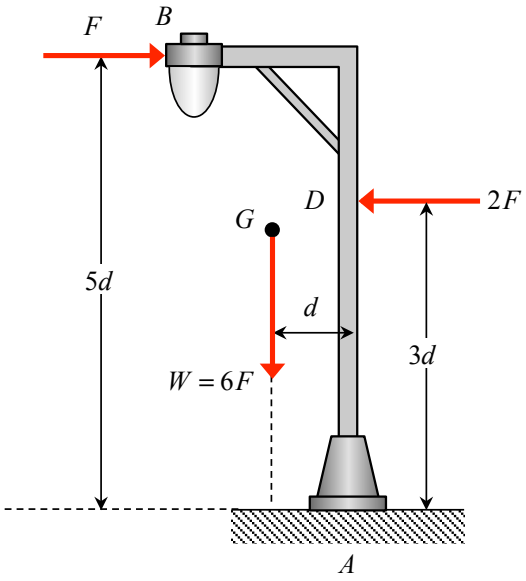
Find: Determine the reactions on the bar at ends A and B. Express your answers in terms of *W*.



Homework H8.B

Given: A street light is acted upon by a pair of horizontal forces at B and D, and by its weight at the center of mass G. Consider the connection of the light at A to be fixed to the ground.

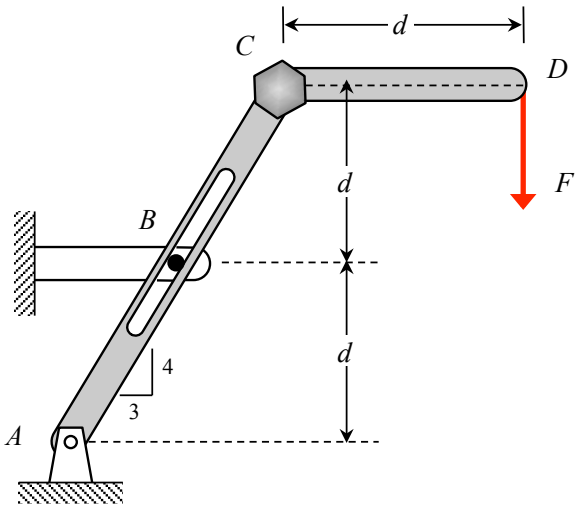
Find: Determine the reactions on the street light at support A. Express your answers as vectors in terms of, at most, W and d.



Homework H9.A

Given: A structure is supported by a pin joint at A and by a smooth pin-in-slot joint at B. A vertical force *F* acts on the structure at D. The weight of the structure is negligible compared to the load *F*.

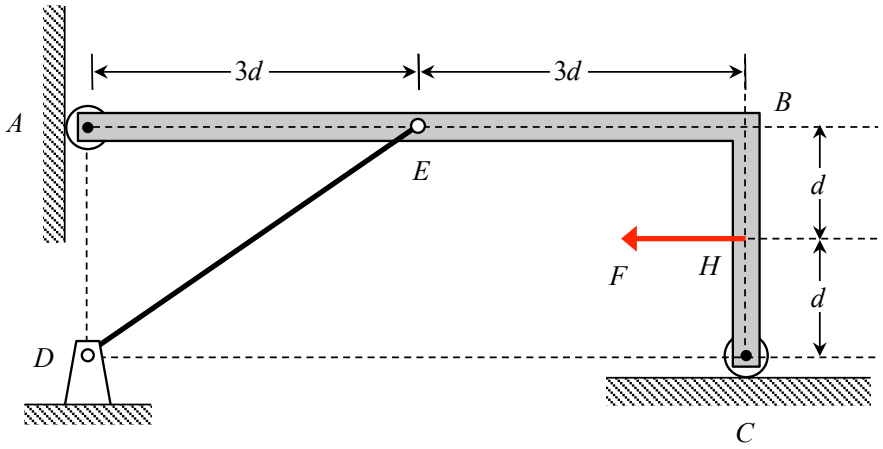
Find: Determine the reactions on the structure at A and B. Express your answers as vectors in terms of *F*.



Homework H9.B

Given: An L-shaped bent bar is supported by smooth rollers at ends A and C, and by cable DE at E. A horizontal force *F* acts on the bar at location H. The weight of the bar is negligible compared to the load *F*.

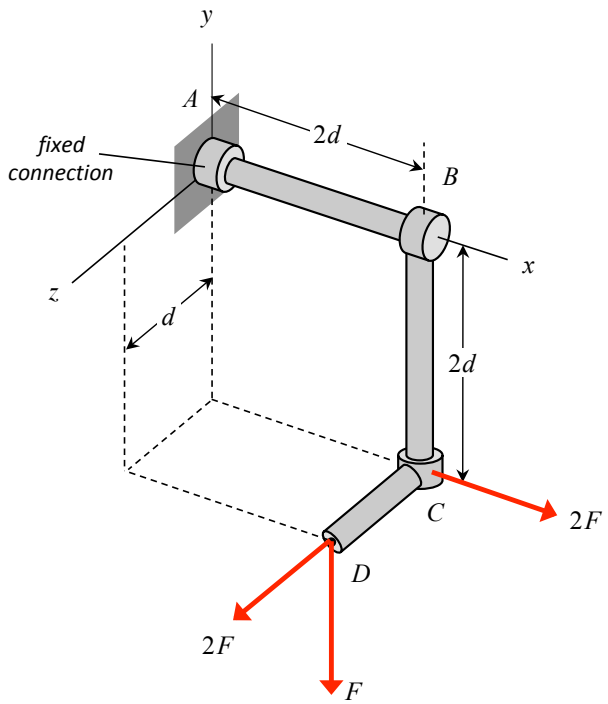
Find: Determine the reactions on the bar at A and C, and the tension in cable DE. Express your answers in terms of *F*.



Homework H10.A

Given: The pipe structure shown is attached to ground with a fixed connection at A. A set of three forces acts on the structure. The weight of the structure is negligible compared to the applied forces acting on the structure.

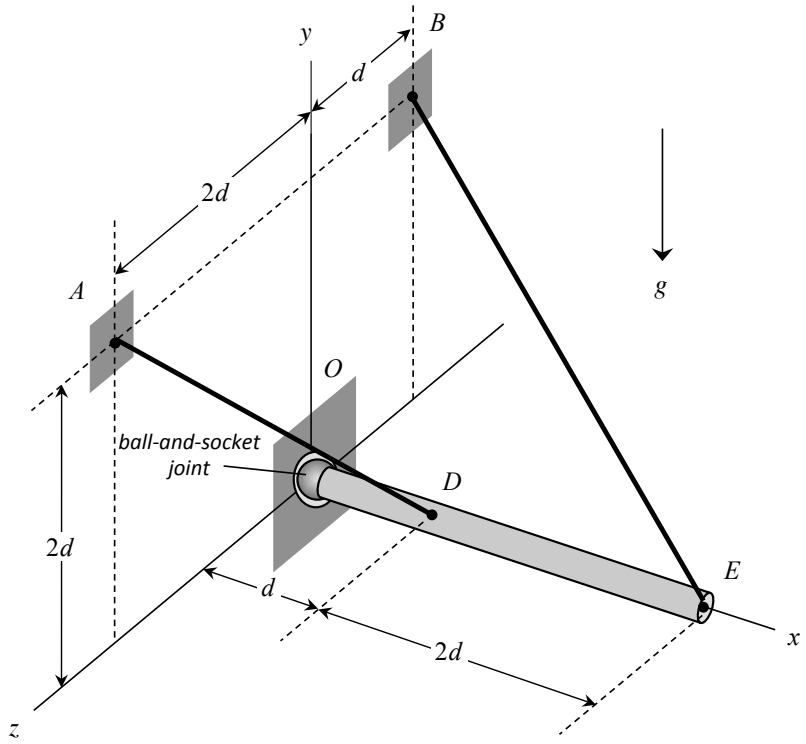
Find: Determine the reactions on the structure at A. Write your answers as vectors in terms of, at most, *F* and *d*.



Homework H10.B

Given: A homogeneous boom pole having a weight of *W* is supported by a ball-and-socket joint at end O, and by two cables, AD and BE.

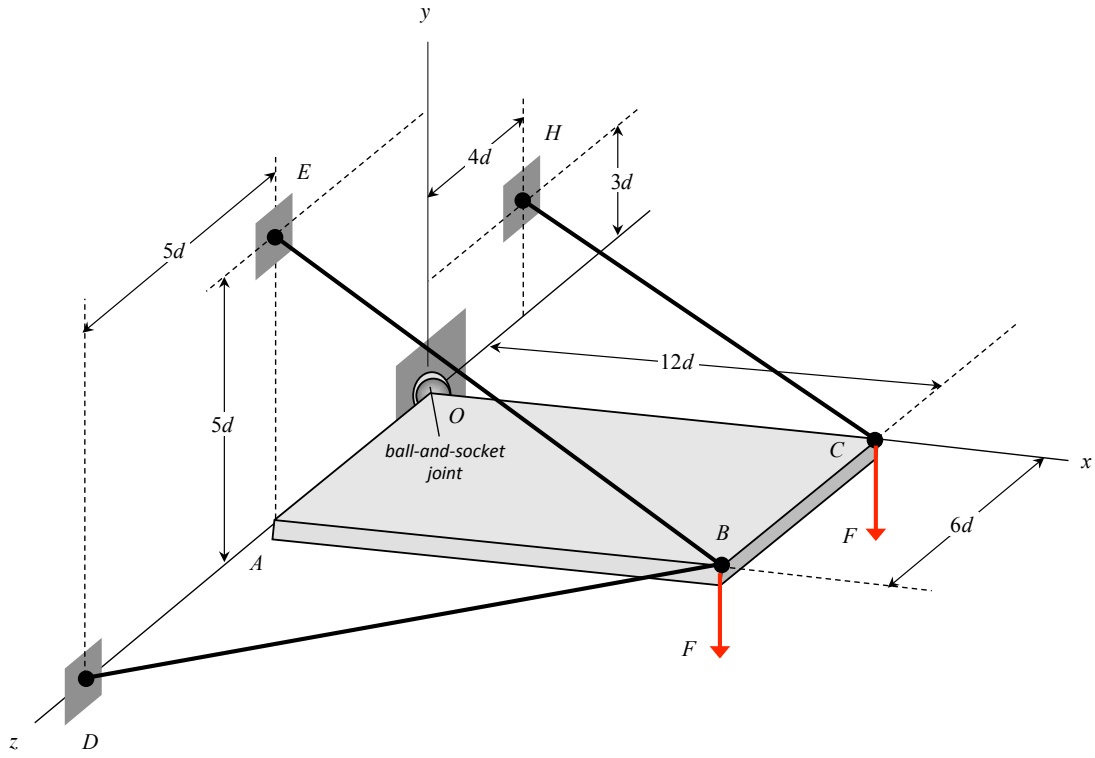
Find: Determine the reactions on the pole at O and the tension forces acting on the pole by the cables. Write your answers as vectors in terms of *W*.



Homework H11.A

Given: A rectangular plate is supported by a ball-and-socket joint at corner O and by three cables: DB, EB and HC. A pair of identical vertical forces act at corners B and C. The weight of the plate is negligible compared to the pair of applied forces.

Find: Determine the tension forces acting on the plate by the cables. Write your answers in terms of *F*.



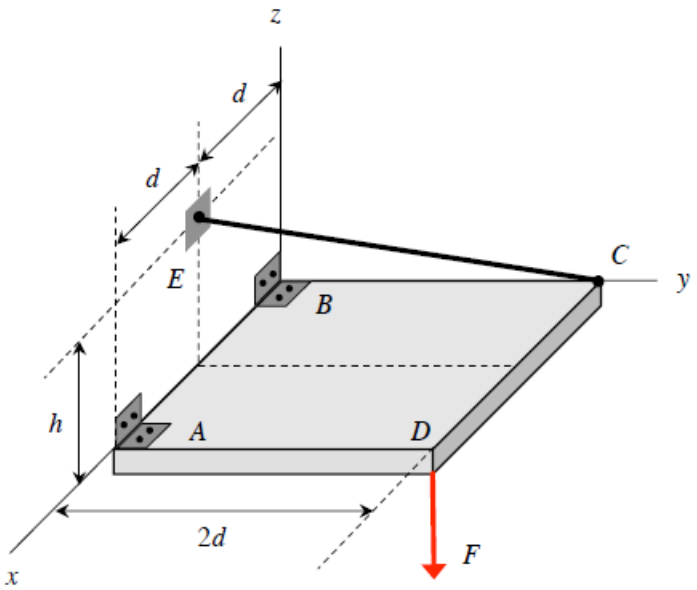
Homework H11.B

Given: The door is loaded at D with a force F and is supported by a cable CE and hinges at A and B. The cable carries a tension of T_{CE}. The hinge at B *carries* a load in the x-direction and the hinge at A *does NOT* carry a load in the x-direction. The weight of the plate is negligible compared to the applied load at D.

Find:

a) Determine the load F.
b) Determine the reactions at hinges A and B.

Use the following parameters in your analysis: $T_{CE} = 200$ N, $h = 0.40$ m and $d = 0.5$ m.

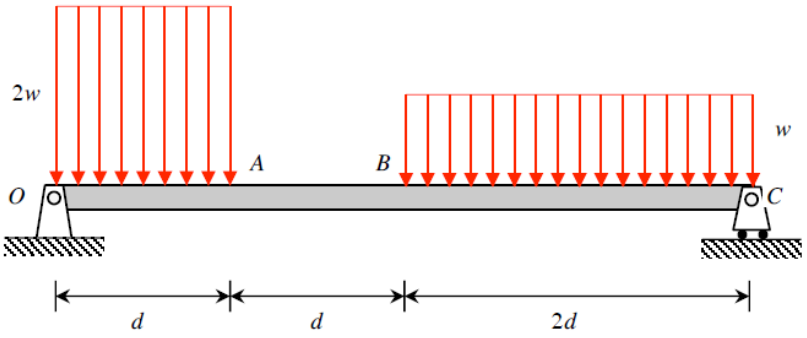


Homework H12.A

Given: The beam is loaded with the distributed load as shown.

