

FUNDAMENTAL PROBLEMS

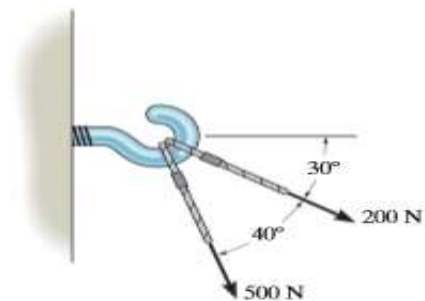
Partial solutions and answers to all Fundamental Problems are given in the back of the book.

F2-1. Determine the magnitude of the resultant force acting on the screw eye and its direction measured clockwise from the x axis.



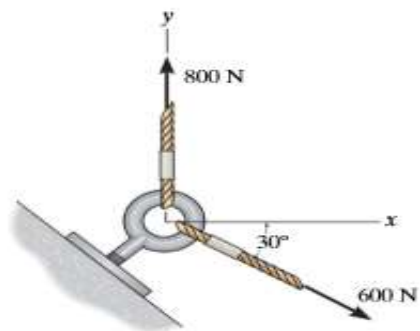
Prob. F2-1

F2-2. Two forces act on the hook. Determine the magnitude of the resultant force.



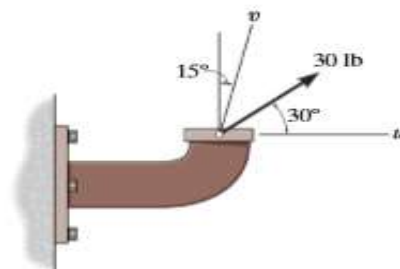
Prob. F2-2

F2-3. Determine the magnitude of the resultant force and its direction measured counterclockwise from the positive x axis.



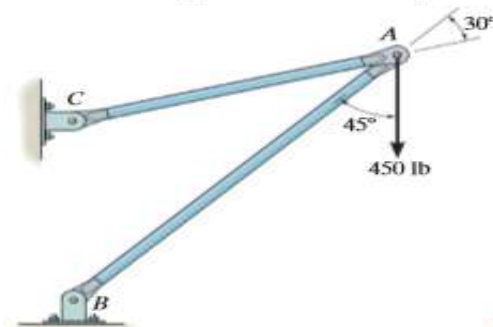
Prob. F2-3

F2-4. Resolve the 30-lb force into components along the u and v axes, and determine the magnitude of each of these components.



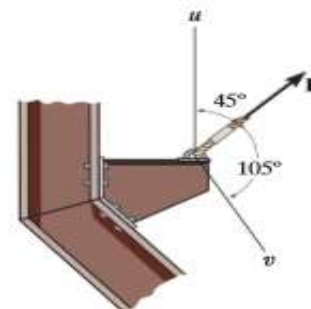
Prob. F2-4

F2-5. The force $F = 450$ lb acts on the frame. Resolve this force into components acting along members AB and AC , and determine the magnitude of each component.



Prob. F2-5

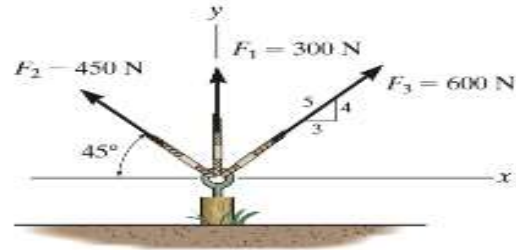
F2-6. If force F is to have a component along the u axis of $F_u = 6$ kN, determine the magnitude of F and the magnitude of its component F_v along the v axis.



Prob. F2-6

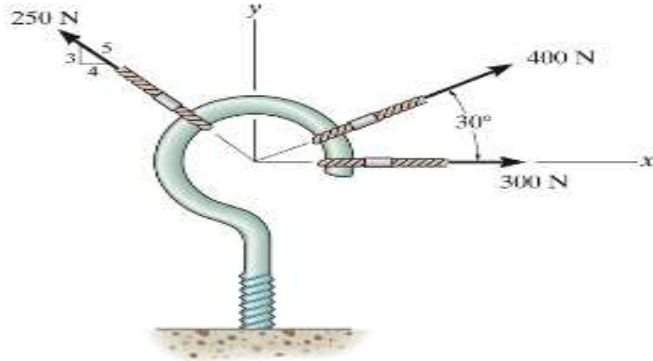
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F2-7. Resolve each force acting on the post into its x and y components.



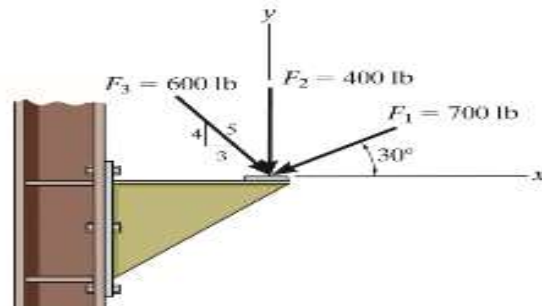
Prob. F2-7

F2-8. Determine the magnitude and direction of the resultant force.



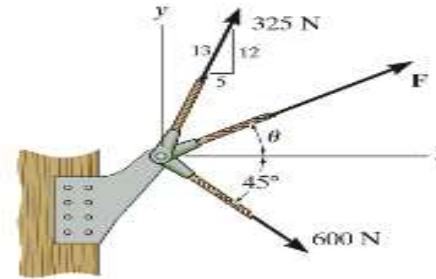
Prob. F2-8

F2-9. Determine the magnitude of the resultant force acting on the corbel and its direction θ measured counterclockwise from the x axis.



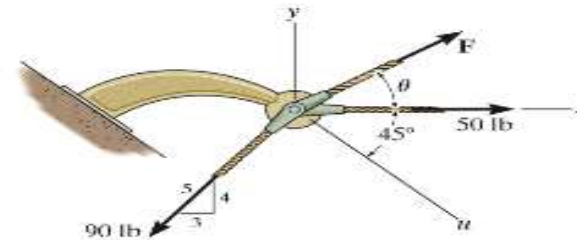
Prob. F2-9

F2-10. If the resultant force acting on the bracket is to be 750 N directed along the positive x axis, determine the magnitude of F and its direction θ .



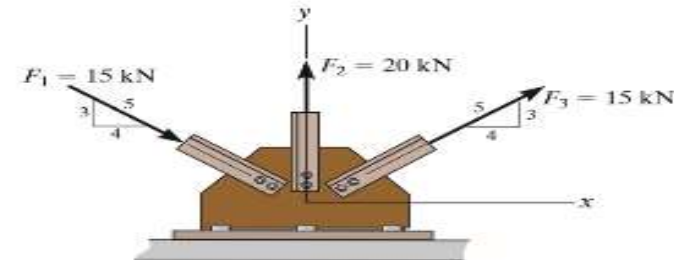
Prob. F2-10

F2-11. If the magnitude of the resultant force acting on the bracket is to be 80 lb directed along the u axis, determine the magnitude of F and its direction θ .



Prob. F2-11

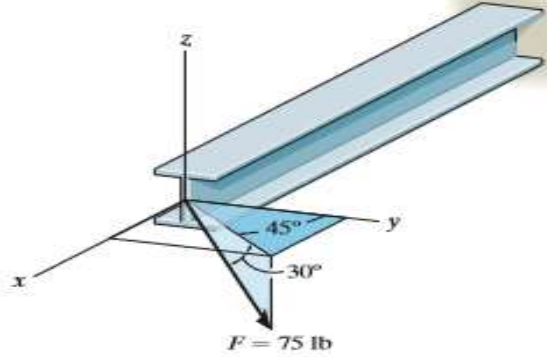
F2-12. Determine the magnitude of the resultant force and its direction θ measured counterclockwise from the positive x axis.



Prob. F2-12

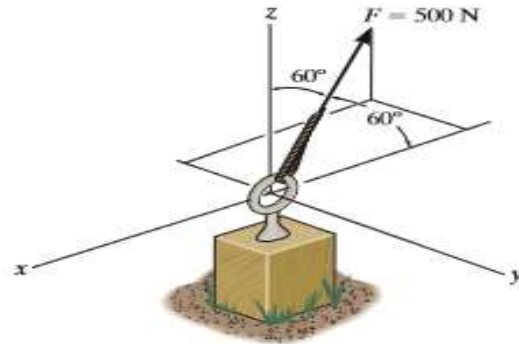
FUNDAMENTAL PROBLEMS

F2-13. Determine the coordinate direction angles of the force.



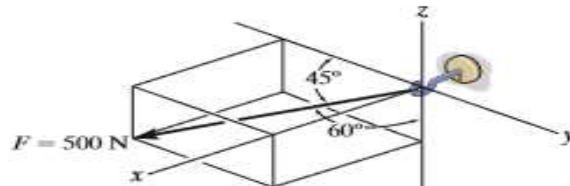
Prob. F2-13

F2-14. Express the force as a Cartesian vector.



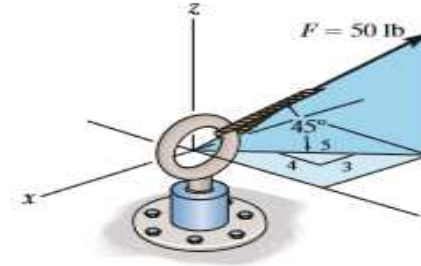
Prob. F2-14

F2-15. Express the force as a Cartesian vector.



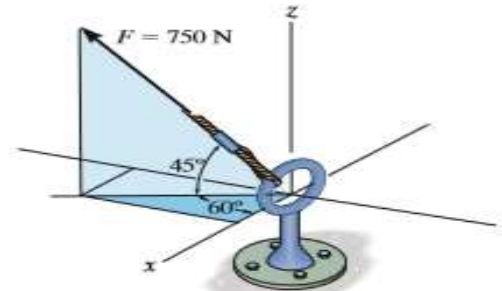
Prob. F2-15

F2-16. Express the force as a Cartesian vector.



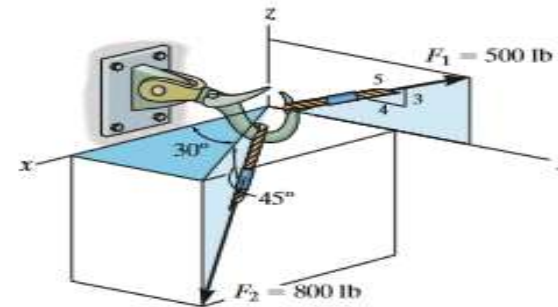
Prob. F2-16

F2-17. Express the force as a Cartesian vector.



Prob. F2-17

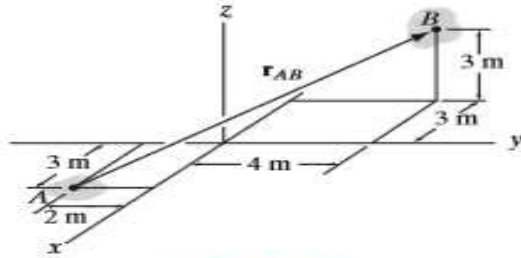
F2-18. Determine the resultant force acting on the hook.



Prob. F2-18

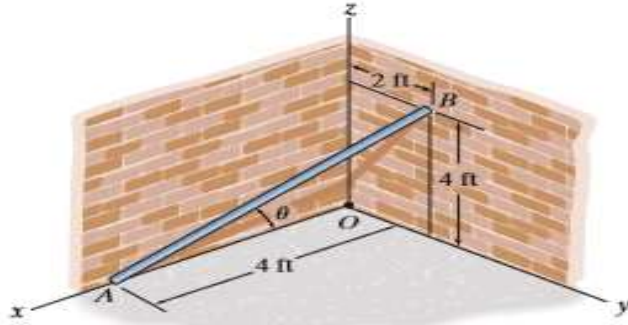
FUNDAMENTAL PROBLEMS

F2-19. Express the position vector \mathbf{r}_{AB} in Cartesian vector form, then determine its magnitude and coordinate direction angles.



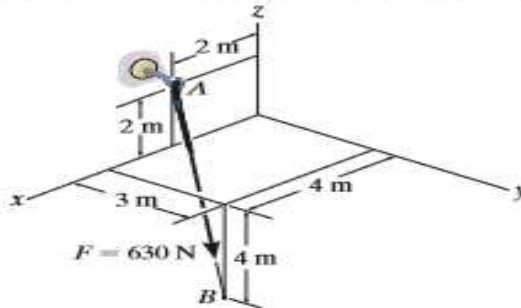
Prob. F2-19

F2-20. Determine the length of the rod and the position vector directed from A to B . What is the angle θ ?



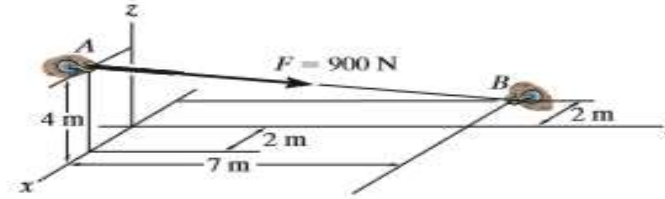
Prob. F2-20

F2-21. Express the force as a Cartesian vector.



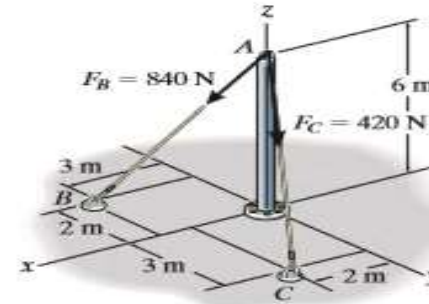
Prob. F2-21

F2-22. Express the force as a Cartesian vector.



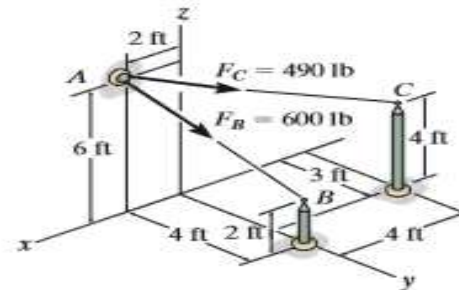
Prob. F2-22

F2-23. Determine the magnitude of the resultant force at A .



Prob. F2-23

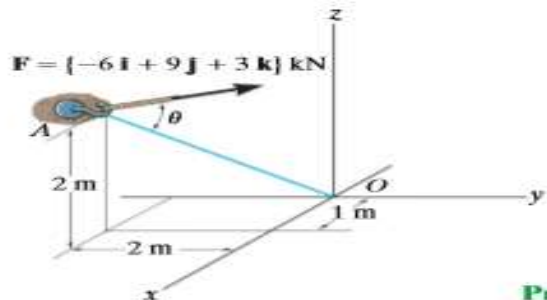
F2-24. Determine the resultant force at A .



Prob. F2-24

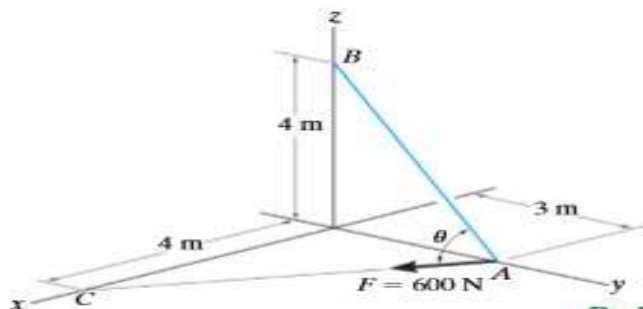
FUNDAMENTAL PROBLEMS

F2-25. Determine the angle θ between the force and the line AO .



Prob. F2-25

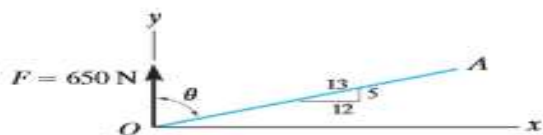
F2-26. Determine the angle θ between the force and the line AB .



Prob. F2-26

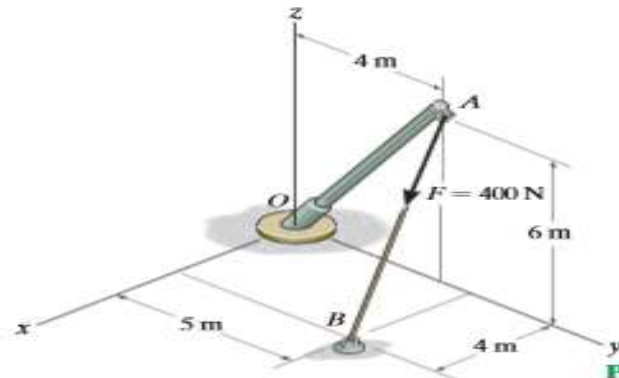
F2-27. Determine the angle θ between the force and the line OA .

F2-28. Determine the projected component of the force along the line OA .



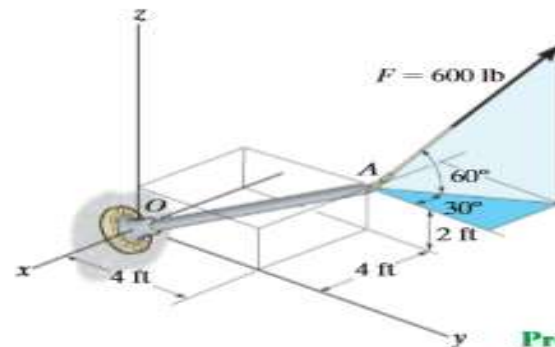
Probs. F2-27/28

F2-29. Find the magnitude of the projected component of the force along the pipe AO .



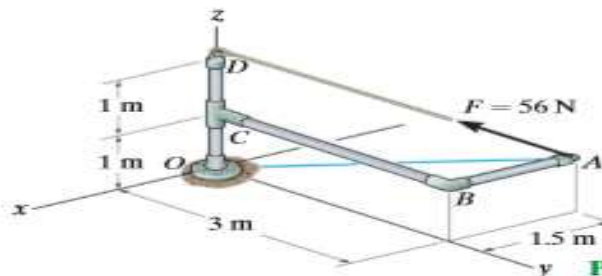
Prob. F2-29

F2-30. Determine the components of the force acting parallel and perpendicular to the axis of the pole.



Prob. F2-30

F2-31. Determine the magnitudes of the components of the force $F = 56 \text{ N}$ acting along and perpendicular to line AO .

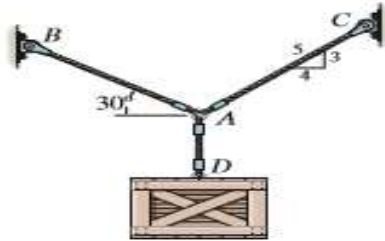


Prob. F2-31

FUNDAMENTAL PROBLEMS

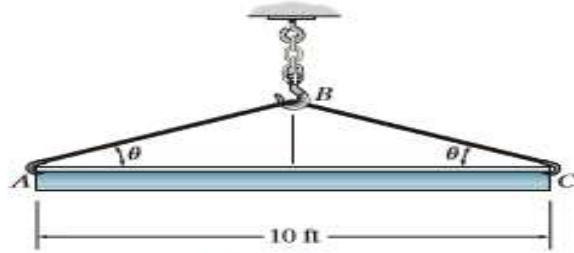
All problem solutions must include an FBD.

F3-1. The crate has a weight of 550 lb. Determine the force in each supporting cable.



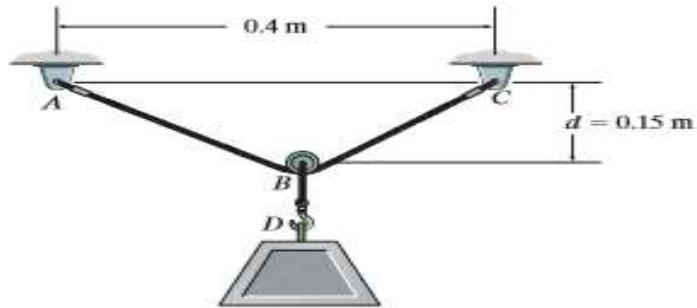
Prob. F3-1

F3-2. The beam has a weight of 700 lb. Determine the shortest cable ABC that can be used to lift it if the maximum force the cable can sustain is 1500 lb.



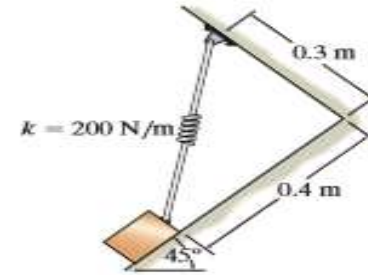
Prob. F3-2

F3-3. If the 5-kg block is suspended from the pulley B and the sag of the cord is $d = 0.15$ m, determine the force in cord ABC . Neglect the size of the pulley.



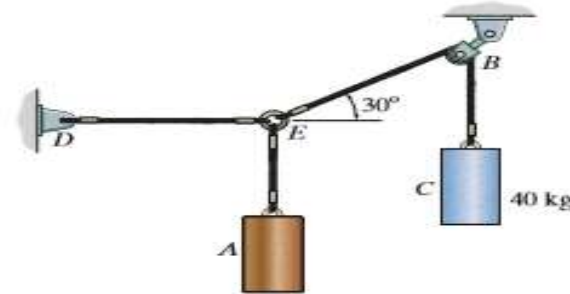
Prob. F3-3

F3-4. The block has a mass of 5 kg and rests on the smooth plane. Determine the unstretched length of the spring.



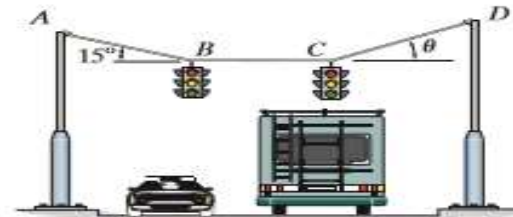
Prob. F3-4

F3-5. If the mass of cylinder C is 40 kg, determine the mass of cylinder A in order to hold the assembly in the position shown.



Prob. F3-5

F3-6. Determine the tension in cables AB , BC , and CD , necessary to support the 10-kg and 15-kg traffic lights at B and C , respectively. Also, find the angle θ .

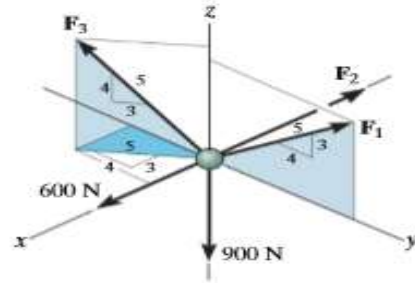


Prob. F3-6

FUNDAMENTAL PROBLEMS

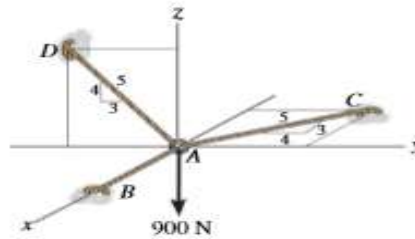
All problem solutions must include an FBD.

F3-7. Determine the magnitude of forces F_1 , F_2 , F_3 , so that the particle is held in equilibrium.



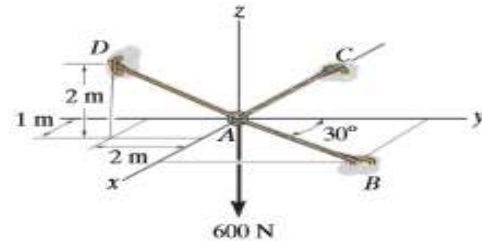
Prob. F3-7

F3-8. Determine the tension developed in cables AB , AC , and AD .



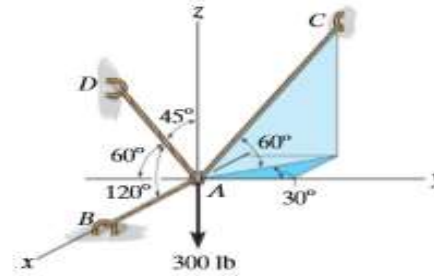
Prob. F3-8

F3-9. Determine the tension developed in cables AB , AC , and AD .



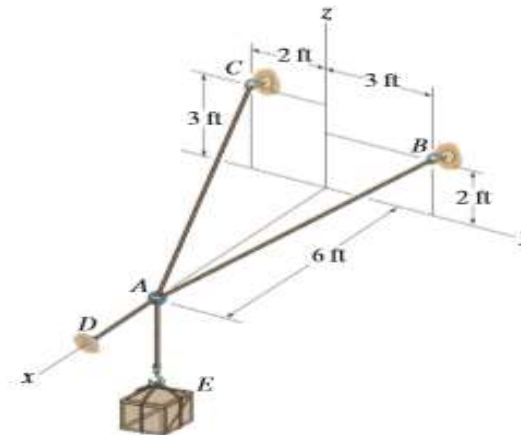
Prob. F3-9

F3-10. Determine the tension developed in cables AB , AC , and AD .



Prob. F3-10

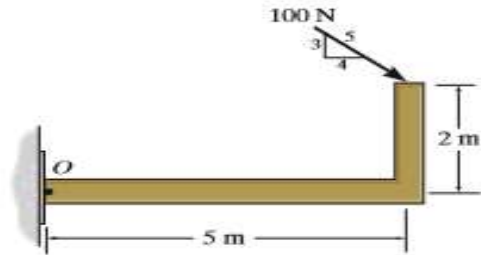
F3-11. The 150-lb crate is supported by cables AB , AC , and AD . Determine the tension in these wires.



Prob. F3-11

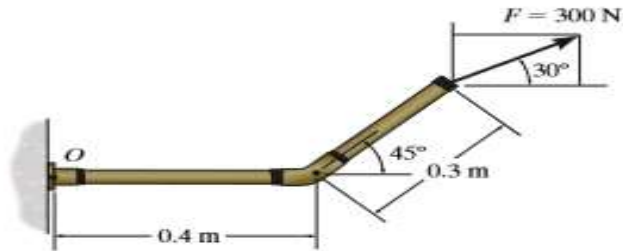
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F4-1. Determine the moment of the force about point O .



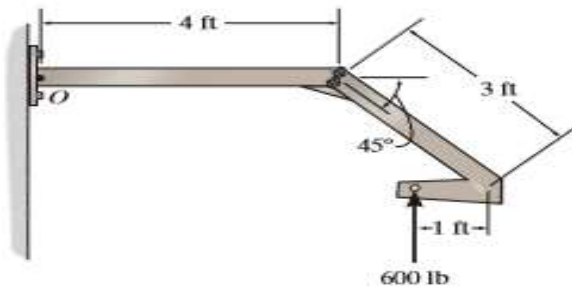
Prob. F4-1

F4-2. Determine the moment of the force about point O .