Find: Calculate the magnitude and location of the single-force equivalent load.

Use the following parameter values for your work: $d = 2$ ft and $w = 100$ lb/ft.

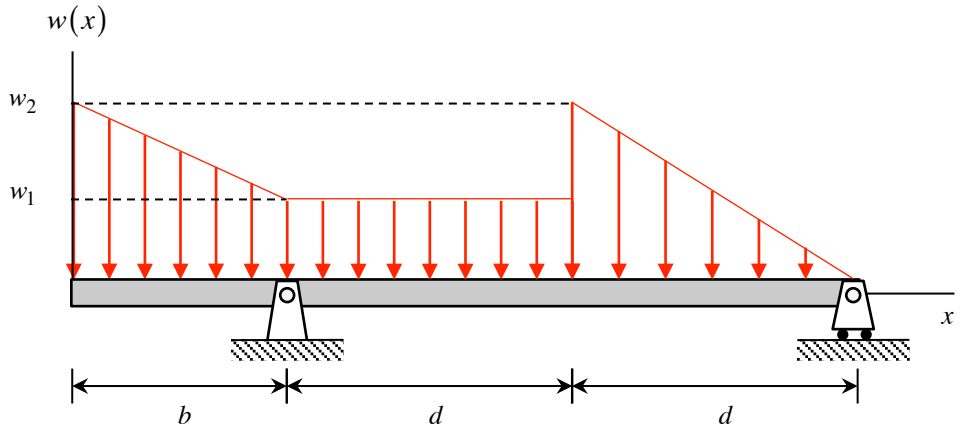


Homework H12.B

Given: The beam is loaded with the distributed load as shown.

Find: Calculate the magnitude and location of the single-force equivalent load.

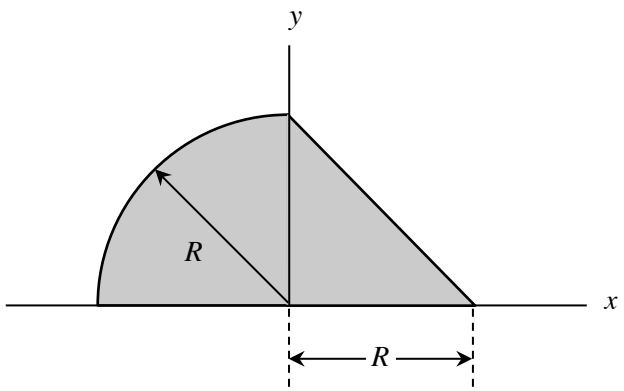
Use the following parameter values for your work: $b = 3$ ft, $d = 4$ ft, $w_1 = 50$ lb/ft and $w_2 = 90$ lb/ft.



Homework H13.A

Given: The area in the figure.

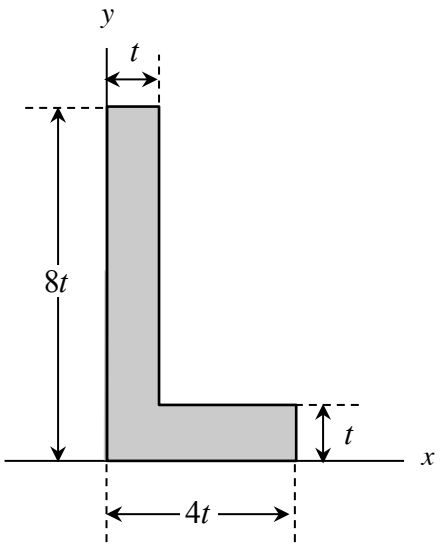
Find: Using the composite section method, determine the area, and the *x*- and *y*-components for the location of the centroid of the area. Leave you answers in terms of *R*.



Homework H13.B

Given: The area in the figure.

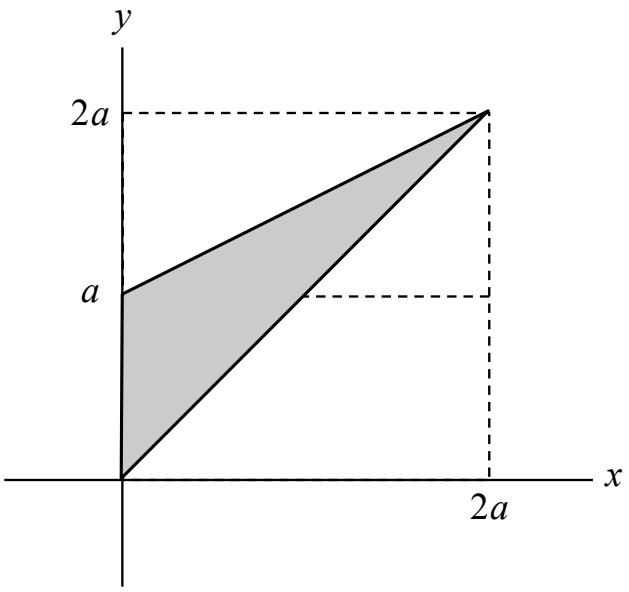
Find: Using the composite section method, determine the area, and the *x*- and *y*-components for the location of the centroid of the area. Leave you answers in terms of *t*.



Homework H14.A

Given: The area in the figure.

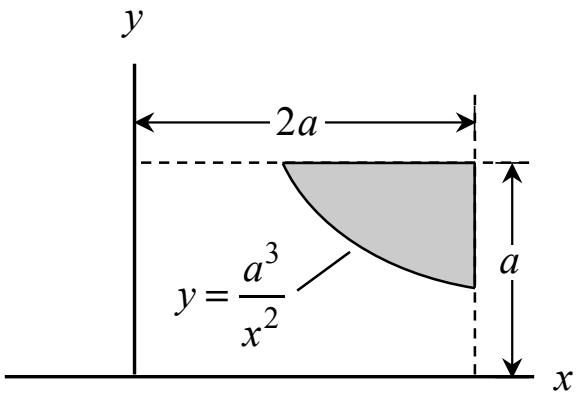
Find: Using integration methods, determine the area, and the *x*- and *y*-components for the location of the centroid of the area. Leave you answers in terms of *a*.



Homework H14.B

Given: The area in the figure.

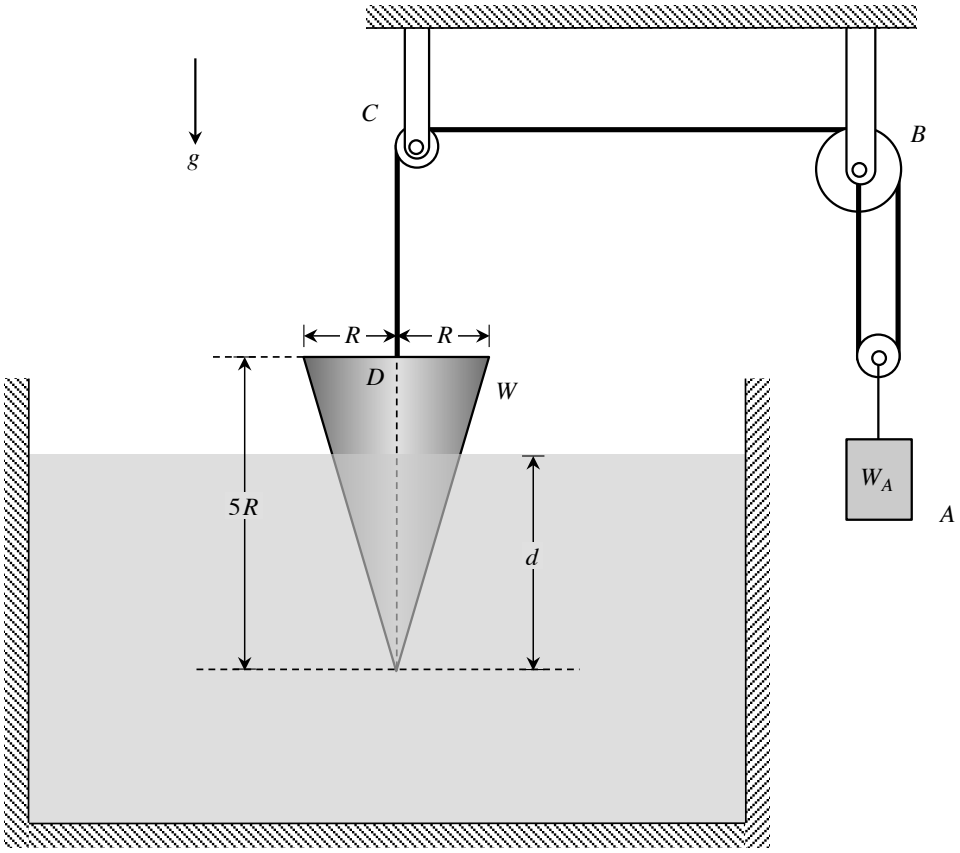
Find: Using integration methods, determine the area, and the *x*- and *y*-components for the location of the centroid of the area. Leave you answers in terms of *a*.



Homework H15.A

Given: A solid cone has a weight of W. The cone is supported through the cable pulley system shown, with the weight of block A being W_A. The cone has also been lowered into a body of water, with the water having a mass density of ρ_w.

Find: What is the minimum weight W_A for which the cone does not sink? Leave your answer in terms of, at most, ρ_w, W and R.



Homework H15.B

Given: A solid cylindrical body has a weight of W. The cylinder has been lowered into a cylindrically-shaped container of water, with the water having a mass density of ρ_w and an original height of H.

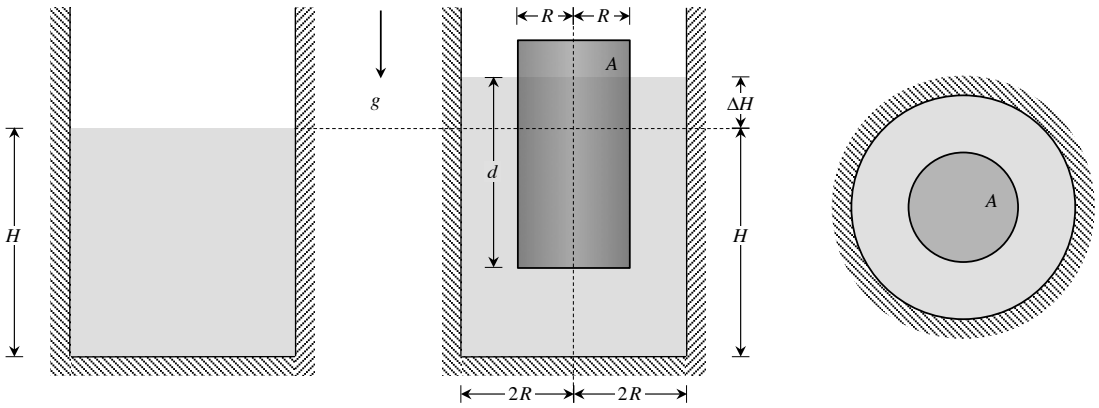
Find:

a) Using the concept of buoyancy, determine the depth d in which the cylinder goes into the water.

b) Using the concept of fluid statics, determine the depth d in which the cylinder goes into the water. Does this answer agree with what you found in a) above?

c) Determine the change in water height ΔH after the cylinder has been lowered into the water.

Leave your answer in terms of, at most, ρ_w, W and R.



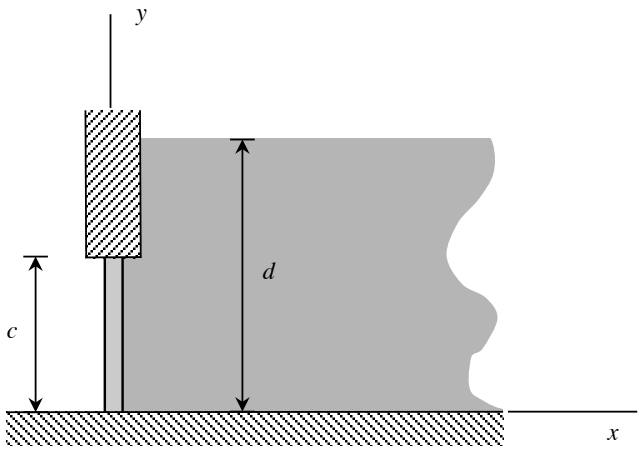
tank with water *tank with water and cylinder* *top view*

Homework H16.A

Given: The submerged door has a width of b (distance out of the paper). The specific weight of the water is ρg.

Find: Calculate the magnitude and location of the single-force equivalent of the hydrostatic force on the door.

Use the following parameter values in your work: b = 4 ft, d = 12 ft, c = 7 ft and ρg = 62.4 lb/ft^3.



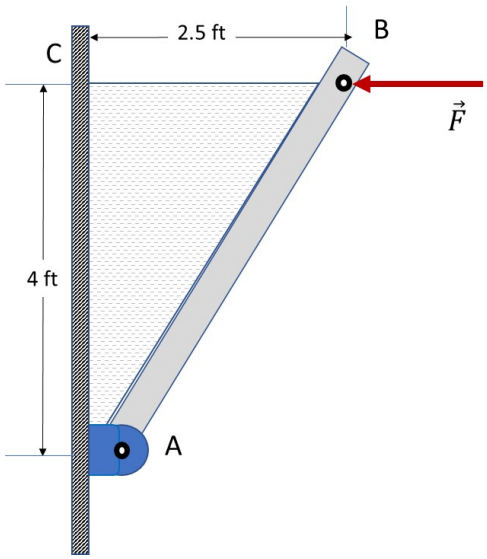
Homework H16.B

Given: The gate is structured as shown and has a width of b (out of the paper). The specific weight of the water is ρg.

Find:

a) Calculate the magnitude and location of the equivalent loading on the face of the gate.
b) Determine the reaction F to maintain the gate in equilibrium.
c) Determine the reactions at pin joint A.

Use the following parameter values in your work: b = 2 ft and ρg = 62.4 lb/ft^3.

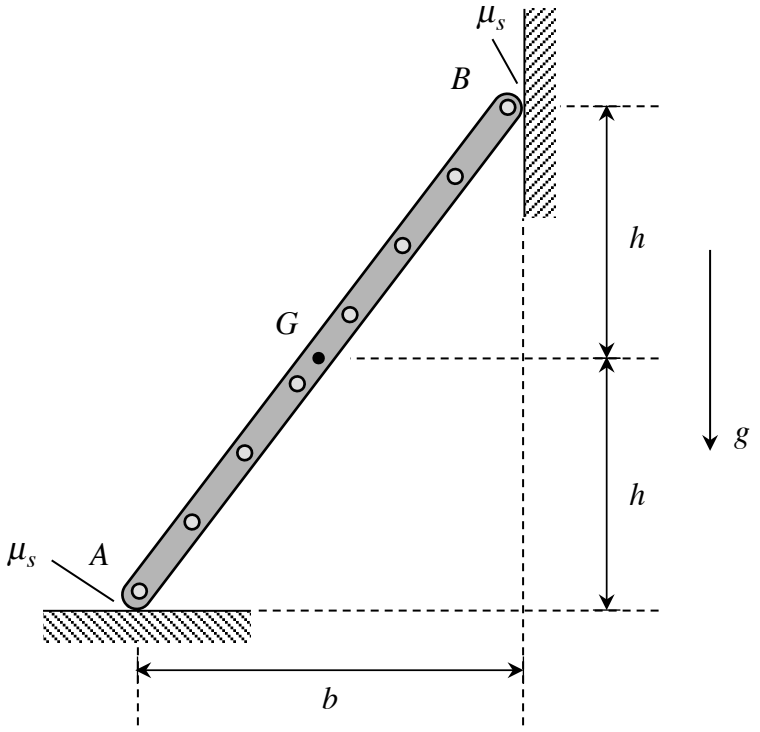


Homework H17.A

Given: A ladder having a weight of W rests on a rough horizontal surface and a rough vertical wall. The center of mass for the ladder is at the midpoint G along the ladder's length. The coefficient of static friction between the ladder and the floor, and between the ladder and the wall, is μ_s.

Find: What is the largest ratio of $b/2h$ that will allow the ladder to remain in equilibrium? What influence does the weight of the ladder have on your answer?

For this problem, use the following parameter: $\mu_s = 0.3$.

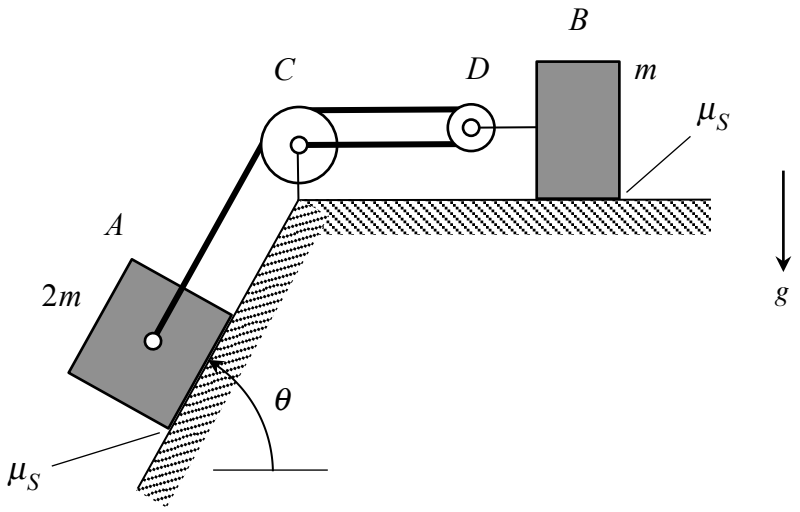


Homework H17.B

Given: Blocks A and B have masses of 2m and m, respectively, and are connected by the cable-pulley system shown. The coefficient of friction between each block and ground is μ_S.

Find: Determine the numerical value for the minimum μ_S required to keep the system in equilibrium.

For this problem, use the following parameter: $\theta = 36.87°$.



Homework H18.A

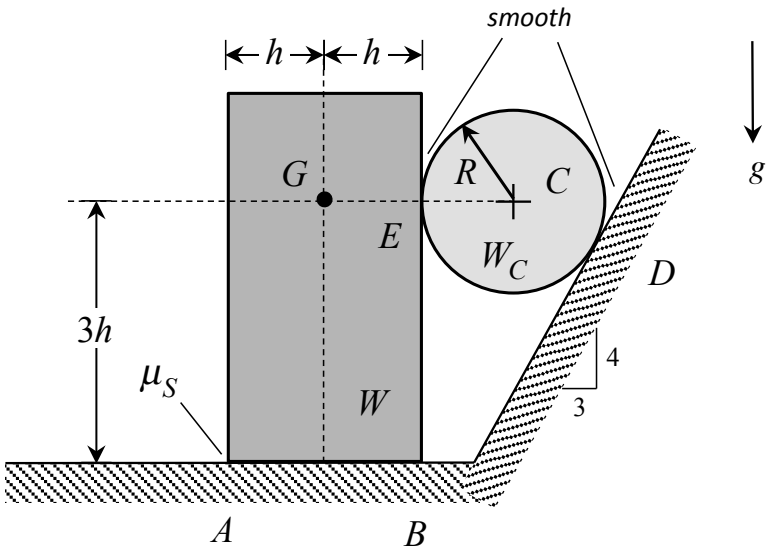
Given: A block having a weight of W rests on a rough horizontal surface, with a coefficient of static friction of μ_S between the block and ground. A smooth cylinder of weight W_C is placed between the right side of the block and an inclined plane.

Find:

a) Determine the largest weight W_C such that the system remains in equilibrium. Express your answer in terms of W.

b) For the cylinder weight found above, is the block in a state of impending tipping or impending slipping?

For this problem, use the following parameter value: $\mu_s = 0.50$.



Homework H18.B

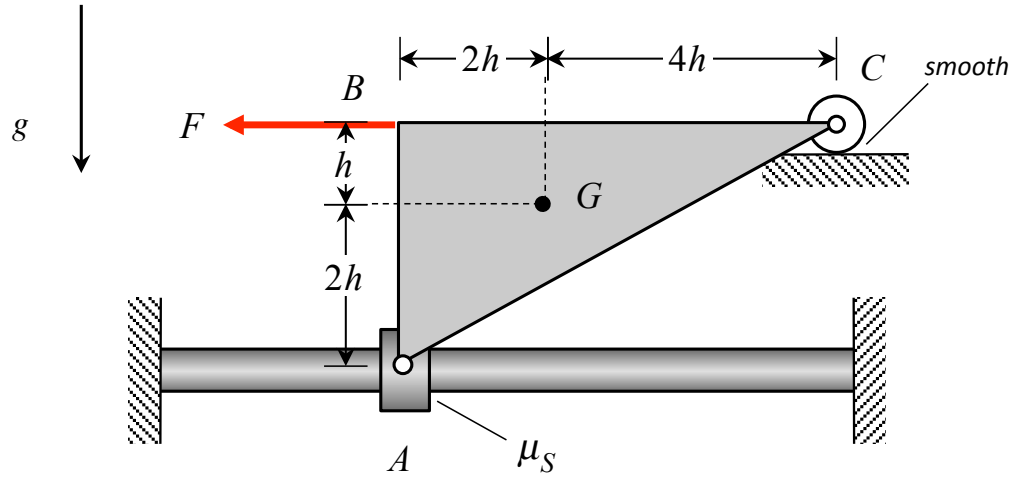
Given: A homogeneous triangular block having a weight of W and its center of mass at G is supported by a slider on a rough horizontal guide at A and by smooth roller on a vertical wall at C. The coefficient of static friction of μ_S exists between the slider and the guide at A.

Find:

a) Determine the maximum force F that can be applied at B and not have the block move. Express your answer in terms of the weight W.

b) For the force F found above, is the block in a state of impending tipping or impending slipping?

For this problem, use the following parameter value: $\mu_s = 0.50$.

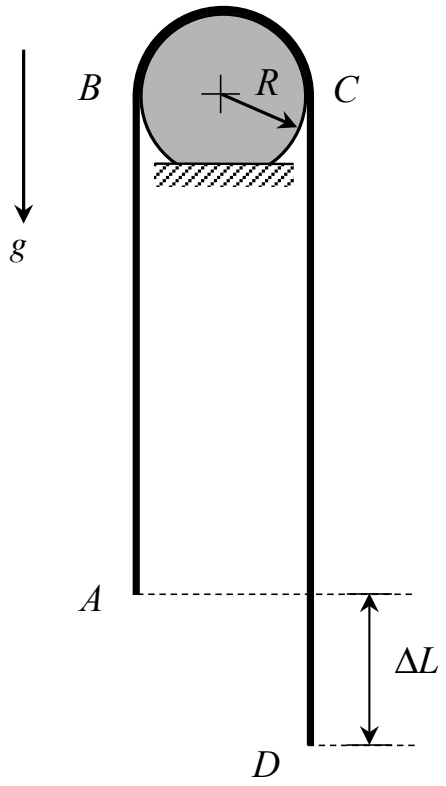


Homework H19.A

Given: Cable AD has a length of L and is has a weight per length of ν. The cable is draped over a rough, fixed cylinder having a radius of R, where μ_S is the static coefficient of friction between the cable and the drum. When the cable is at rest, the difference in height between ends A and D is ΔL. Note that for smooth contact between the drum and the cable ($\mu_S = 0$), $\Delta L = 0$ for equilibrium. For $\mu_S \neq 0$, the cable can remain in equilibrium for a range of values for ΔL.

Find: Assuming that R << L such that the weight of the cable section BC is small compared to the rest of the cable, determine the range of values for ΔL for the cable to remain at rest. Give your answer in terms of the cable length L.

For this problem, use the following parameter: $\mu_s = 0.6$.

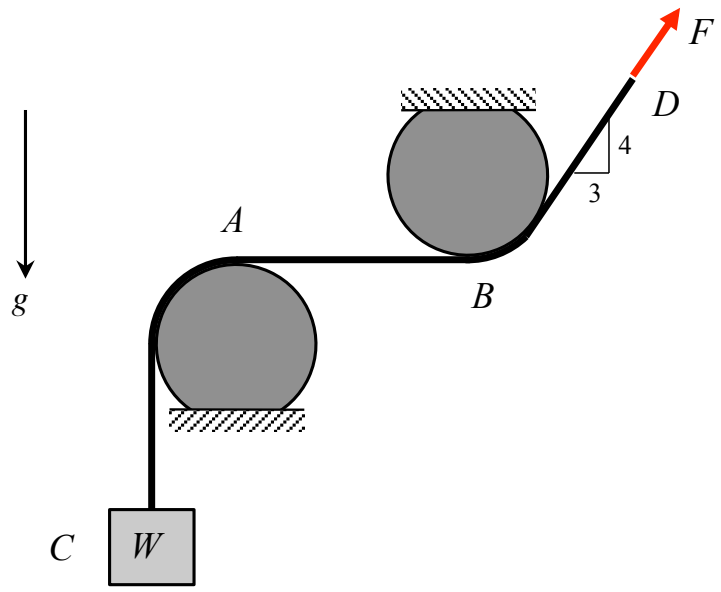


Homework H19.B

Given: Block C, having a weight of W, is supported by cable CD that is pulled over a pair of rough, fixed cylinders, where μ_s is the coefficient of static friction between the cable and cylinders. Note that section AB is horizontal.

Find: Determine the range of values for the force F applied to end D of the cable for which block C remains in static equilibrium. Provide your answer in terms of the block's weight W.

For this problem, use the following parameter: $\mu_s = 0.7$.

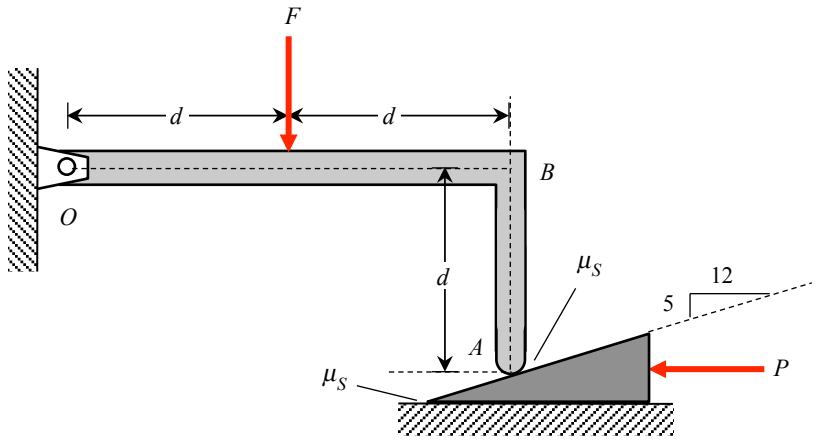


Homework H20.A

Given: The L-shaped arm OA is pinned to ground at end O. End A is supported by a wedge, with the coefficient of static friction between the wedge and the arm, and between the wedge and ground being μ_S. A vertical force F acts on the arm as shown. A horizontal force P is applied to the wedge to hold the wedge in place. Consider the weights of the wedge and arm to be negligible compared to the other forces acting on the system.

Find: Determine the largest force P for which the system remains in equilibrium. Express your answers in terms of the applied force F.

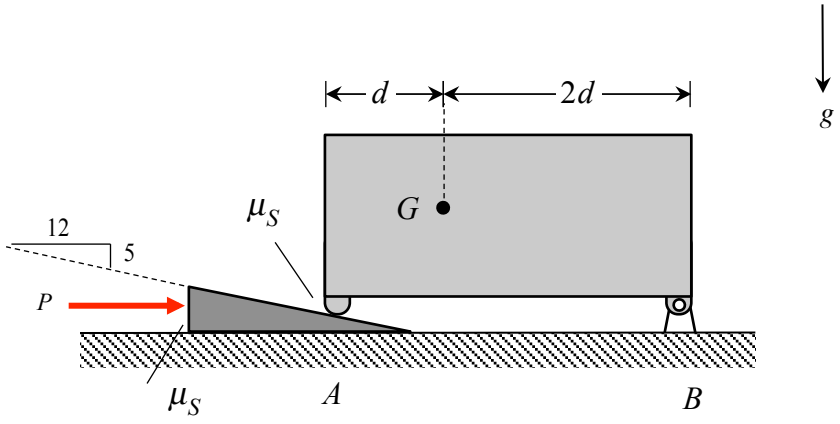
For this problem, use the following parameter: $\mu_s = 0.3$.