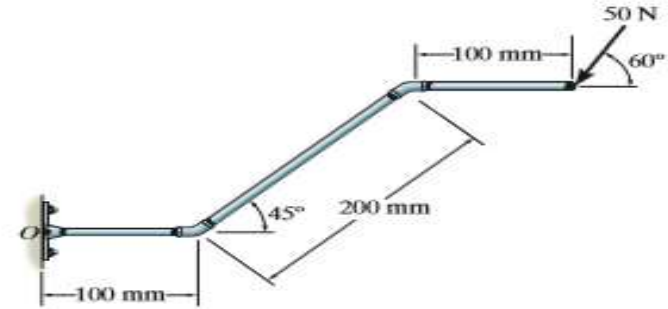
Prob. F4-2

F4-3. Determine the moment of the force about point O .



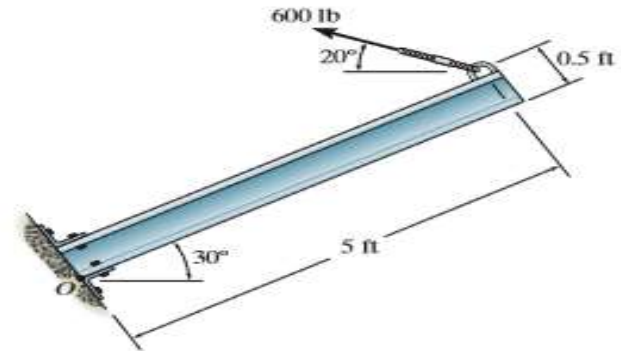
Prob. F4-3

F4-4. Determine the moment of the force about point O . Neglect the thickness of the member.



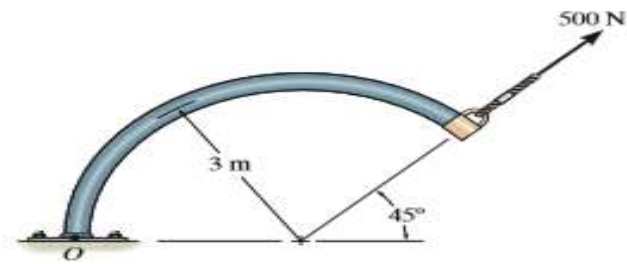
Prob. F4-4

F4-5. Determine the moment of the force about point O .



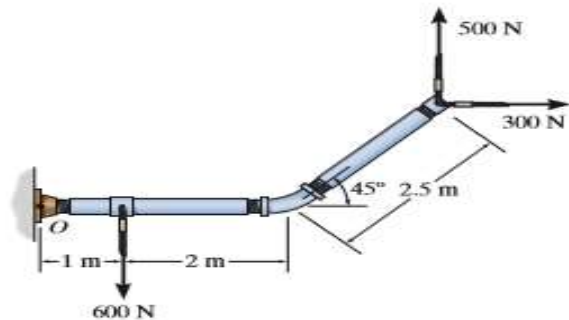
Prob. F4-5

F4-6. Determine the moment of the force about point O .



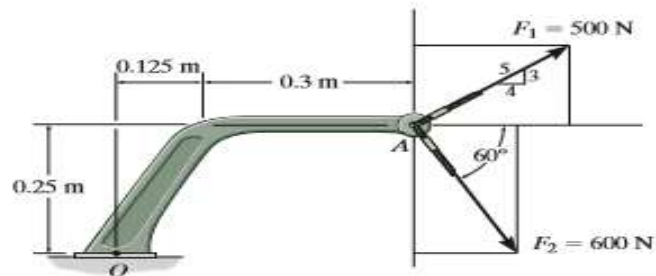
Prob. F4-6

F4-7. Determine the resultant moment produced by the forces about point O .



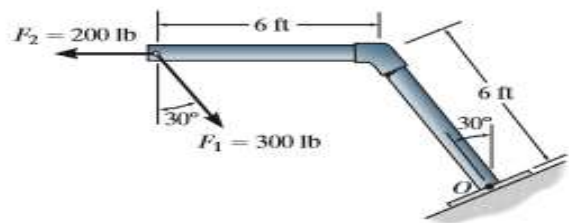
Prob. F4-7

F4-8. Determine the resultant moment produced by the forces about point O .



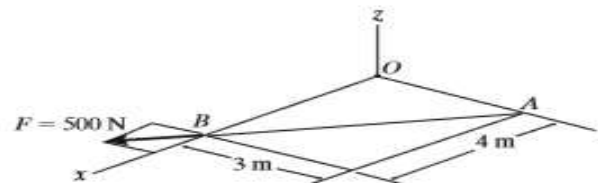
Prob. F4-8

F4-9. Determine the resultant moment produced by the forces about point O .



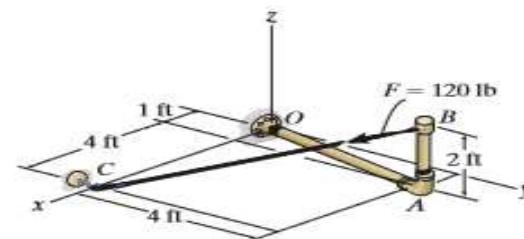
Prob. F4-9

F4-10. Determine the moment of force F about point O . Express the result as a Cartesian vector.



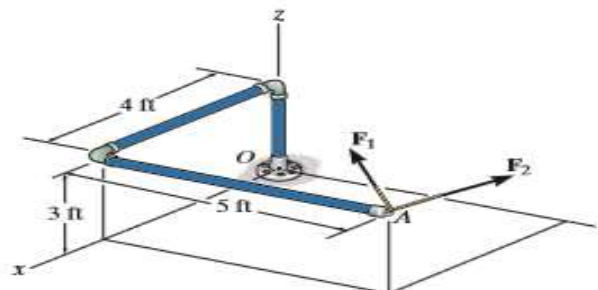
Prob. F4-10

F4-11. Determine the moment of force F about point O . Express the result as a Cartesian vector.



Prob. F4-11

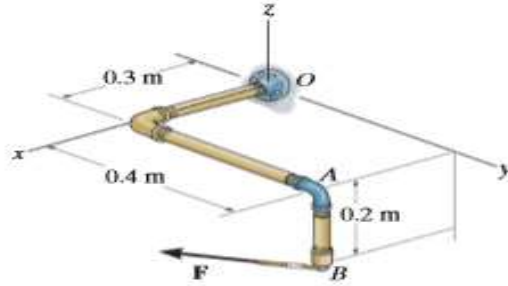
F4-12. If the two forces $F_1 = \{100\mathbf{i} - 120\mathbf{j} + 75\mathbf{k}\}$ lb and $F_2 = \{-200\mathbf{i} + 250\mathbf{j} + 100\mathbf{k}\}$ lb act at A , determine the resultant moment produced by these forces about point O . Express the result as a Cartesian vector.



Prob. F4-12

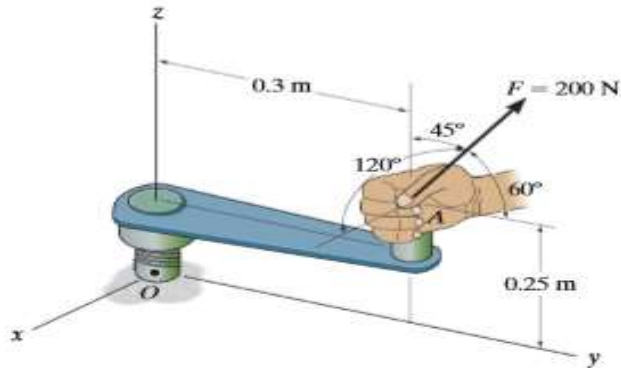
F4-13. Determine the magnitude of the moment of the force $\mathbf{F} = \{300\mathbf{i} - 200\mathbf{j} + 150\mathbf{k}\}$ N about the x axis.

F4-14. Determine the magnitude of the moment of the force $\mathbf{F} = \{300\mathbf{i} - 200\mathbf{j} + 150\mathbf{k}\}$ N about the OA axis.



Probs. F4-13/14

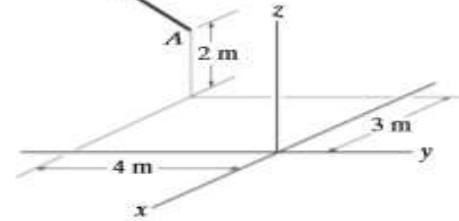
F4-15. Determine the magnitude of the moment of the 200-N force about the x axis. Solve the problem using both a scalar and a vector analysis.



Prob. F4-15

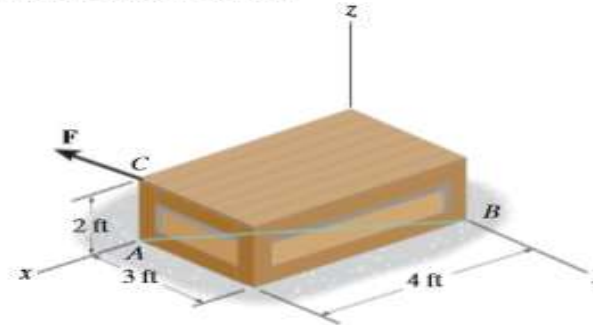
F4-16. Determine the magnitude of the moment of the force about the y axis.

$$\mathbf{F} = \{30\mathbf{i} - 20\mathbf{j} + 50\mathbf{k}\} \text{ N}$$



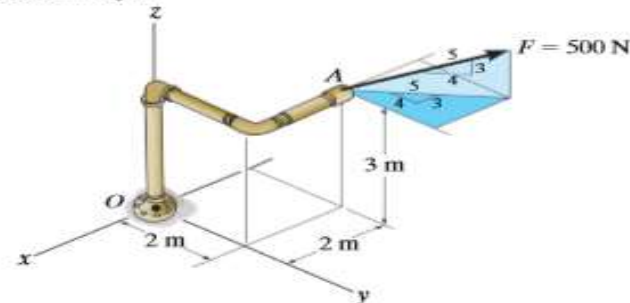
Prob. F4-16

F4-17. Determine the moment of the force $\mathbf{F} = \{50\mathbf{i} - 40\mathbf{j} + 20\mathbf{k}\}$ lb about the AB axis. Express the result as a Cartesian vector.



Prob. F4-17

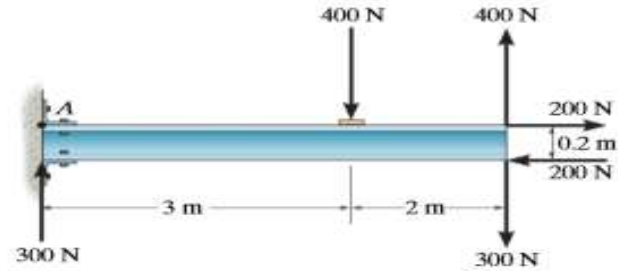
F4-18. Determine the moment of force \mathbf{F} about the x , the y , and the z axes. Solve the problem using both a scalar and a vector analysis.



Prob. F4-18

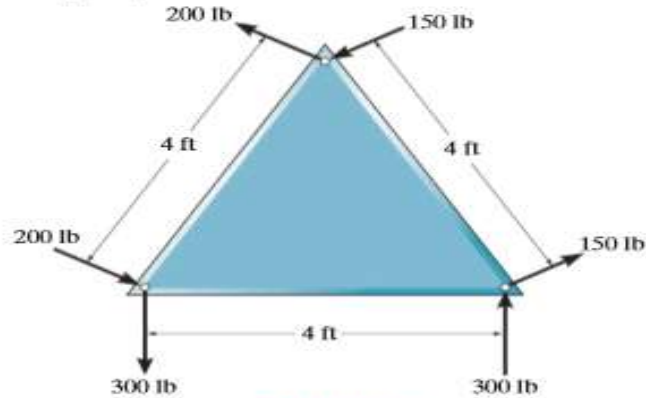
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F4-19. Determine the resultant couple moment acting on the beam.



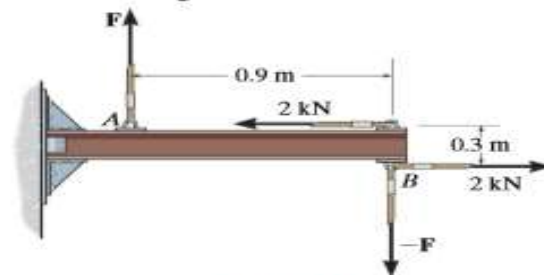
Prob. F4-19

F4-20. Determine the resultant couple moment acting on the triangular plate.



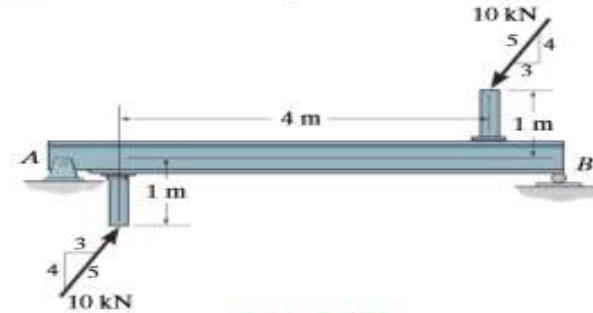
Prob. F4-20

F4-21. Determine the magnitude of F so that the resultant couple moment acting on the beam is $1.5 \text{ kN} \cdot \text{m}$ clockwise.



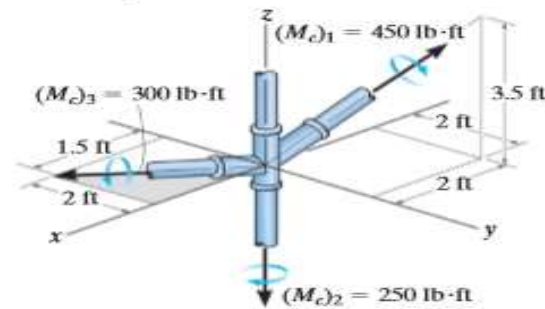
Prob. F4-21

F4-22. Determine the couple moment acting on the beam.