Homework H20.B

Given: An inhomogeneous block having a weight of W and its center of mass at G is to be raised with a wedge at support A. The coefficient of static friction between the block and the wedge is μ_S.

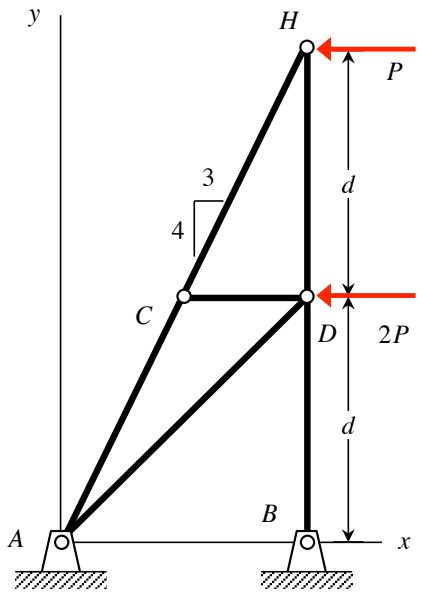
Find: Determine the minimum value of the wedge force P in order to raise the block at A.



Homework H21.A

Given: Consider the truss shown below with the loading on joints D and H.

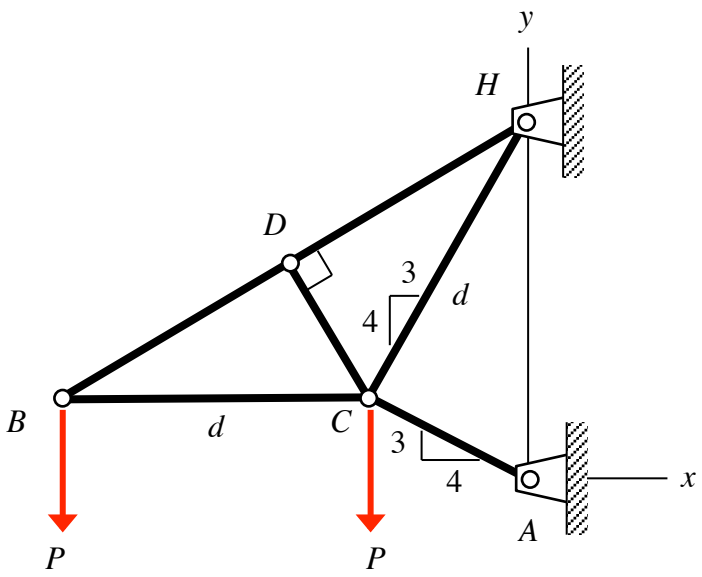
Find: Determine the load carried by all members in the truss. Identify each member as either being in tension, in compression or carrying zero load. Leave your answers in terms of *P*.



Homework H21.B

Given: Consider the truss shown below with the loading on joints B and C.

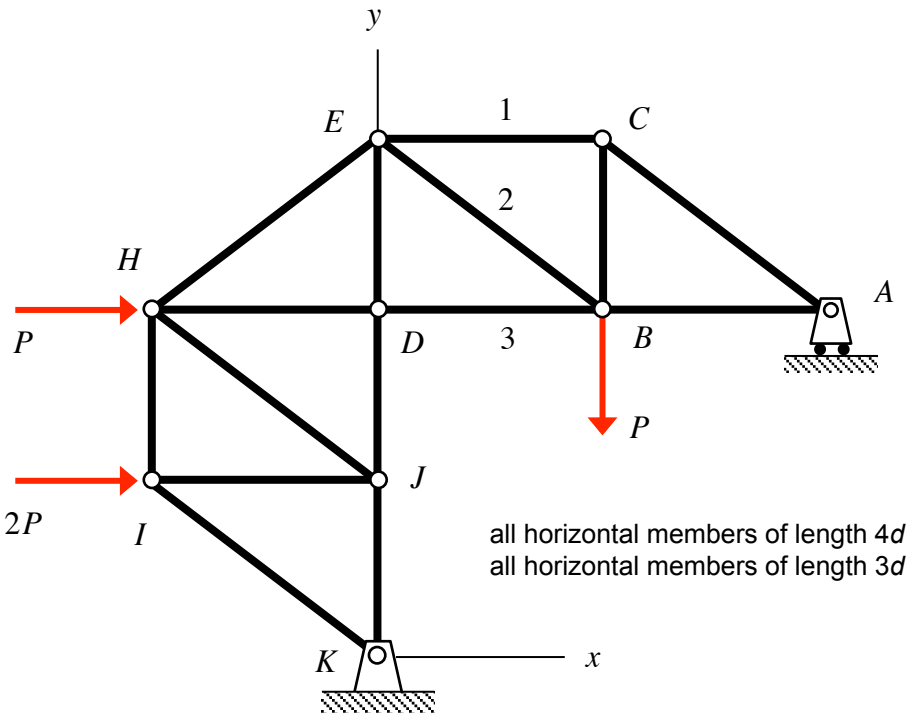
Find: Determine the load carried by all members in the truss. Identify each member as either being in tension, in compression or carrying zero load. Leave your answers in terms of *P*.



Homework H22.A

Given: Consider the truss shown below with the loading on joints B, I and H.

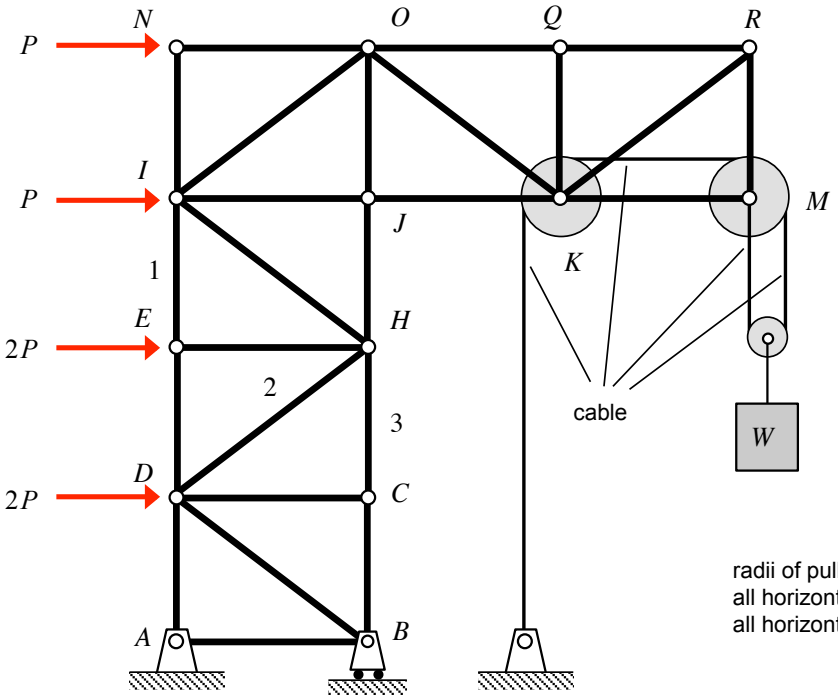
Find: Determine the load carried members 1, 2 and 3. Identify each member as either being in tension, in compression or carrying zero load. Leave your answers in terms of *P*.



Homework H22.B

Given: Consider the truss shown below with the loading on joints D, E, I and H, in addition to the loading due to the weight W of the block that is supported by the cable-pulley system shown, where $W = 2P$.

Find: Determine the load carried members 1, 2 and 3. Identify each member as either being in tension, in compression or carrying zero load. Leave your answers in terms of P.



radii of pulleys at K and M: r
all horizontal members of length: 4*d*
all horizontal members of length: 3*d*

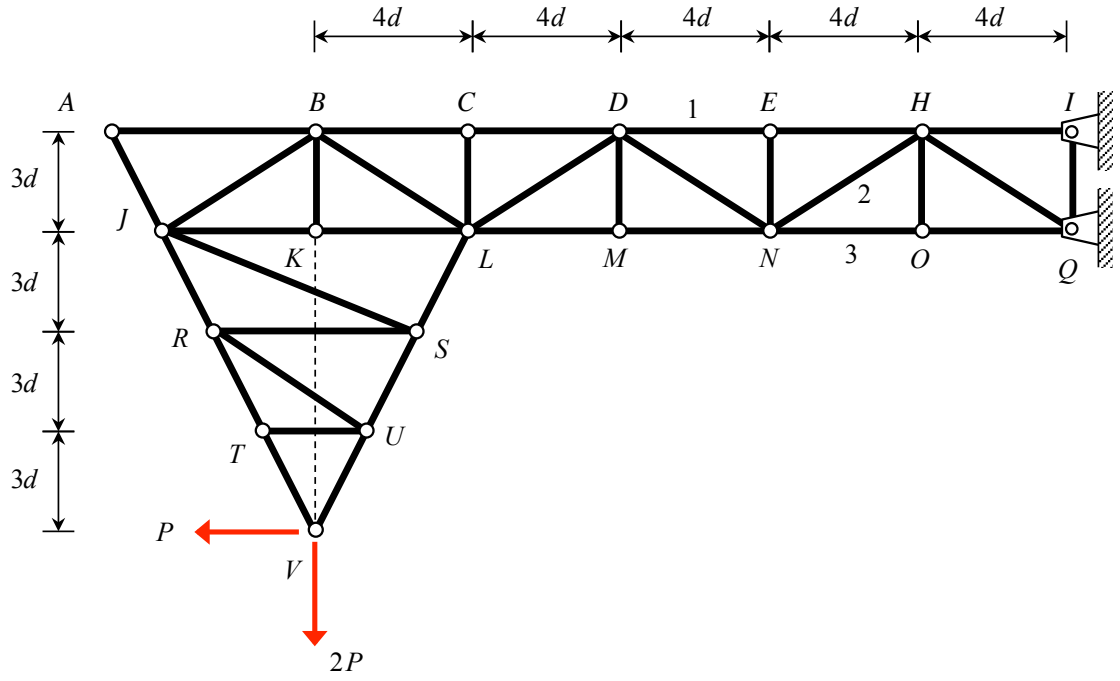
Homework H23.A

Given: Consider the truss shown below with the loading on joint V.

Find: For this problem:

a) Identify all zero-force members in the truss.

b) Determine the load carried by members 1, 2 and 3 of the truss. Identify each member as either being in tension, in compression or carrying zero load. Leave your answers in terms of *P*.



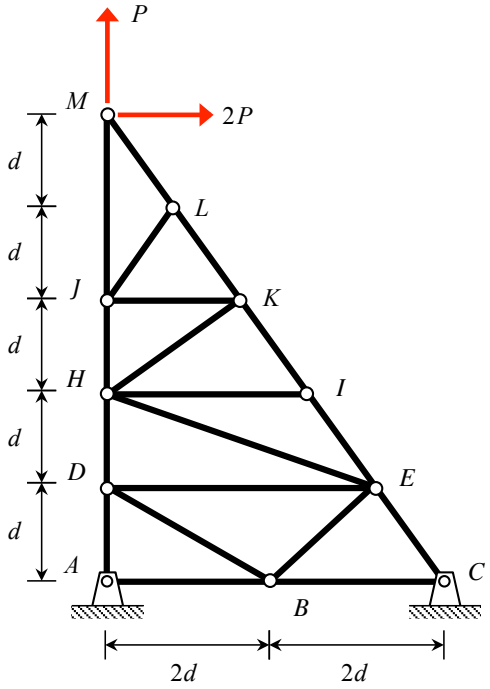
Homework H23.B

Given: Consider the truss shown below with the loading on joint V.

Find: For this problem:

a) Identify all zero-force members in the truss.

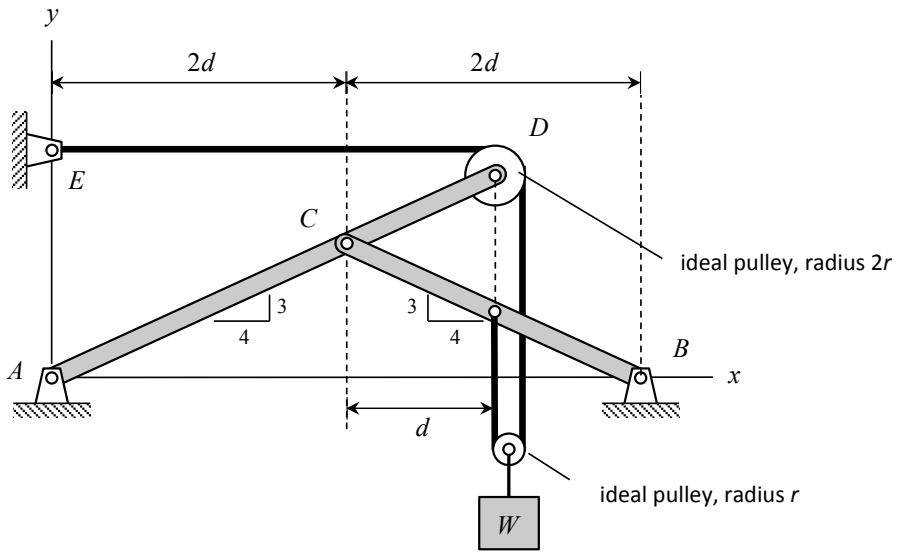
b) Determine the load carried by members HJ, HK, HI and EI of the truss. Identify each member as either being in tension, in compression or carrying zero load. Leave your answers in terms of P.



Homework H24.A

Given: A frame is made up of members AD and BC, with these two member pinned together at C. A pulley system with one pulley pinned to AD at D, one pulley supporting a block having a weight of W and with the cable attached to points E and the midpoint of BC.