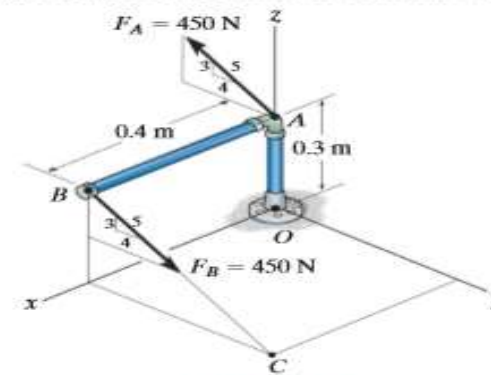
Prob. F4-22

F4-23. Determine the resultant couple moment acting on the pipe assembly.



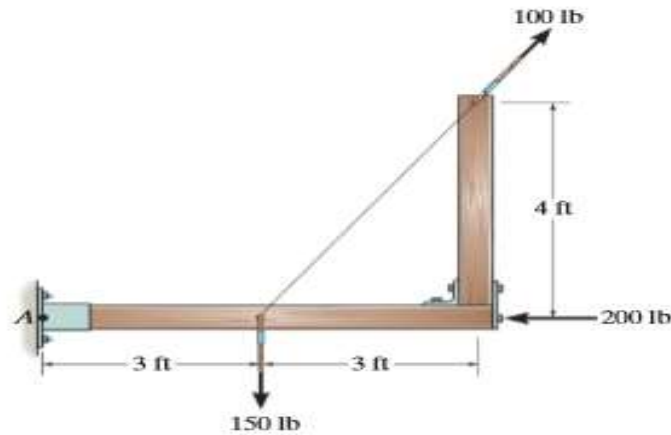
Prob. F4-23

F4-24. Determine the couple moment acting on the pipe assembly and express the result as a Cartesian vector.



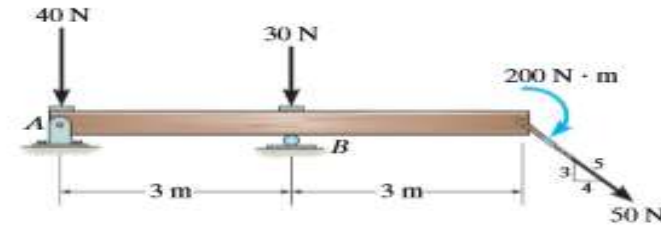
Prob. F4-24

F4-25. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



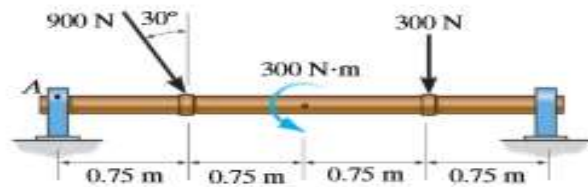
Prob. F4-25

F4-26. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



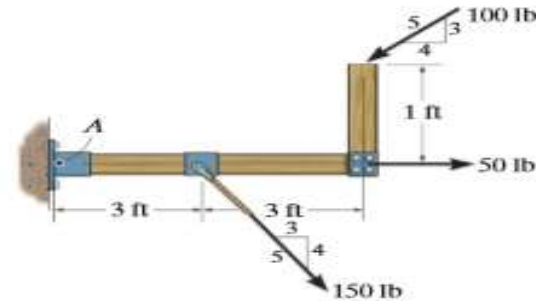
Prob. F4-26

F4-27. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



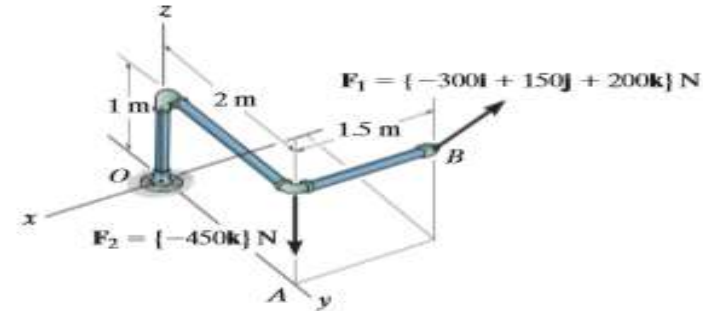
Prob. F4-27

F4-28. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



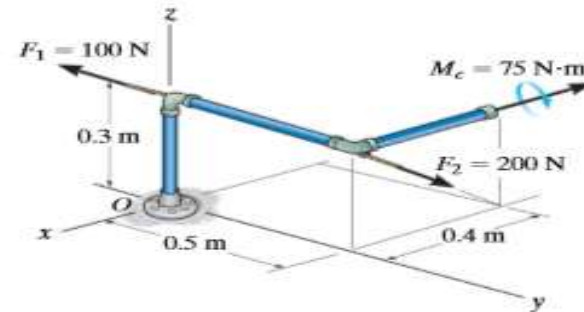
Prob. F4-28

F4-29. Replace the loading system by an equivalent resultant force and couple moment acting at point O.



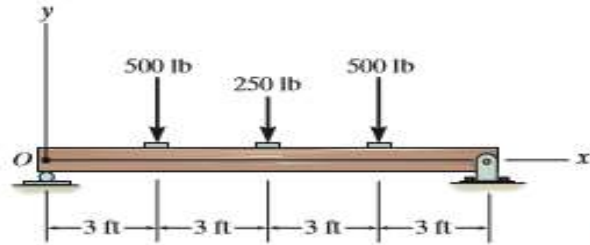
Prob. F4-29

F4-30. Replace the loading system by an equivalent resultant force and couple moment acting at point O.



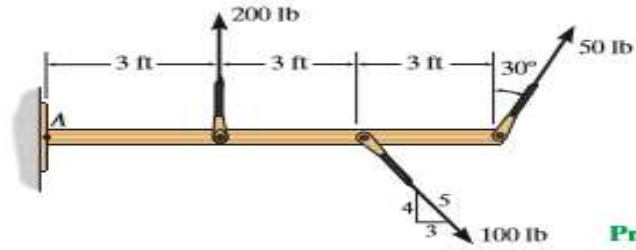
Prob. F4-30

F4-31. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the beam measured from O .



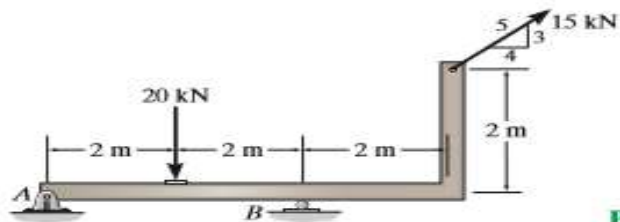
Prob. F4-31

F4-32. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the member measured from A .



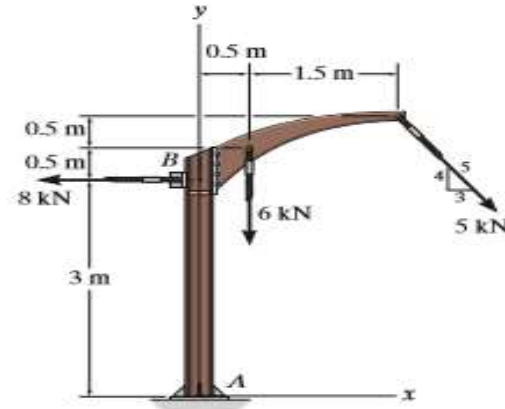
Prob. F4-32

F4-33. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the horizontal segment of the member measured from A .



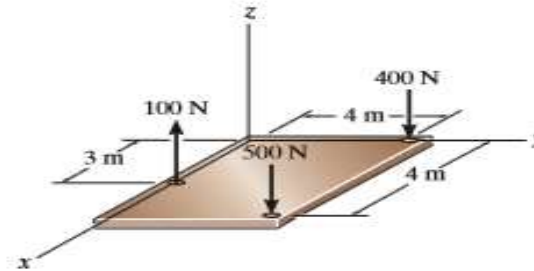
Prob. F4-33

F4-34. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the member AB measured from A .



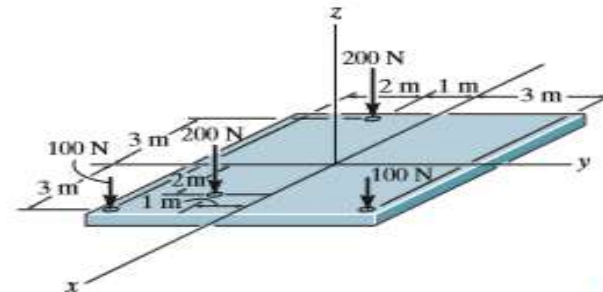
Prob. F4-34

F4-35. Replace the loading shown by an equivalent single resultant force and specify the x and y coordinates of its line of action.



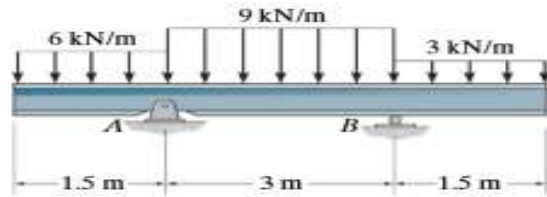
Prob. F4-35

F4-36. Replace the loading shown by an equivalent single resultant force and specify the x and y coordinates of its line of action.



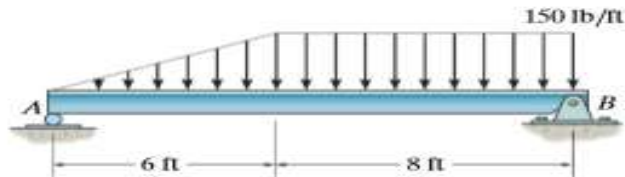
Prob. F4-36

F4-37. Determine the resultant force and specify where it acts on the beam measured from A .



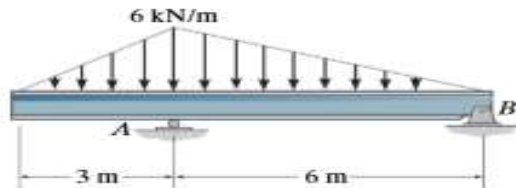
Prob. F4-37

F4-38. Determine the resultant force and specify where it acts on the beam measured from A .



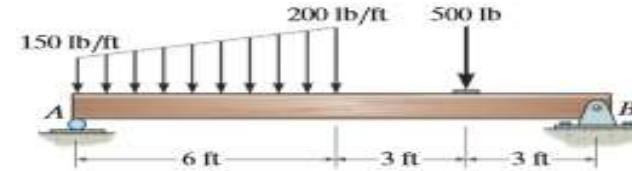
Prob. F4-38

F4-39. Determine the resultant force and specify where it acts on the beam measured from A .



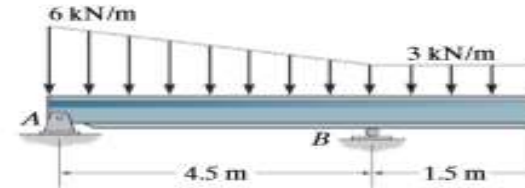
Prob. F4-39

F4-40. Determine the resultant force and specify where it acts on the beam measured from A .



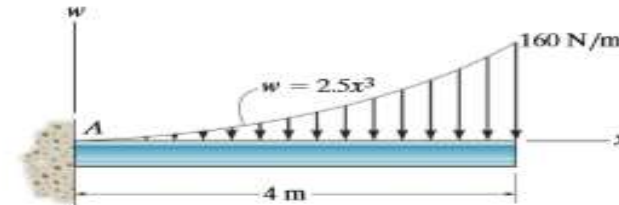
Prob. F4-40

F4-41. Determine the resultant force and specify where it acts on the beam measured from A .



Prob. F4-41

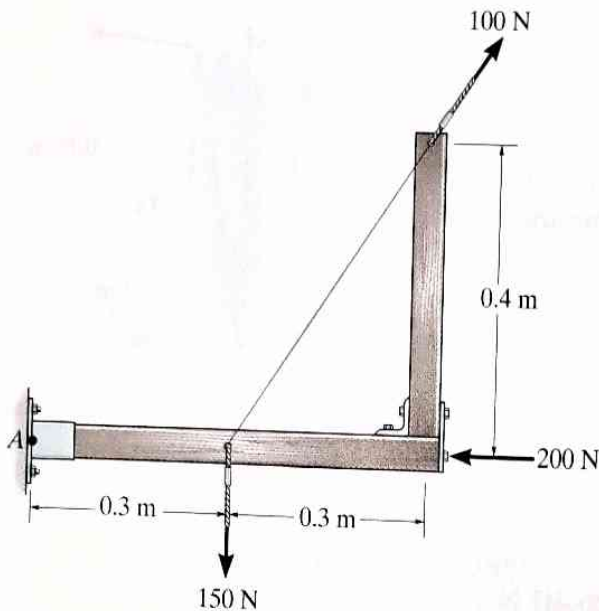
F4-42. Determine the resultant force and specify where it acts on the beam measured from A .



Prob. F4-42

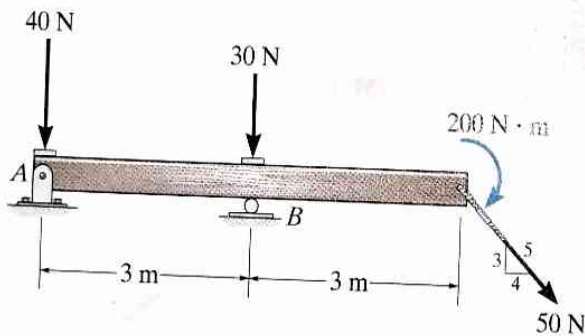
FUNDAMENTAL PROBLEMS

F4-25. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



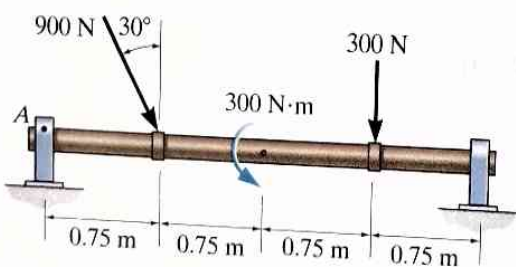
F4-25

F4-26. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



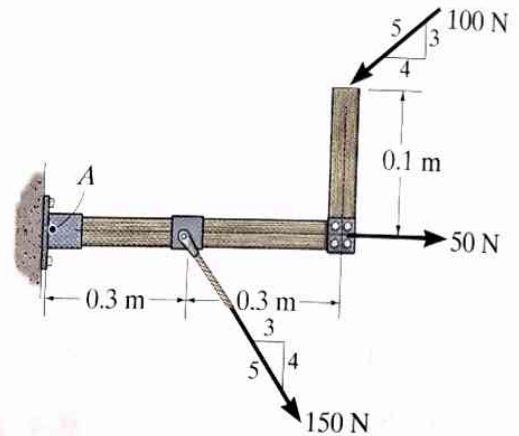
F4-26

F4-27. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



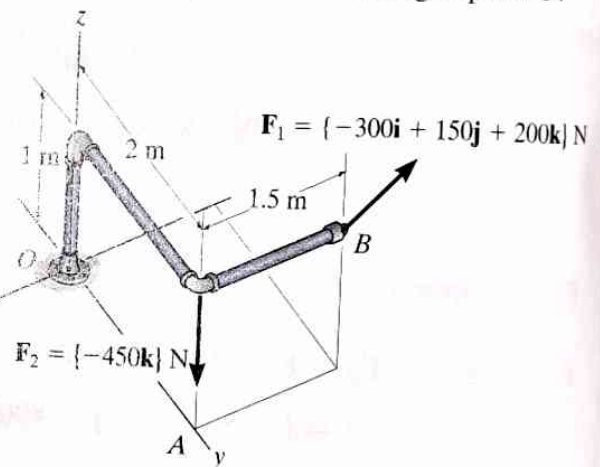
F4-27

F4-28. Replace the loading system by an equivalent resultant force and couple moment acting at point A.



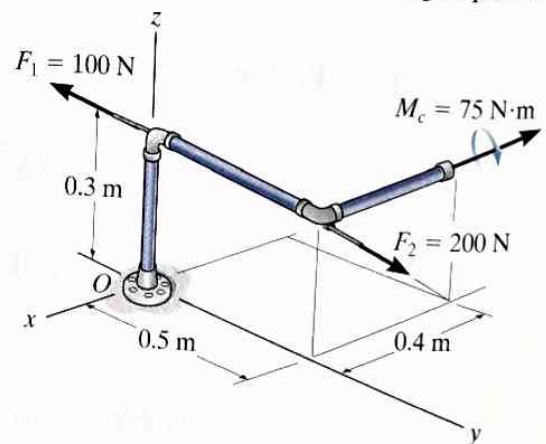
F4-28

F4-29. Replace the loading system by an equivalent resultant force and couple moment acting at point O.



F4-29

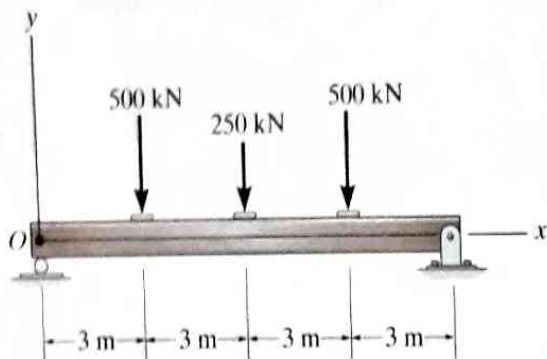
F4-30. Replace the loading system by an equivalent resultant force and couple moment acting at point O.



F4-30

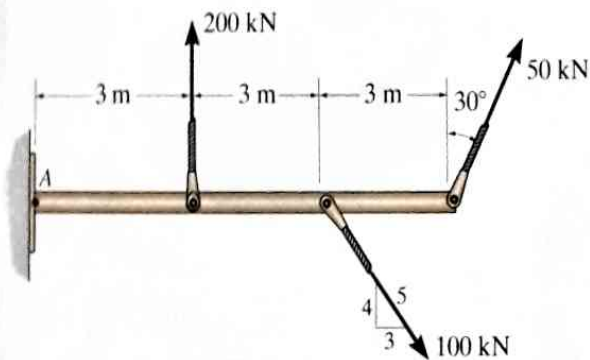
FUNDAMENTAL PROBLEMS

F4-31. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the beam measured from O .



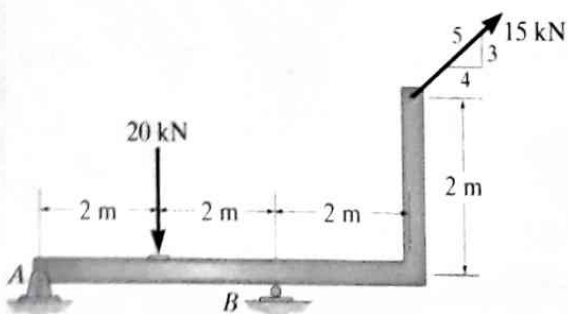
F4-31

F4-32. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the member measured from A .



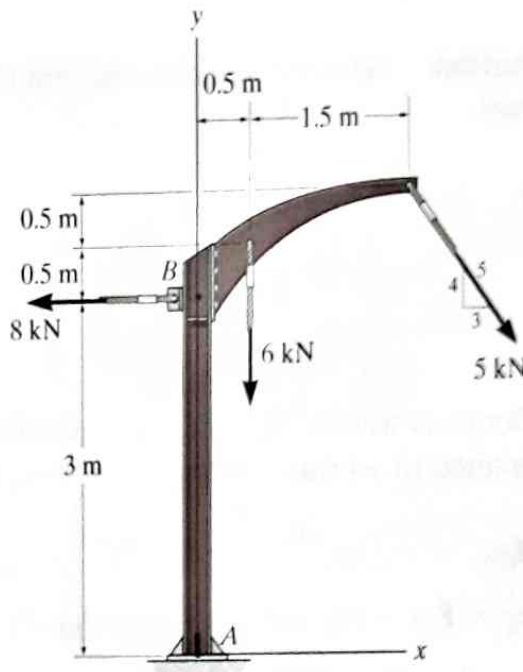
F4-32

F4-33. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the horizontal segment of the member measured from A .



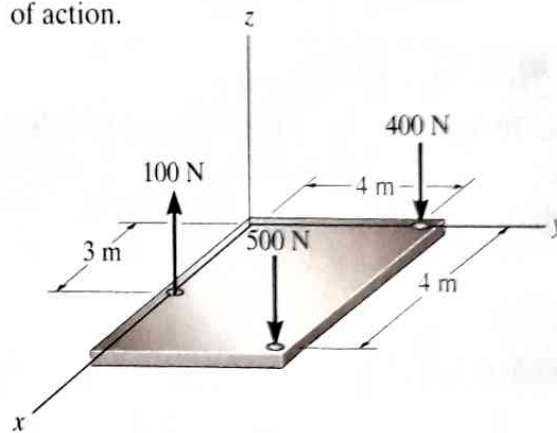
F4-33

F4-34. Replace the loading system by an equivalent resultant force and specify where the resultant's line of action intersects the member AB measured from A .



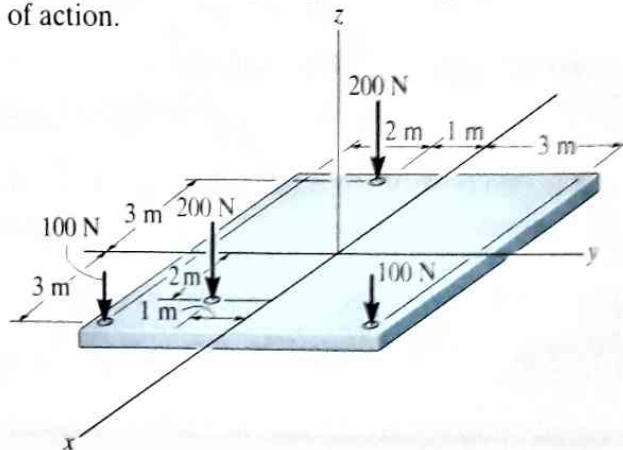
F4-34

F4-35. Replace the loading shown by an equivalent single resultant force and specify the x and y coordinates of its line of action.



F4-35

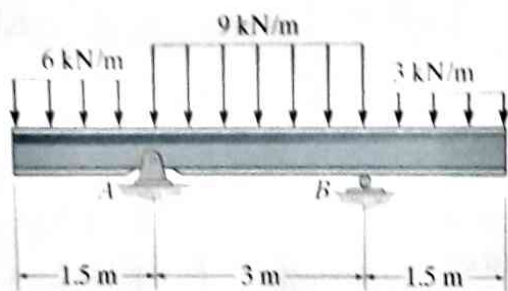
F4-36. Replace the loading shown by an equivalent single resultant force and specify the x and y coordinates of its line of action.



F4-36

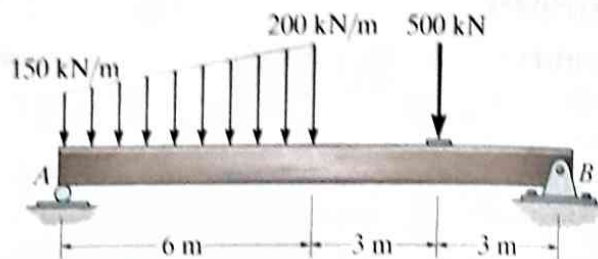
FUNDAMENTAL PROBLEMS

F4-37. Determine the resultant force and specify where it acts on the beam measured from A .



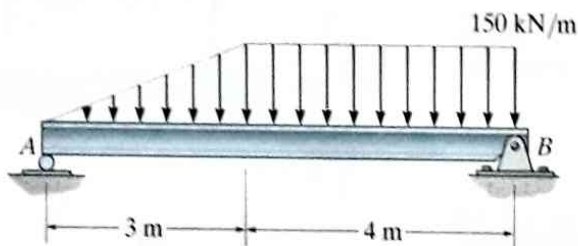
F4-37

F4-40. Determine the resultant force and specify where it acts on the beam measured from A .



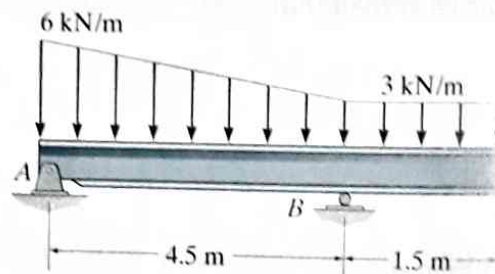
F4-40

F4-38. Determine the resultant force and specify where it acts on the beam measured from A .



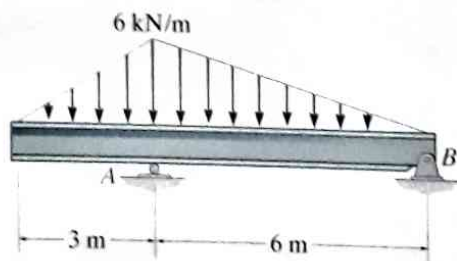
F4-38

F4-41. Determine the resultant force and specify where it acts on the beam measured from A .



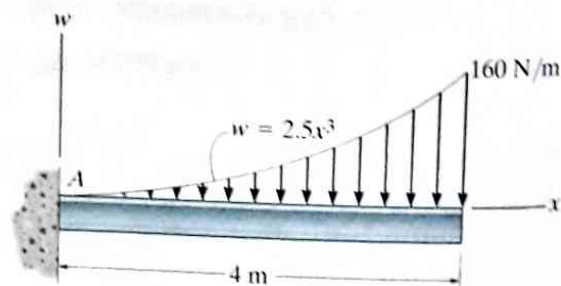
F4-41

F4-39. Determine the resultant force and specify where it acts on the beam measured from A .



F4-39

F4-42. Determine the resultant force and specify where it acts on the beam measured from A .

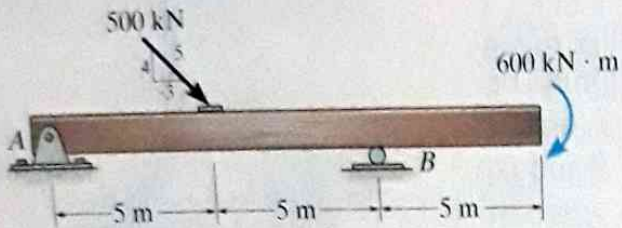


F4-42

FUNDAMENTAL PROBLEMS

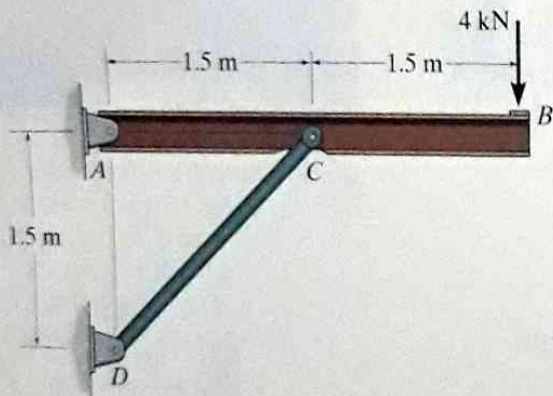
All problem solutions must include an FBD.