Find: Determine the reactions at A and B on the frame. Express your answer in terms *W*.

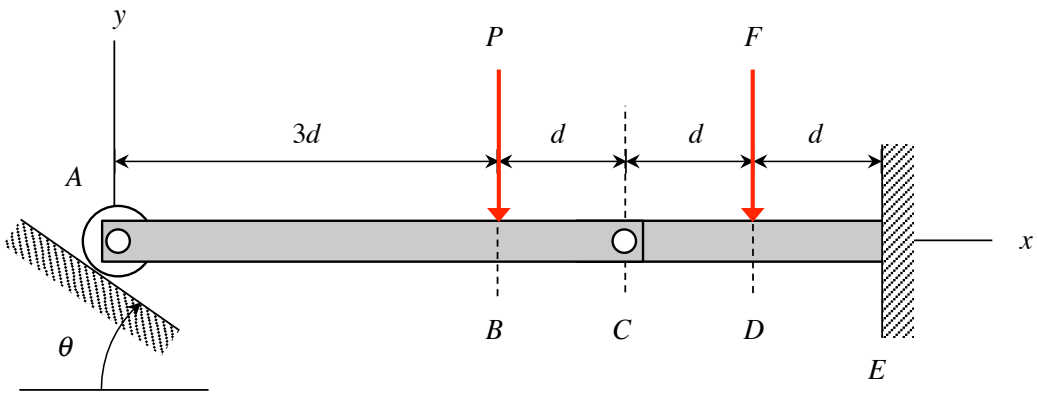


Homework H24.B

Given: A structure is made up of members AC and CE. CE is fixed to ground at end E, whereas AC is pinned to CE at C and has end A constrained to move along a *smooth* incline at its left end.

Find: Determine the reactions on member AC at A and the reactions on CE at E.

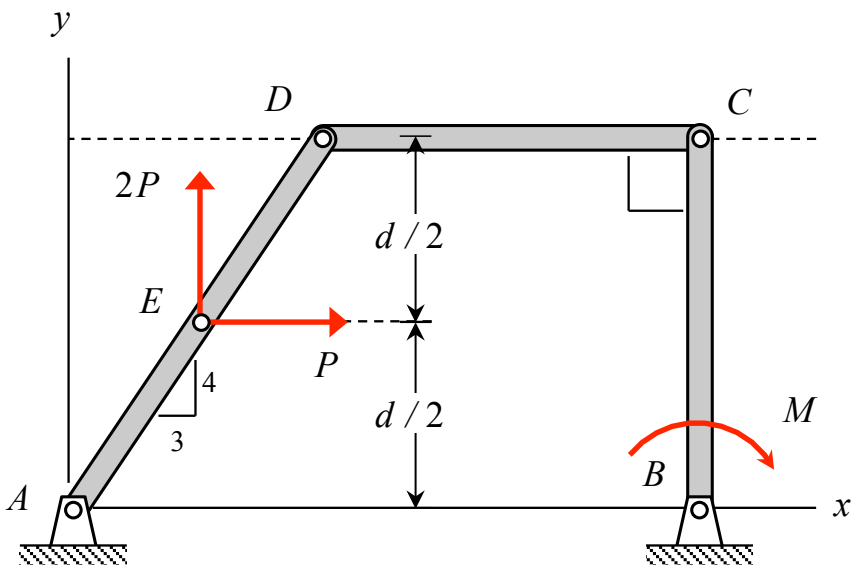
For this problem, use the following parameters: $d = 2$ ft, $F = 10$ kips and $P = 20$ kips.



Homework H25.A

Given: A machine is made up of links AD, DC and BC. A pair of forces is applied at E on link AB, and a couple *M* acts on member BC, as shown in the figure.

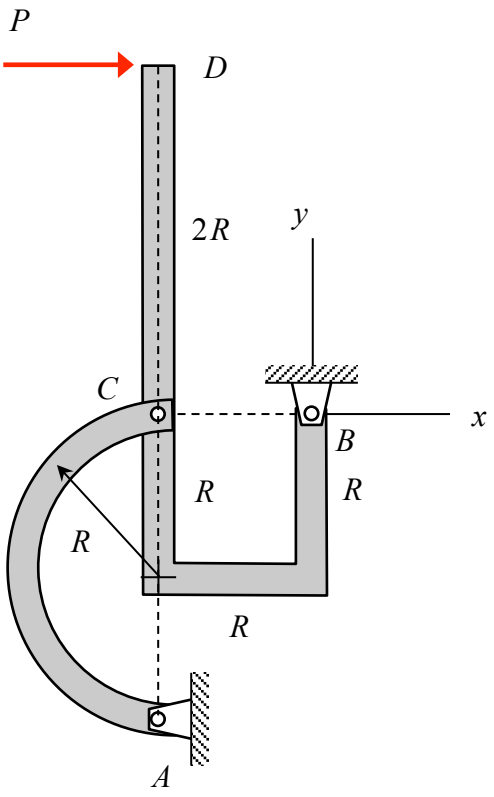
Find: For the position shown below with DC being horizontal and BC being vertical, determine the value of *M* required for equilibrium. Express your answer in terms of *P* and *d*.



Homework H25.B

Given: A structure is made up of members BD and AC, as shown below. A force *P* is applied at end D of member BD.

Find: Determine the reactions acting on the structure at A and B. Write your answers as vectors and in terms of the applied force *P*.

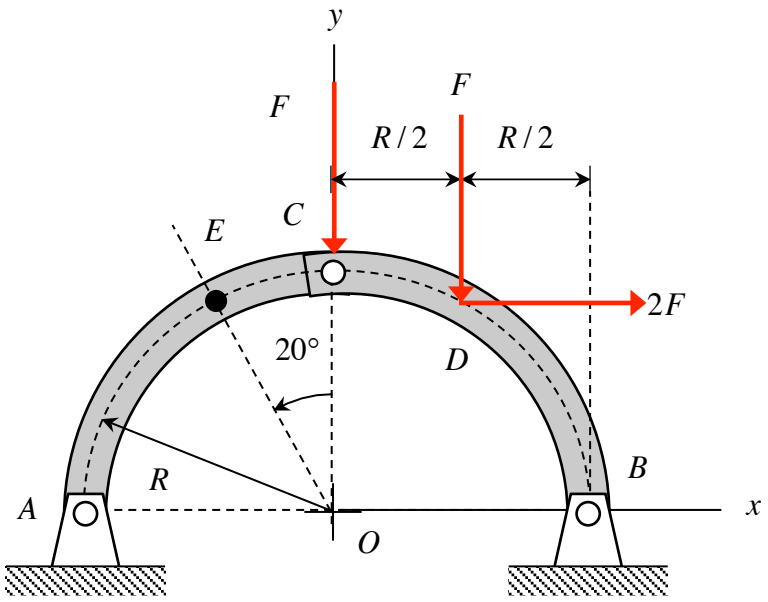


Homework H26.A

Given: The frame shown is made up of members AC and BC, with concentrated loads being applied at C and D on member BC.

Find: Consider a mathematical cut in member AC at point E on member AC. Determine the internal resultants on section AE of member AC.

For this problem, use the following parameters: $R = 2$ ft and $F = 400$ lb.

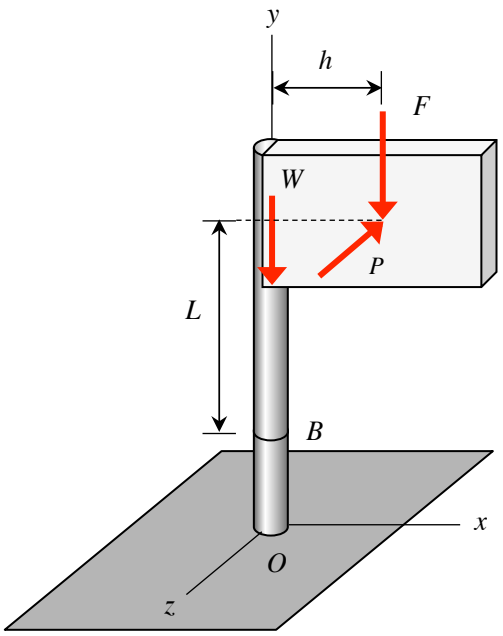


Homework H26.B

Given: A sign/pole structure is acted up by three forces F, P and W, in the $-y$, $-z$ and $-y$ directions, respectively.

Find: Determine internal resultants acting on section OB of the pole at location B.

For this problem, use the following parameters: $W = 800$ lb, $F = 600$ lb and $P = 1200$ lb.

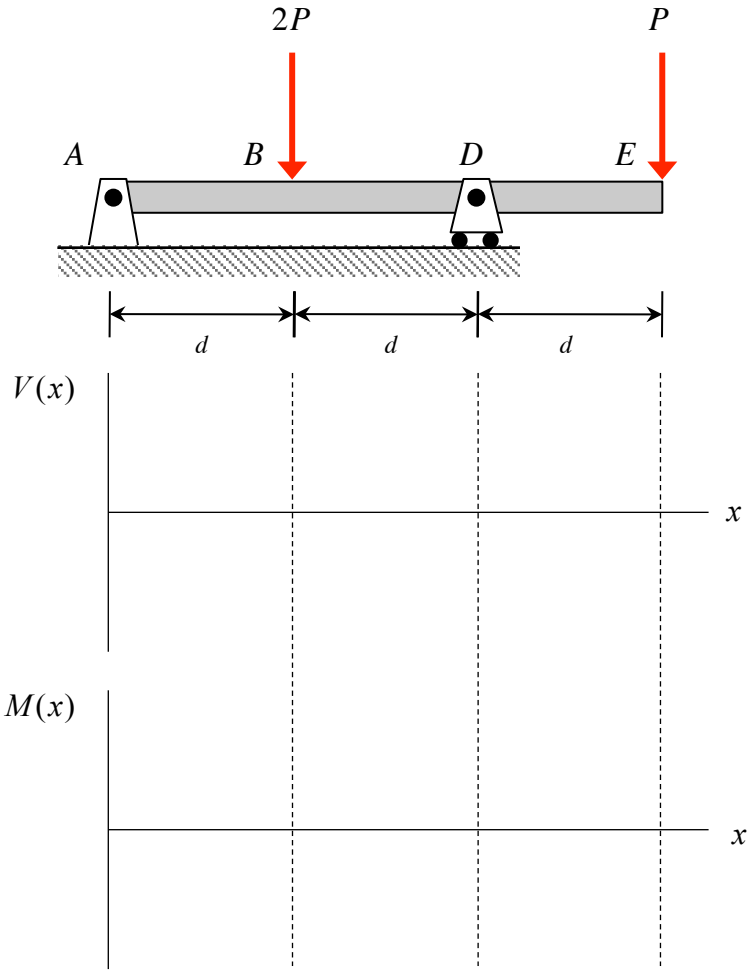


Homework H27.A

Given: Beam loaded with two forces $2P$ and P at B and E, respectively.

Find: Construct the shear force and bending moment diagrams for this beam.

For this problem, use the following parameters: $d = 0.4$ m and P = 40 kN.

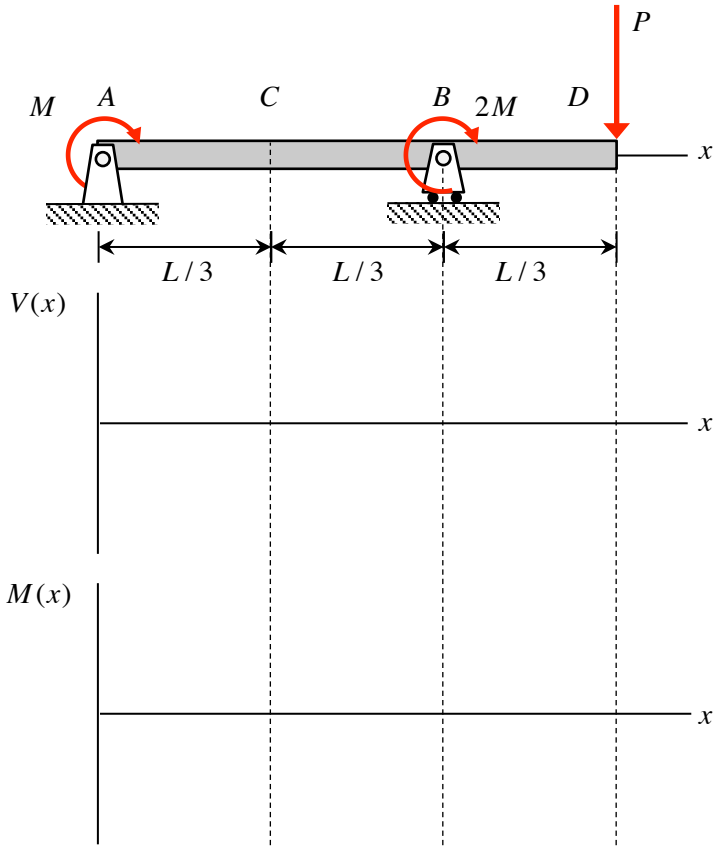


Homework H27.B

Given: Beam loaded with force *P* at D, along with concentrated couples at A and B.

Find: Construct the shear force and bending moment diagrams for this beam.

For this problem, use the following parameters: $L = 9$ ft, $M = 50$ kip-ft and P = 50 kips.

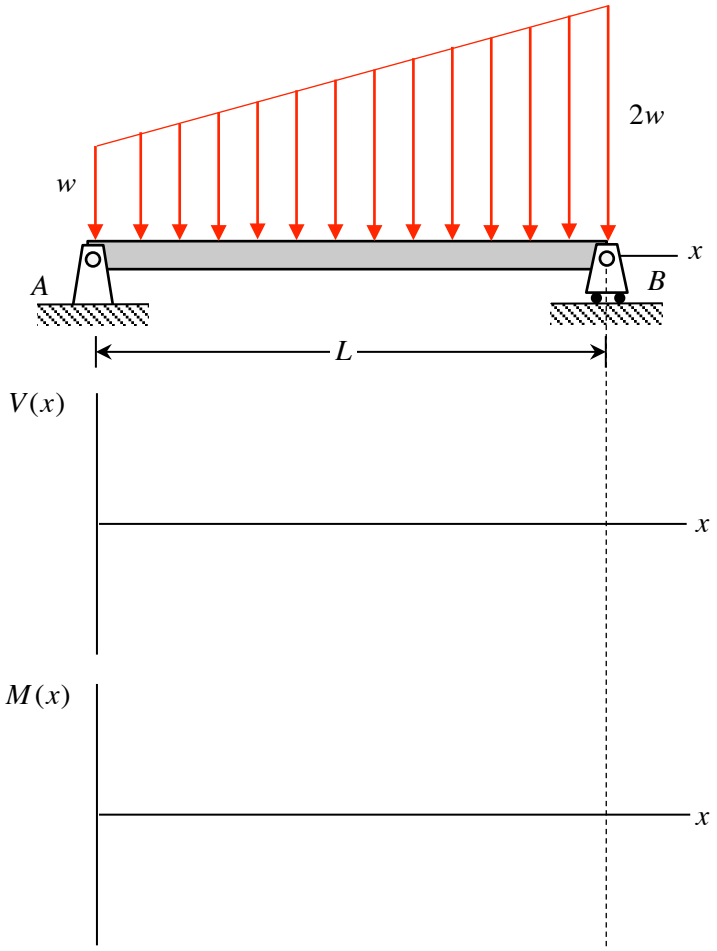


Homework H28.A

Given: Simply-supported beam with linearly-varying line load acting along its length.

Find: Construct the shear force and bending moment diagrams for this beam.

For this problem, use the following parameters: $w = 50$ kips/ft and $L = 10$ ft.

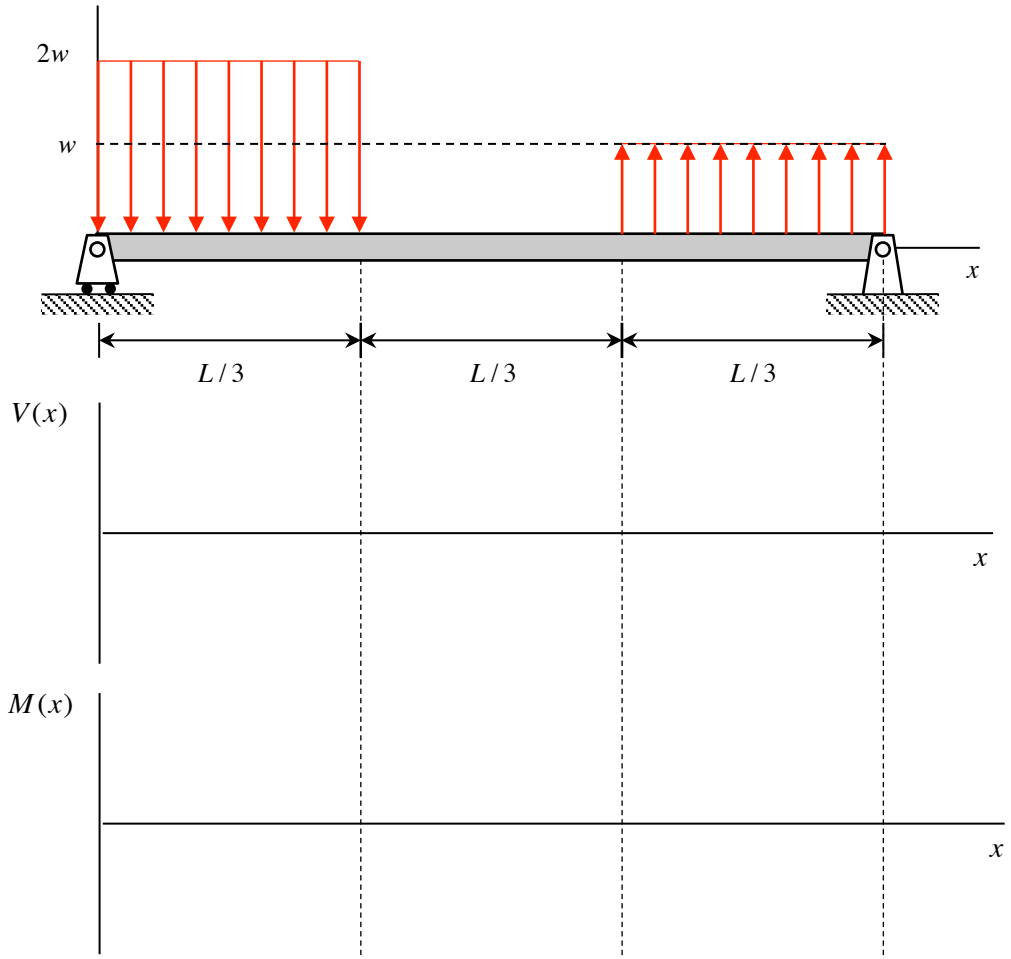


Homework H28.B

Given: Simply-supported beam with the line loading shown.

Find: Construct the shear force and bending moment diagrams for this beam.

For this problem, use the following parameters: $w = 10$ kips/ft and $L = 6$ ft.

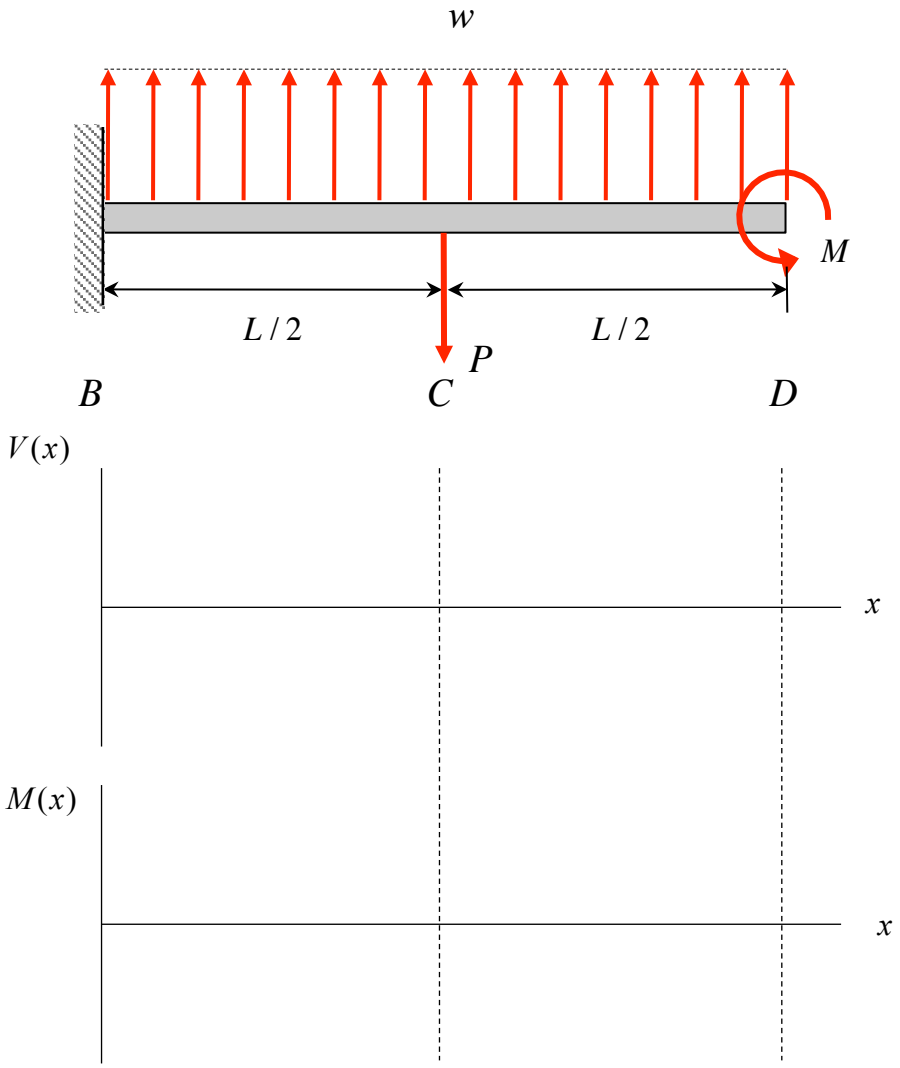


Homework H29.A

Given: Cantilevered beam with the line loading w acting over its length, a concentrated force P acting at C and a concentrated couple M acting at end D.

Find: Construct the shear force and bending moment diagrams for this beam.

For this problem, use the following parameters: $w = 10$ kN/m, $P = 40$ kN, $M = 80$ kN-m and $L = 4$ m.

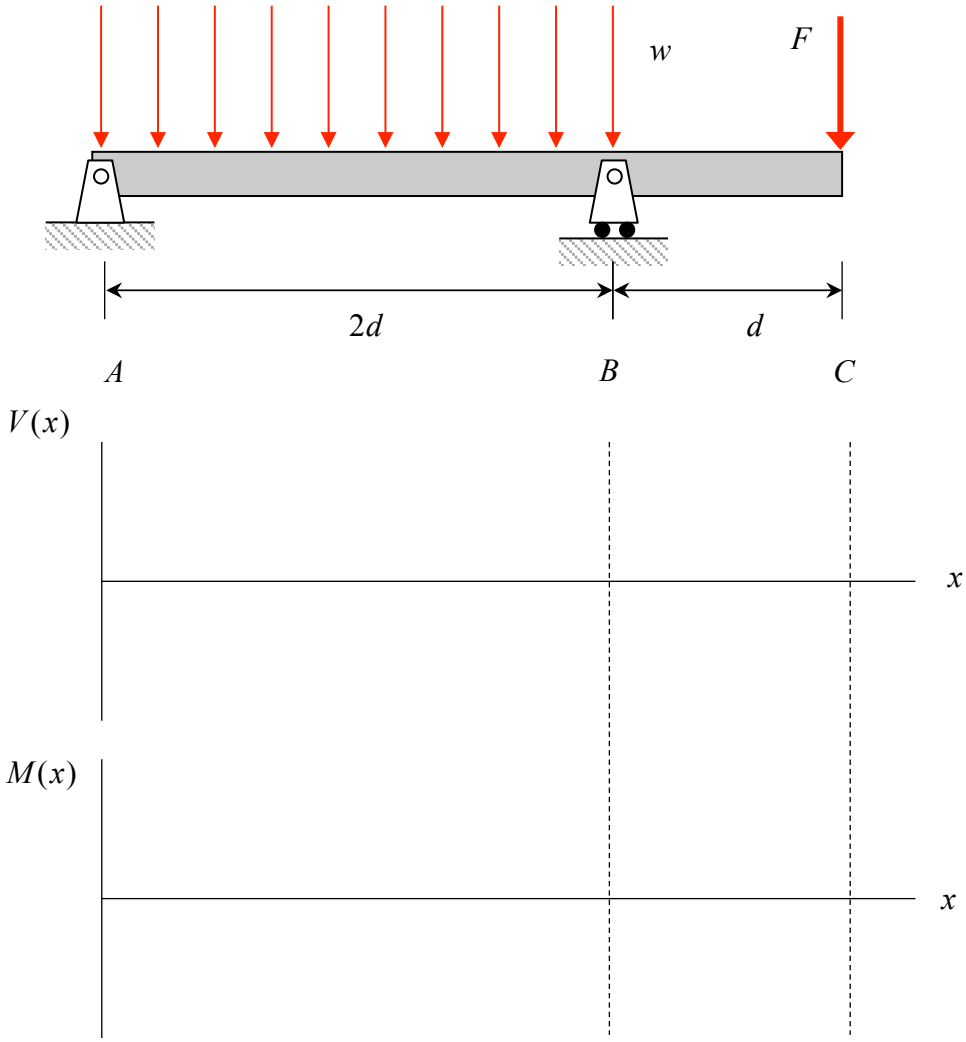


Homework H29.B

Given: Beam with the line loading w acting over section AM and a concentrated force F acting at end C.

Find: Using the graphical technique, construct the shear force and bending moment diagrams for this beam.

For this problem, use the following parameters: $w = 15$ kips/ft, $F = 60$ kips and $d = 3$ ft.

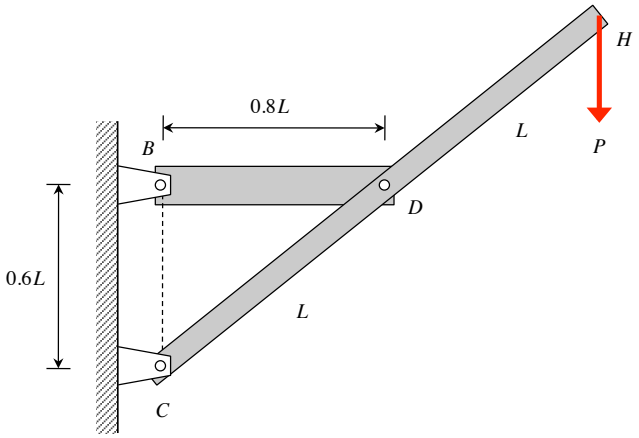


Homework H30.A

Given: Consider the frame structure shown below that is supporting a load of P at end H of member CH. Member BD has a known cross-sectional area of A.

Find: Determine the stress in member BD.

For this problem, use the following parameters: $P = 10$ kN, $L = 0.5$ m and $A = 500$ mm^2.