F5-1. Determine the horizontal and vertical components of reaction at the supports. Neglect the thickness of the beam.



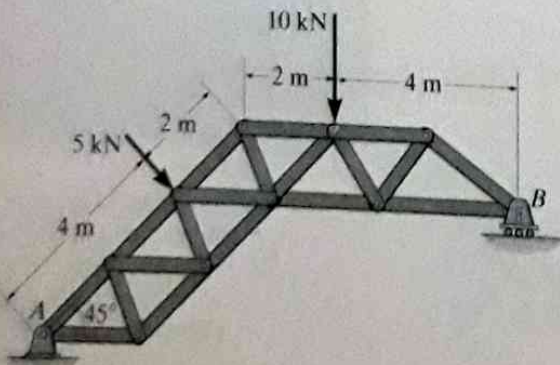
F5-1

F5-2. Determine the horizontal and vertical components of reaction at the pin A and the reaction on the beam at C.



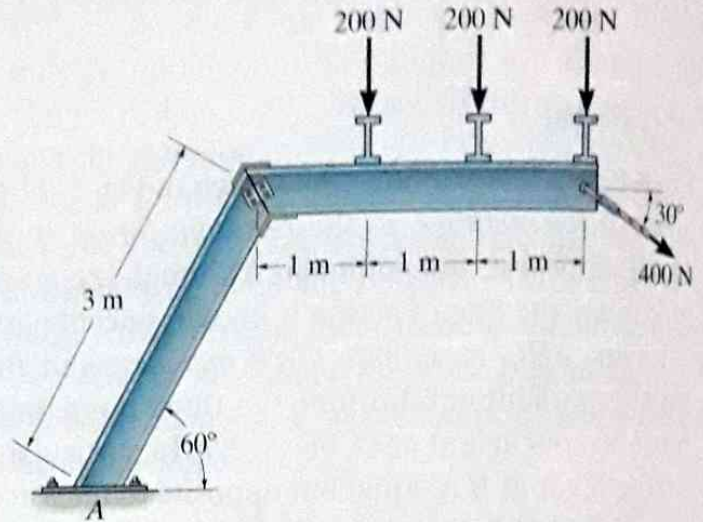
F5-2

F5-3. The truss is supported by a pin at A and a roller at B. Determine the support reactions.



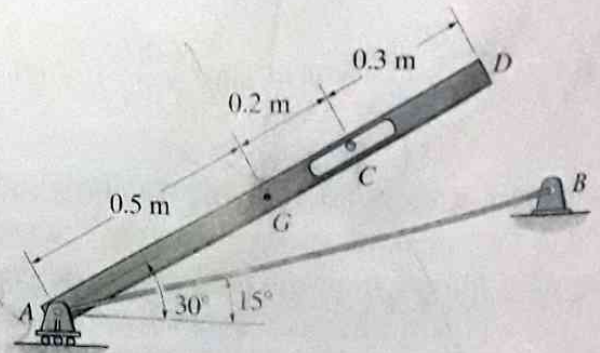
F5-3

F5-4. Determine the components of reaction at the fixed support A. Neglect the thickness of the beam.



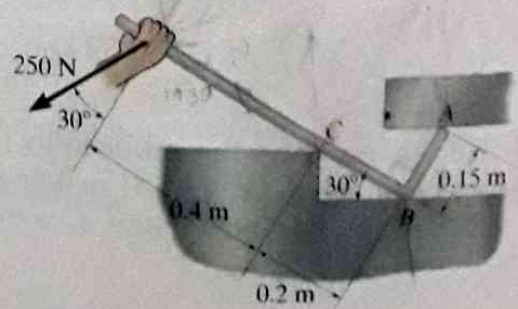
F5-4

F5-5. The 25-kg bar has a center of mass at G. If it is supported by a smooth peg at C, a roller at A, and cord AB, determine the reactions at these supports.



F5-5

F5-6. Determine the reactions at the smooth contact points A, B, and C on the bar.

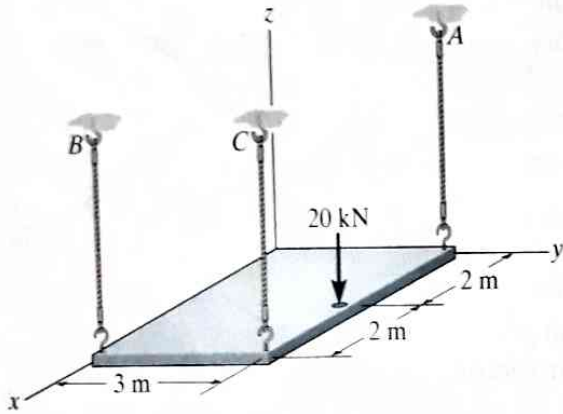


F5-6

FUNDAMENTAL PROBLEMS

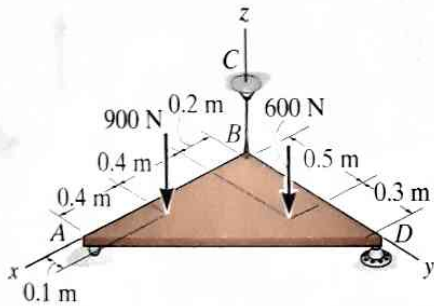
All problem solutions must include an FBD.

F5-7. The uniform plate has a weight of 50 kN. Determine the tension in each of the supporting cables.



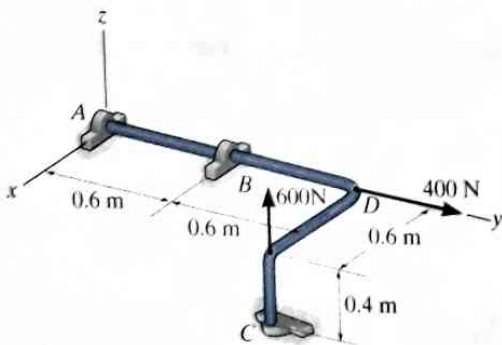
F5-7

F5-8. Determine the reactions at the roller support *A*, the ball-and-socket joint *D*, and the tension in cable *BC* for the plate.



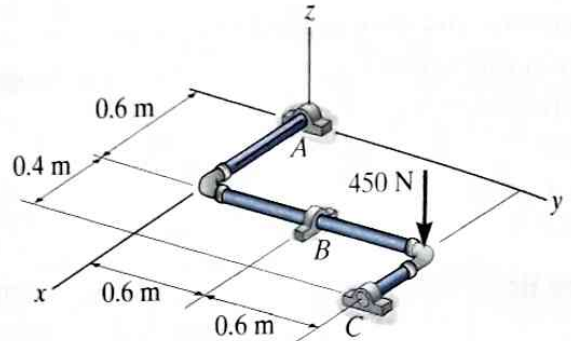
F5-8

F5-9. The rod is supported by smooth journal bearings at *A*, *B*, and *C* and is subjected to the two forces. Determine the reactions at these supports.



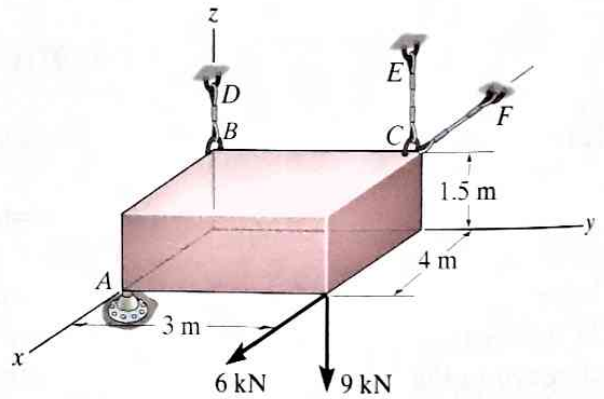
F5-9

F5-10. Determine the support reactions at the smooth journal bearings *A*, *B*, and *C* of the pipe assembly.



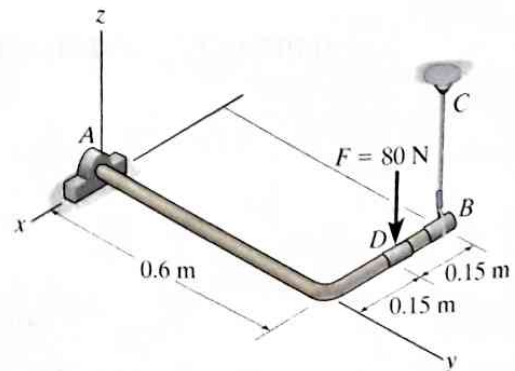
F5-10

F5-11. Determine the force developed in the short link *BD*, and the tension in the cords *CE* and *CF*, and the reactions of the ball-and-socket joint *A* on the block.



F5-11

F5-12. Determine the components of reaction that the thrust bearing *A* and cable *BC* exert on the bar.

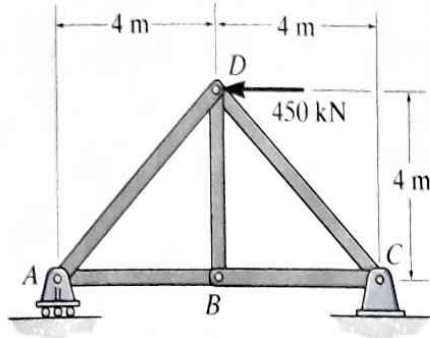


F5-12

FUNDAMENTAL PROBLEMS

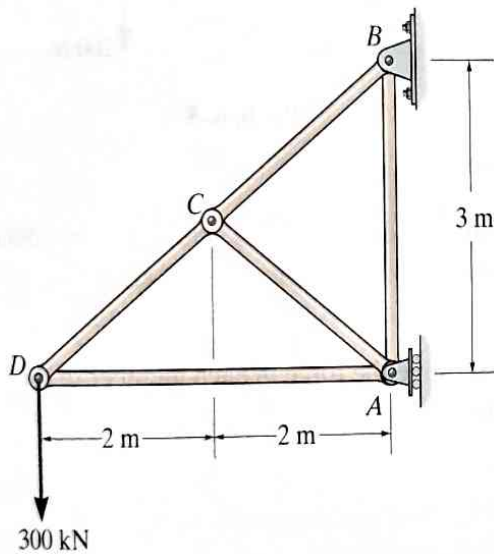
All problem solutions must include FBDs.

F6-1. Determine the force in each member of the truss. State if the members are in tension or compression.



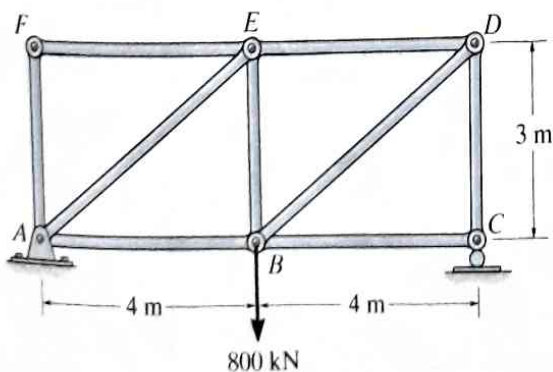
F6-1

F6-2. Determine the force in each member of the truss. State if the members are in tension or compression.



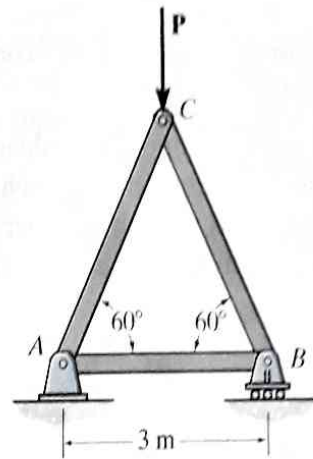
F6-2

F6-3. Determine the force in members AE and DC. State if the members are in tension or compression.



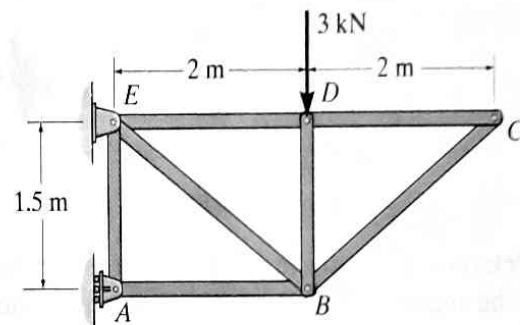
F6-3

F6-4. Determine the greatest load P that can be applied to the truss so that none of the members are subjected to a force exceeding either 2 kN in tension or 1.5 kN in compression.



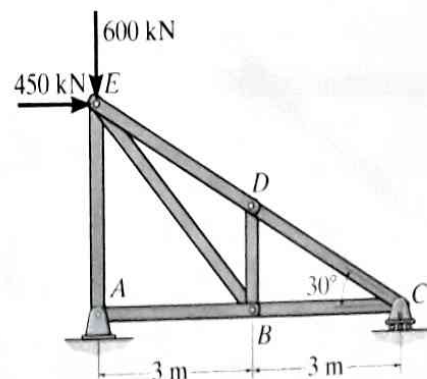
F6-4

F6-5. Identify the zero-force members in the truss.



F6-5

F6-6. Determine the force in each member of the truss. State if the members are in tension or compression.