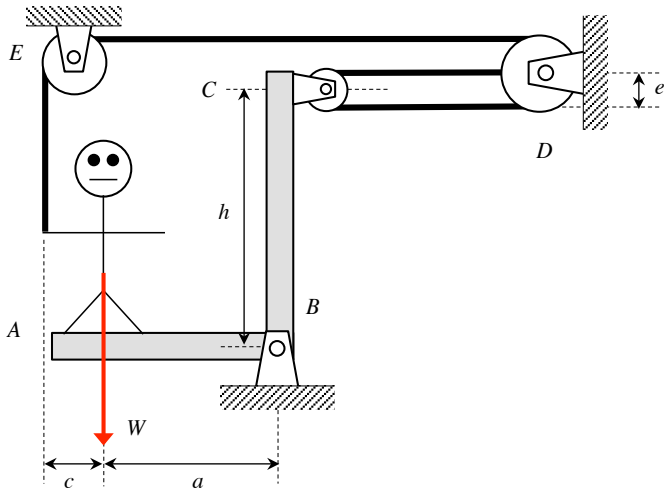


Homework H30.B

Given: The L-shaped stand is pinned to ground at B. A person having a weight of W is positioned near end A of the stand. The person is supporting herself and the stand through a cable-pulley system as shown. Consider the weight of the stand to be negligible compared to the weight of the person, and consider the pulleys to be ideal. The cable has a diameter of d.

Find: Determine the stress in the cable.

For this problem, use the following parameters: $W = 140$ lb, $h = 6$ ft, $a = 4$ ft, $c = 1$ ft, $e = 0.5$ ft and $d = 0.75$ in.



Homework H31.A

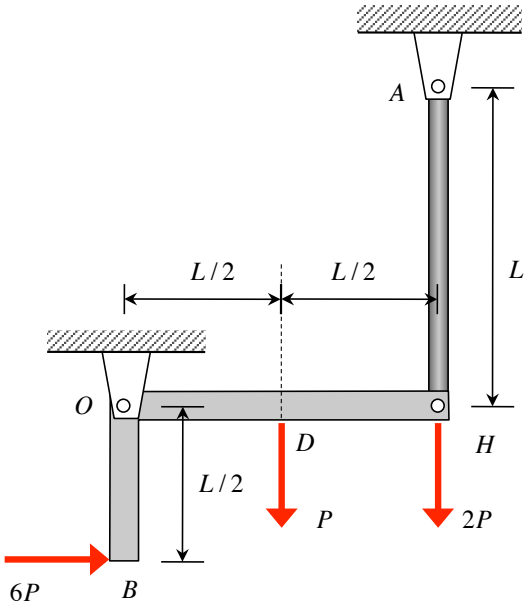
Given: The frame shown below is made up of the L-shaped member BH that is pinned to ground at O. AB is also supported by the rod AH that has a cross-sectional area of A. Member BH carries loads at locations B, D and H, as shown. Rod AH is made up of an aluminum alloy 6061-T6.

Find: For this problem:

a) Determine the stress in rod AH.

b) Has the material in rod AH failed due to yielding? If not, what is the factor of safety for this loading against yielding?

For this problem, use the following parameters: $P = 30$ kN, $L = 1.5$ m and $A = 100$ mm^2.



Homework H31.B

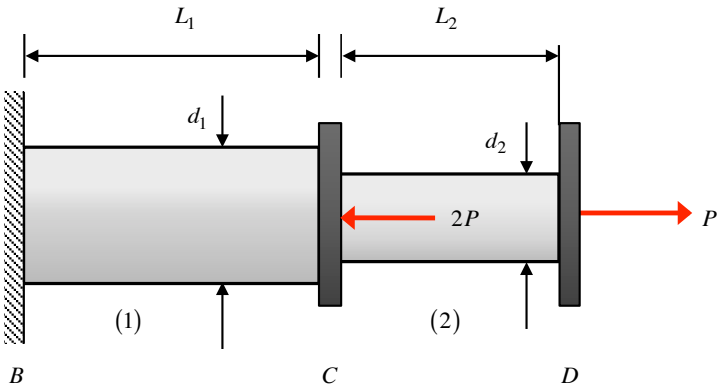
Given: A rod is made up of members (1) and (2) with these members having diameters of d_1 and d_2, respectively, and are made of a material having a Young's modulus of E. The members are connected by the rigid connector C. Both members are made of a material having a Young's modulus of E and a yield strength of σ_{YP}.

Find: For this problem:

a) Determine the stress in each member of the rod.

b) Has the material in either member failed? If not, what is the factor of safety for the rod for this loading?

For this problem, use the following parameters: $d_1 = 1$ in, $d_2 = 2$ in, $P = 10$ kips, $E = 15 \times 10^3$ ksi and $\sigma_{YP} = 36$ ksi.

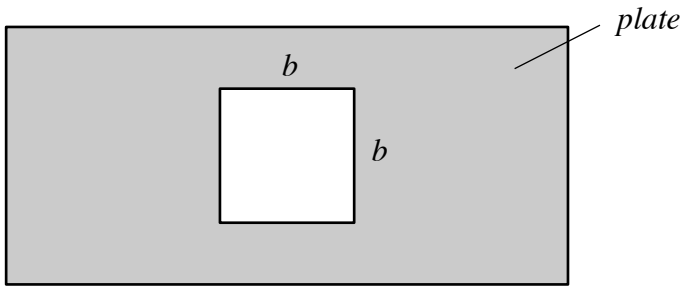


Homework H32.A

Given: It is desired to punch of hole in a sheet of metal, with the metal having a thickness of t. The desired hole is square with dimensions of b x b, as shown below. The punching force is given by P.

Find: Determine the shear stress in the plate as a result of the punching force P.

For this problem, use the following parameters: $t = 0.1$ in, $b = 1$ in and $P = 20$ kips.



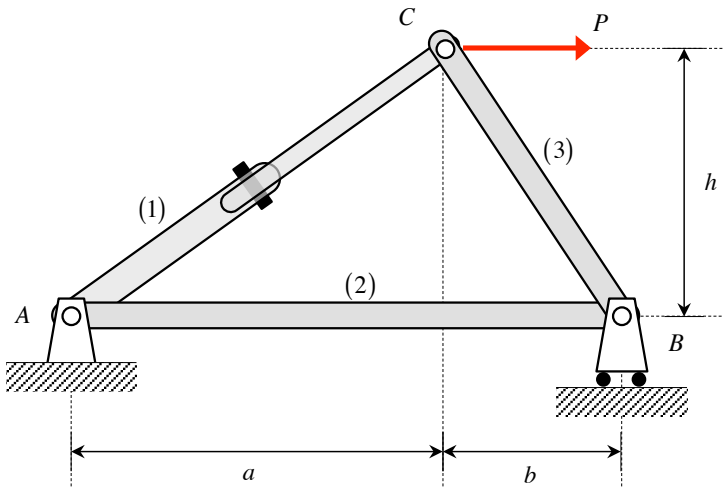
Homework H32.B

Given: The truss shown below is loaded with a force P at joint C. Member (1) of the truss is made up of two components that are joined with a pin having a diameter of d with a yield strength in shear of τ_Y.

Find: For this problem,

a) Determine the loads carried by the three members of the truss.
b) Determine the minimum diameter d of the pin joining the two components of member AC such that the material of the pin does not yield.

For this problem, use the following parameters: a = 16/15 ft, b = 3/5 ft, h =4/5 ft, P = 20 kips and τ_Y = 18 ksi.



Homework H33.A

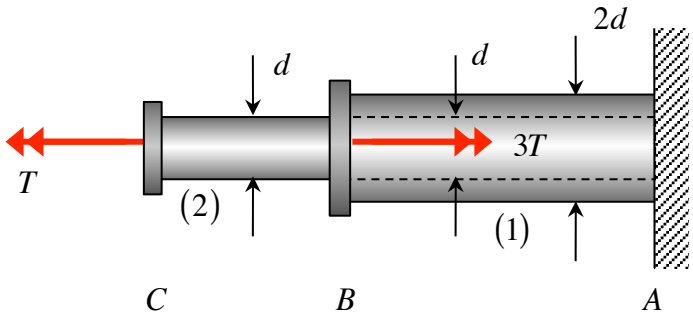
Given: A circular cross-sectioned shaft is made up of components (1) and (2). Component (1) has a tubular cross section, with inner and outer diameters of d and $2d$, respectively. Component (2) has a solid cross section with a diameter of d. Components (1) and (2) are joined by a rigid connector at B with (1) being attached to a fixed wall at end A. Rigid connector C is attached to end C of component (2). Torques $3T$ and T act on connectors B and C, respectively, as shown.

Find: For this problem:

a) Determine the torque load on each of the components as a result of the applied torques.

b) What is the maximum shear stress in the shaft? At what location(s) does this maximum stress exist?

Leave your answers in terms of T and d.



Homework H33.B

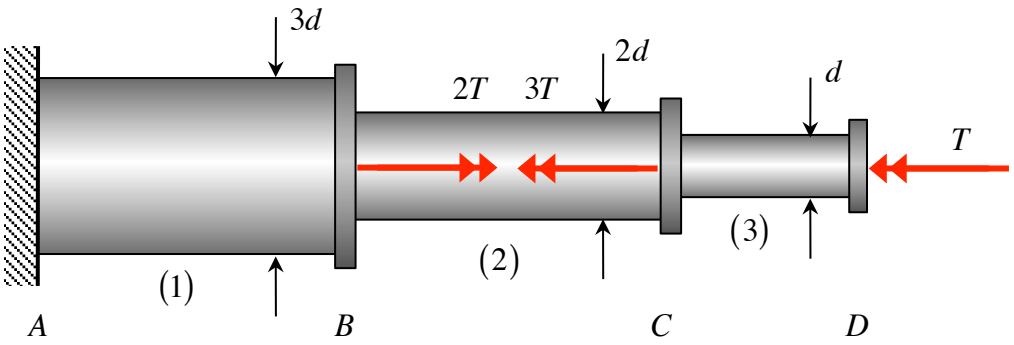
Given: A circular cross-sectioned shaft is made up of solid shaft components (1), (2) and (3), having diameters of $3d$, $2d$ and d, respectively. (1) and (2) are joined with the rigid connector B, (2) and (3) are joined by rigid connector C and (1) is attached to a fixed wall at its left end. A rigid connector is attached to the right end of (3). Torques $2T$, $3T$ and T act on connectors B, C and D, as shown.

Find: For this problem:

a) Determine the torque load on each of the components as a result of the applied torques.

b) What is the maximum shear stress in the shaft? At what location(s) does this maximum stress exist?

Leave your answers in terms of T and d.



Homework H34.A

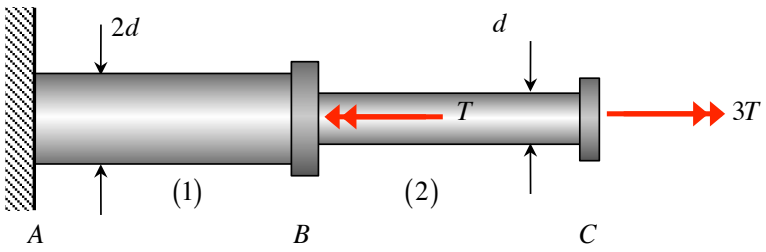
Given: A circular cross-sectioned shaft is made up of solid shaft components (1) and (2), having diameters of $2d$ and d, respectively. (1) and (2) are joined with the rigid connector B, and (1) is attached to a fixed wall at its left end. A rigid connector is attached to the right end of (2). Torques T and $3T$ act on connectors B and C, as shown.

Find: For this problem:

a) Determine the torque load on each of the components as a result of the applied torques.

b) What is the maximum shear stress in the shaft? At what location(s) does this maximum stress exist?

Leave your answers in terms of T and d.

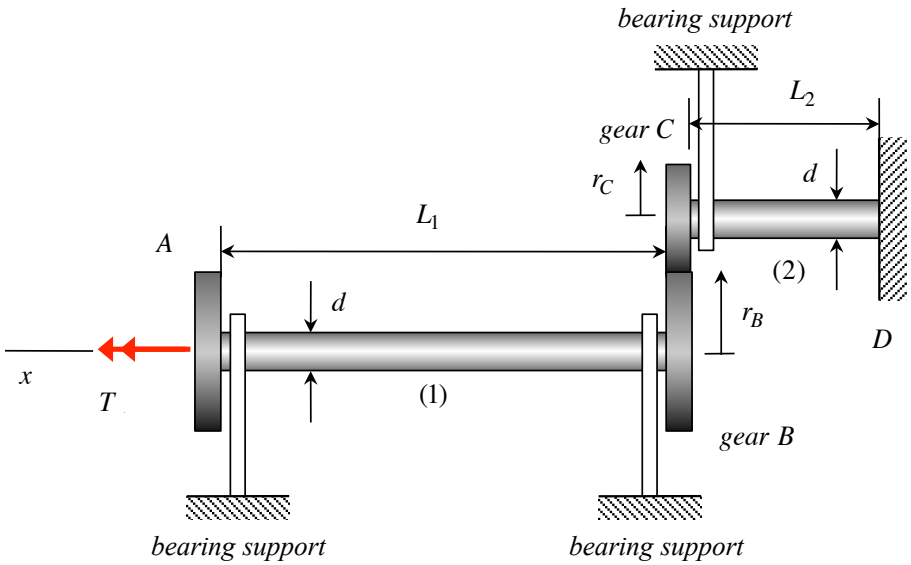


Homework H34.B

Given: Circular cross-sectioned shafts (1) and (2) are coupled through a pair of meshing gears B and C, where $r_B > r_C$. End D of shaft (2) is connected to a fixed wall, whereas a torque of T is applied to end A of shaft (1). Both shafts have solid cross sections with a diameter of d.

Find: For this problem, determine the maximum shear stress in the system. In which shaft does this maximum shear stress occur, and where on the cross section does it occur?

Express your answers in terms of the parameters defined in the figure.