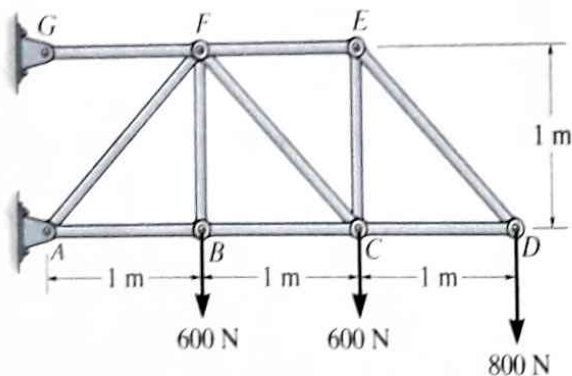


F6-6

FUNDAMENTAL PROBLEMS

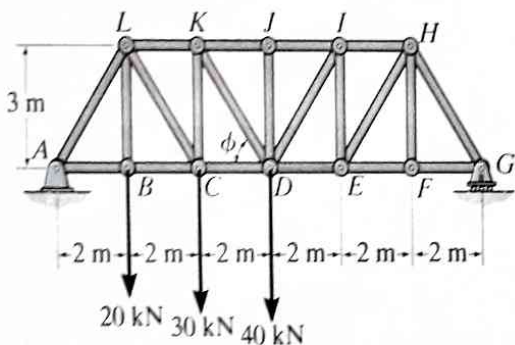
All problem solutions must include FBDs.

F6-7. Determine the force in members BC , CF , and FE . State if the members are in tension or compression.



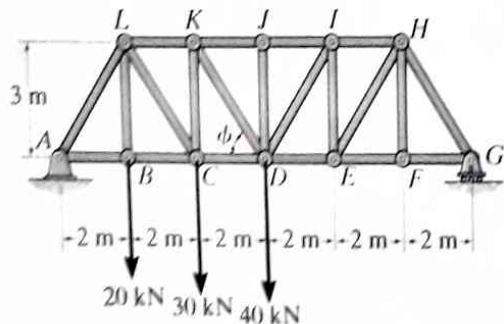
F6-7

F6-8. Determine the force in members LK , KC , and CD of the Pratt truss. State if the members are in tension or compression.



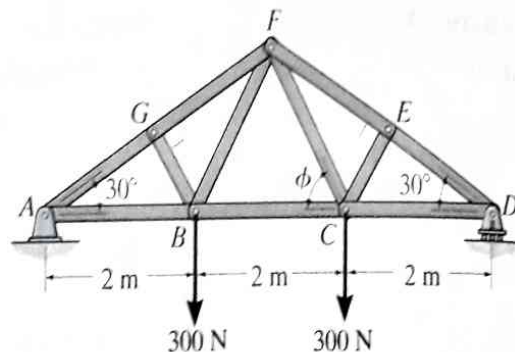
F6-8

F6-9. Determine the force in members KJ , KD , and CD of the Pratt truss. State if the members are in tension or compression.



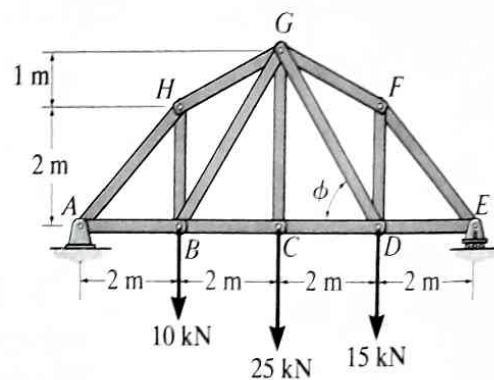
F6-9

F6-10. Determine the force in members EF , CF , and BC of the truss. State if the members are in tension or compression.



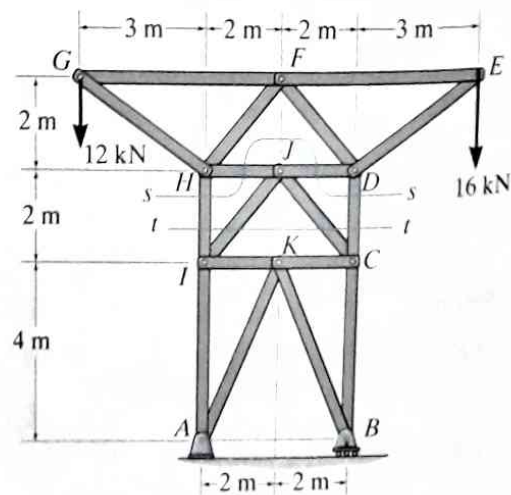
F6-10

F6-11. Determine the force in members GF , GD , and CD of the truss. State if the members are in tension or compression.



F6-11

F6-12. Determine the force in members DC , HI , and II of the truss. State if the members are in tension or compression. *Suggestion:* Use the sections shown.

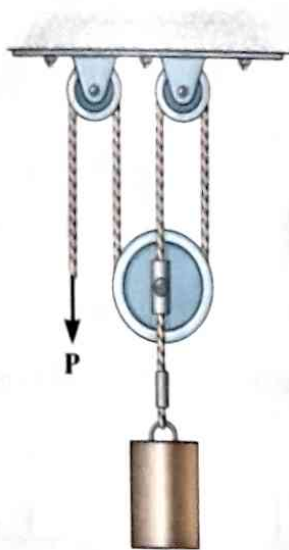


F6-12

FUNDAMENTAL PROBLEMS

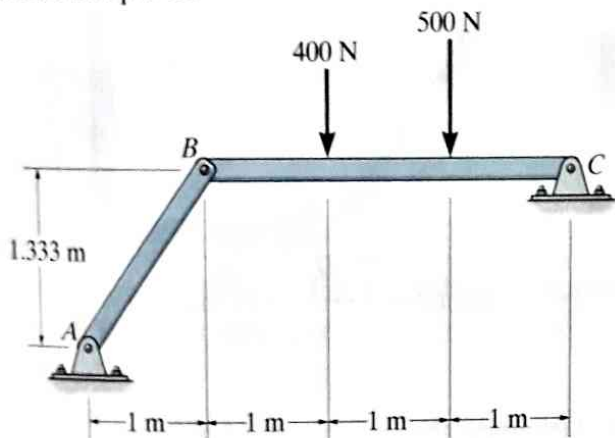
All problem solutions must include FBDs.

F6-13. Determine the force P needed to hold the 60-N weight in equilibrium.



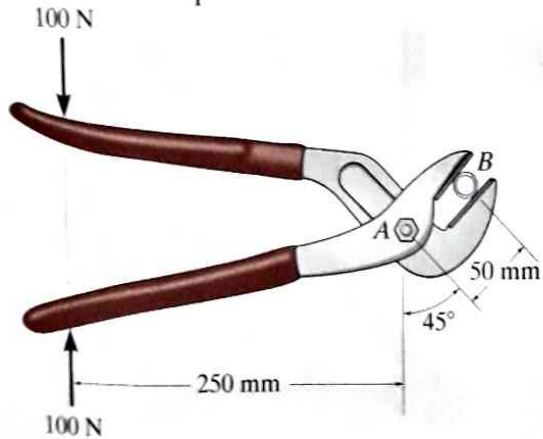
F6-13

F6-14. Determine the horizontal and vertical components of reaction at pin C .



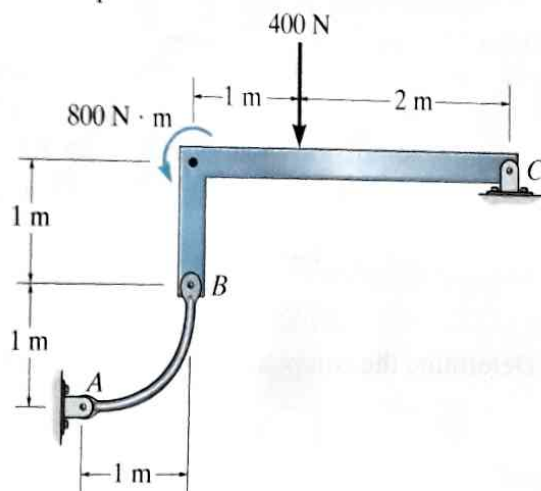
F6-14

F6-15. If a 100-N force is applied to the handles of the pliers, determine the clamping force exerted on the smooth pipe B and the magnitude of the resultant force that one of the members exerts on pin A .



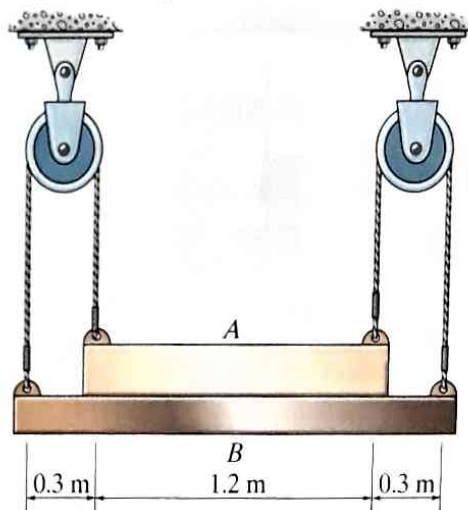
F6-15

F6-16. Determine the horizontal and vertical components of reaction at pin C .



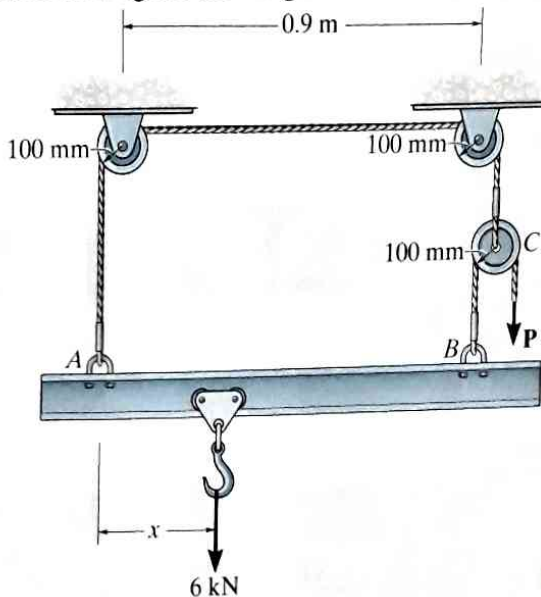
F6-16

F6-17. Determine the normal force that the 100-N plate A exerts on the 30-N plate B .



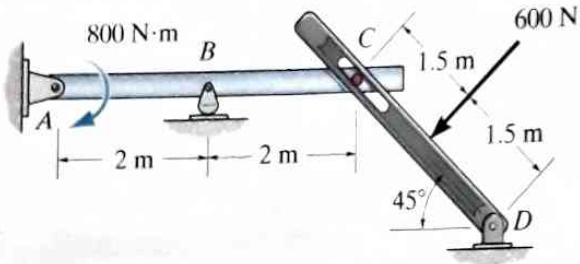
F6-17

F6-18. Determine the force P needed to lift the load. Also, determine the proper placement x of the hook for equilibrium. Neglect the weight of the beam.



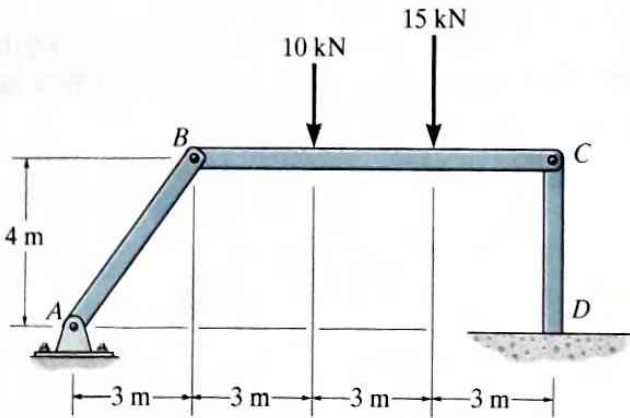
F6-18

F6-19. Determine the components of reaction at A and B.



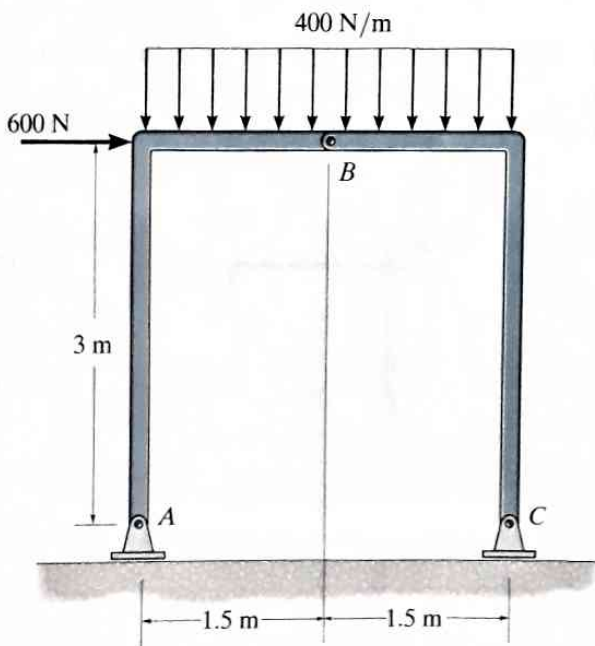
F6-19

F6-20. Determine the components of reaction at D.