Homework H35.A

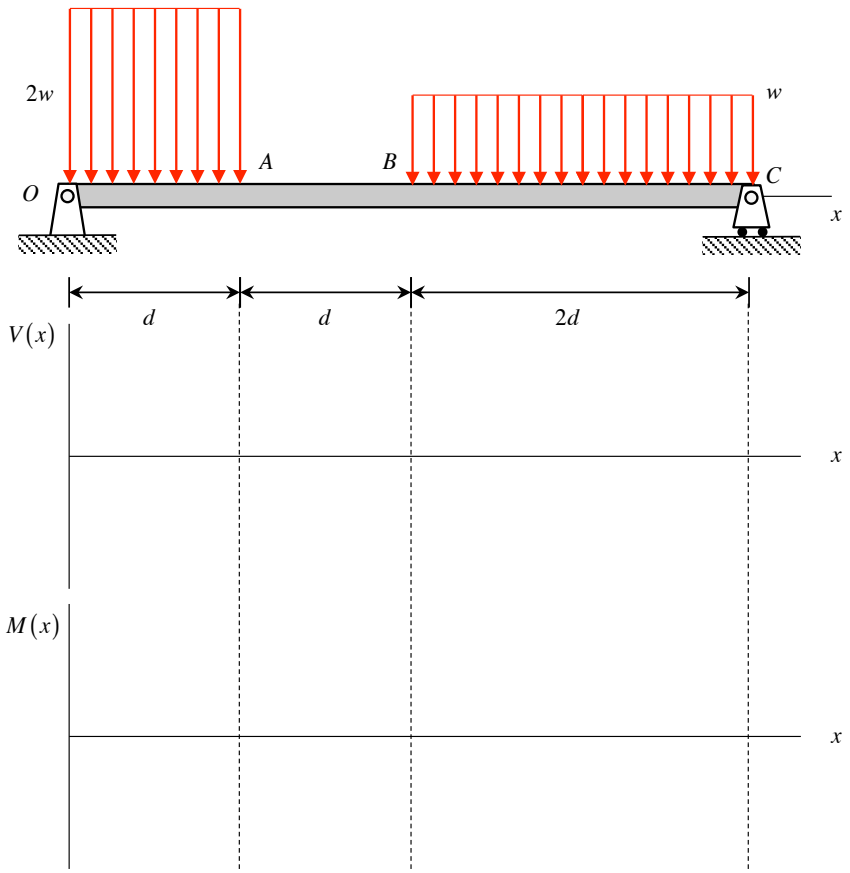
Given: Consider the beam loaded as shown below. The beam has a solid circular cross section with a radius of R.

Find: For this problem:

a) Determine the location(s) for which pure bending exists on the cross section of the beam.

b) For the location(s) found in a) above, determine the maximum normal stress.

For this problem, use the following parameters: $d = 4$ ft, $w = 10$ kips/ft and $R = 3$ in.



Homework H35.B

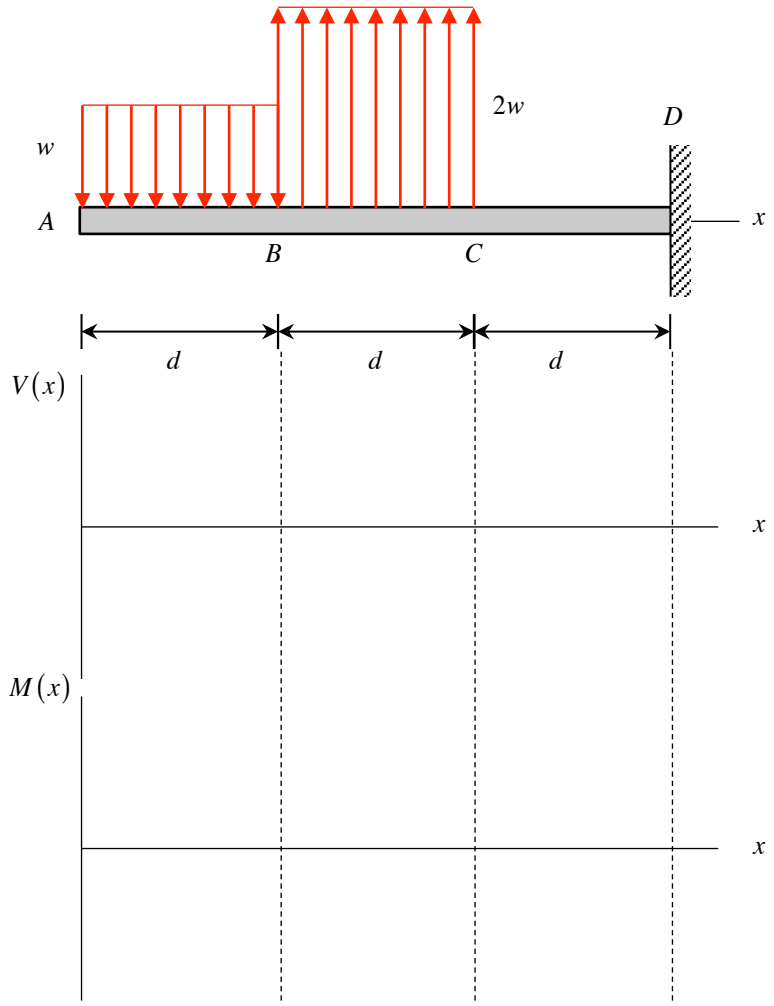
Given: Consider the beam loaded as shown below. The beam has a solid square cross section with cross-section dimensions b x b.

Find: For this problem:

a) Determine the location(s) for which pure bending exists on the cross section of the beam.

b) For the location(s) found in a) above, determine the maximum normal stress.

For this problem, use the following parameters: $d = 2$ m, $w = 10$ kN/m and $b = 100$ mm.



Homework H36.A

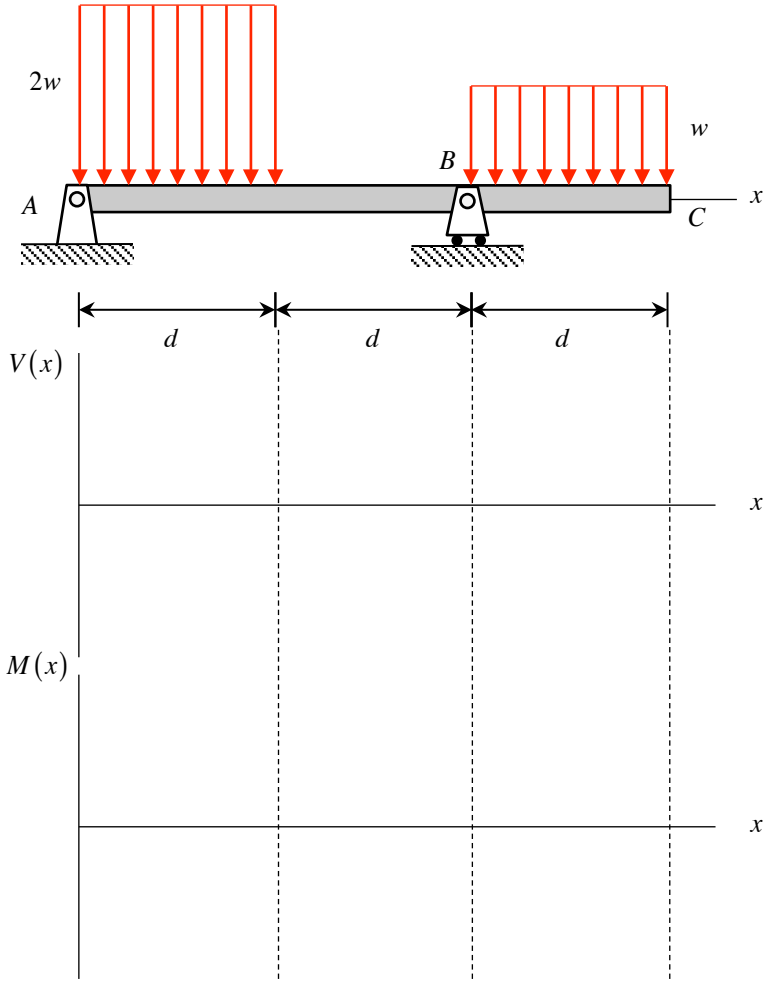
Given: Consider the beam loaded as shown below. The beam has a tubular cross section with inner and outer radii of R/2 and R, respectively.

Find: For this problem:

a) Determine the location(s) for which pure bending exists on the cross section of the beam.

b) For the location(s) found in a) above, determine the maximum normal stress.

For this problem, use the following parameters: $d = 3$ ft, $w = 15$ kips/ft and $R = 4$ in.



Homework H36.B

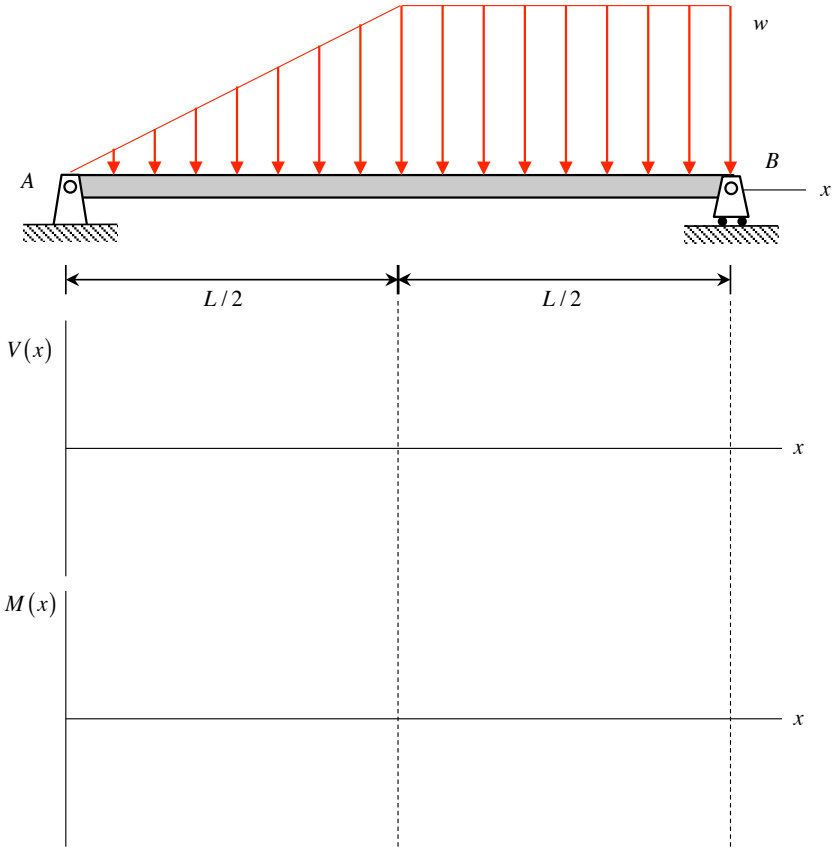
Given: Consider the beam loaded as shown below. The beam has a rectangular cross section with cross-section dimensions of b x h, where b is the dimension into the page.

Find: For this problem:

a) Determine the location(s) for which pure bending exists on the cross section of the beam.

b) For the location(s) found in a) above, determine the maximum normal stress.

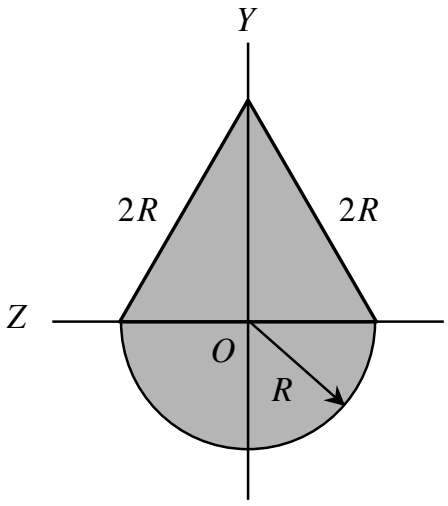
For this problem, use the following parameters: $L = 5$ m, $w = 20$ kN/m, $b = 0.1$ m and $h = 0.3$ m.



Homework H37.A

Given: Consider the greyed area shown below.

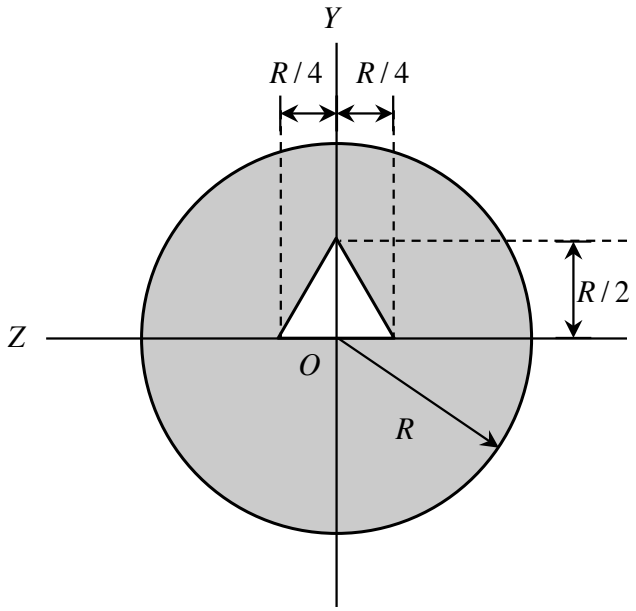
Find: Using the method of composite sections, determine the Y-position of the centroid for this area and the second area moment for the section about its centroid for bending about the Z direction.



Homework H37.B

Given: Consider the greyed area shown below.

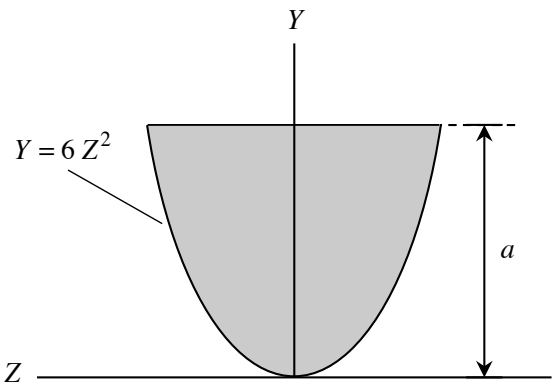
Find: Using the method of composite sections, determine the Y-position of the centroid for this area and the second area moment for the section about its centroid for bending about the Z direction.



Homework H38.A

Given: Consider the greyed area shown below.

Find: Using integration, determine the Y-position of the centroid for this area and the second area moment for the section about its centroid for bending about the Z direction.



Homework H38.B

Given: Consider the greyed area shown below.

Find: Using integration, determine the Y-position of the centroid for this area and the second area moment for the section about its centroid for bending about the Z direction.