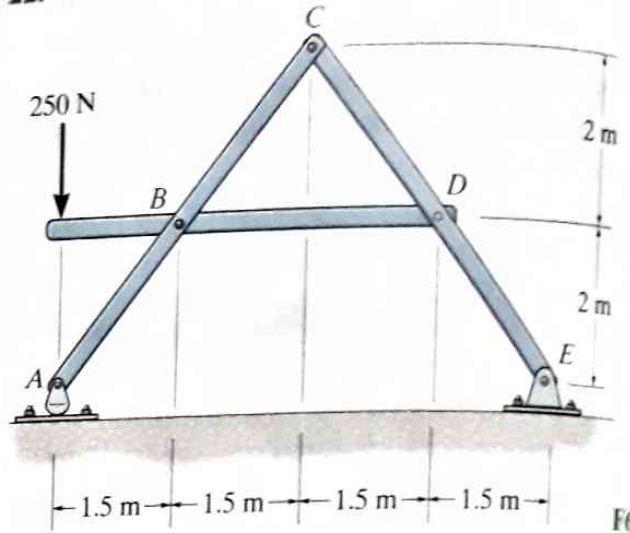
F6-20

F6-21. Determine the components of reaction at A and C.



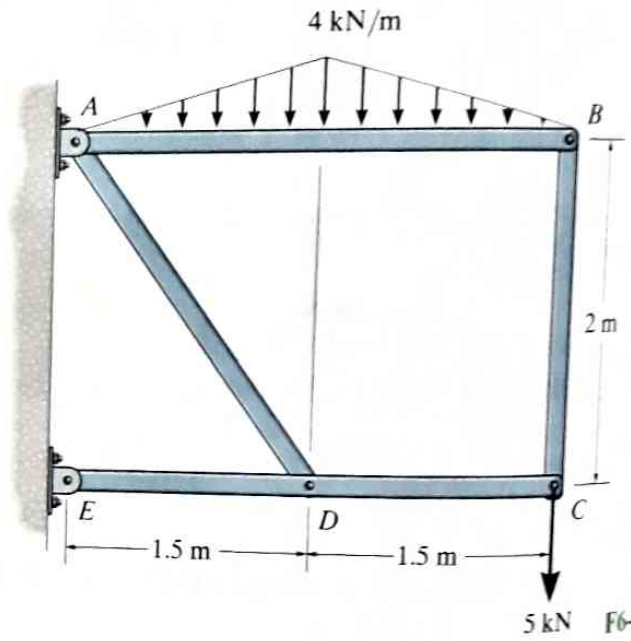
F6-21

F6-22. Determine the components of reaction at C.



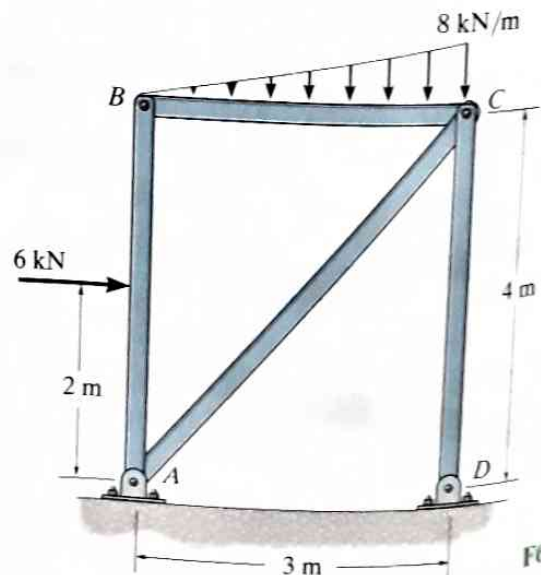
F6-22

F6-23. Determine the components of reaction at E.



F6-23

F6-24. Determine the components of reaction at D and the components of reaction the pin at A exerts on member BA.

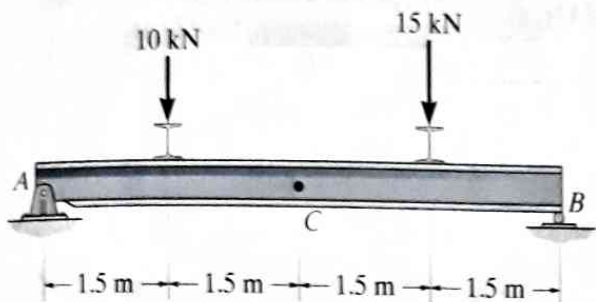


F6-24

FUNDAMENTAL PROBLEMS

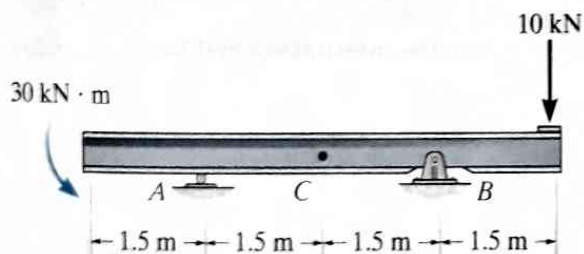
All problem solutions must include FBDs.

F7-1. Determine the normal force, shear force, and moment at point C.



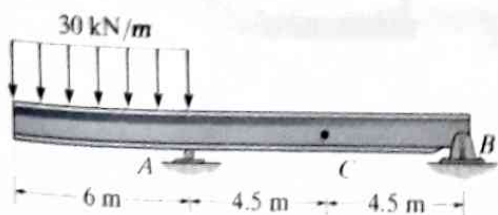
F7-1

F7-2. Determine the normal force, shear force, and moment at point C.



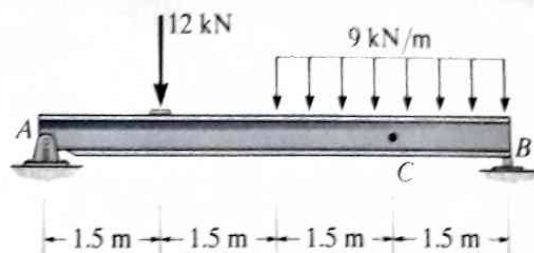
F7-2

F7-3. Determine the normal force, shear force, and moment at point C.



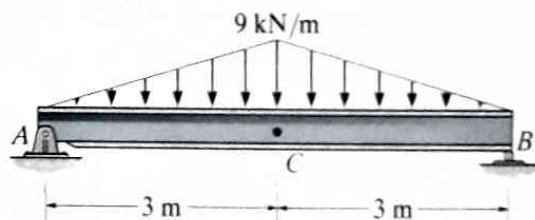
F7-3

F7-4. Determine the normal force, shear force, and moment at point C.



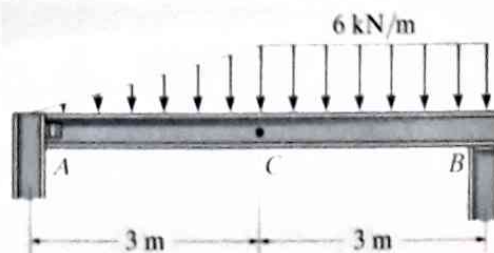
F7-4

F7-5. Determine the normal force, shear force, and moment at point C.



F7-5

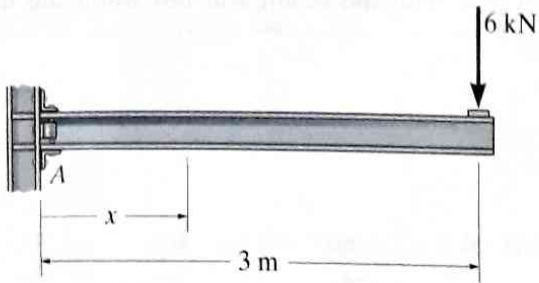
F7-6. Determine the normal force, shear force, and moment at point C. Assume A is pinned and B is a roller.



F7-6

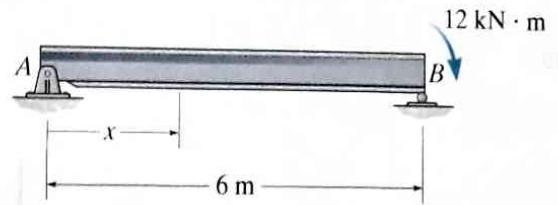
FUNDAMENTAL PROBLEMS

F7-7. Determine the shear and moment as a function of x , and then draw the shear and moment diagrams.



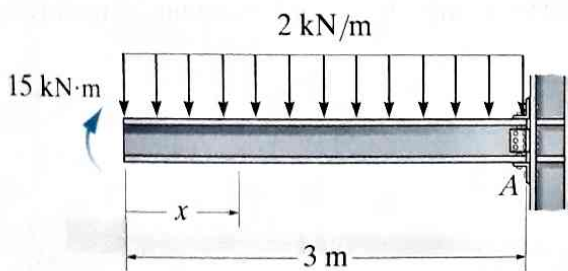
F7-7

F7-10. Determine the shear and moment as a function of x , and then draw the shear and moment diagrams.



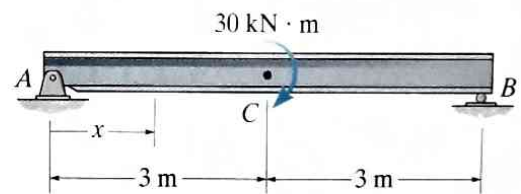
F7-10

F7-8. Determine the shear and moment as a function of x , and then draw the shear and moment diagrams.



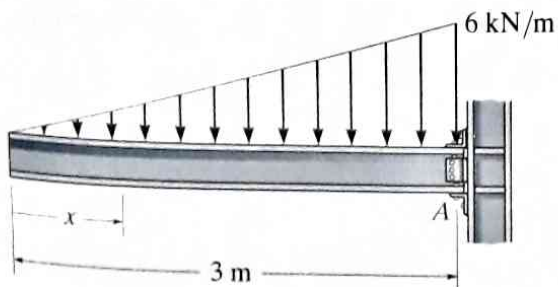
F7-8

F7-11. Determine the shear and moment as a function of x , where $0 \leq x < 3$ m and 3 m $< x \leq 6$ m, and then draw the shear and moment diagrams.



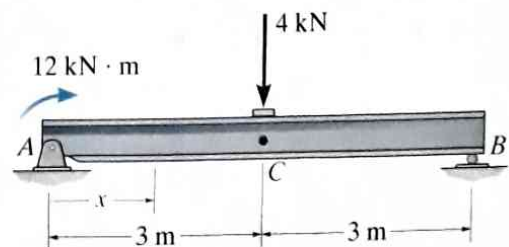
F7-11

F7-9. Determine the shear and moment as a function of x , and then draw the shear and moment diagrams.



F7-9

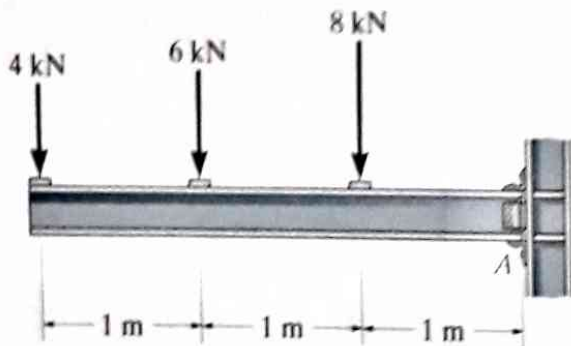
F7-12. Determine the shear and moment as a function of x , where $0 \leq x < 3$ m and 3 m $< x \leq 6$ m, and then draw the shear and moment diagrams.



F7-12

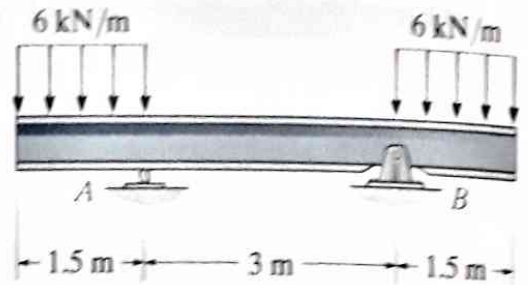
FUNDAMENTAL PROBLEMS

13. Draw the shear and moment diagrams for the beam.



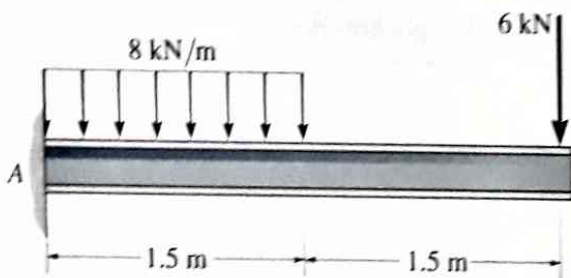
F7-13

F7-16. Draw the shear and moment diagrams for the beam.



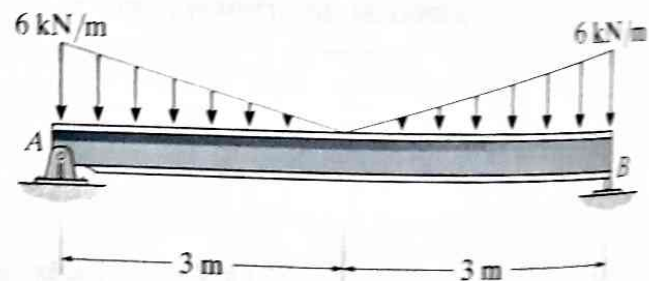
F7-16

14. Draw the shear and moment diagrams for the beam.



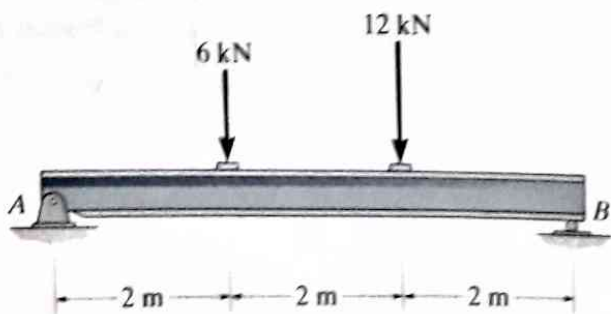
F7-14

F7-17. Draw the shear and moment diagrams for the beam.



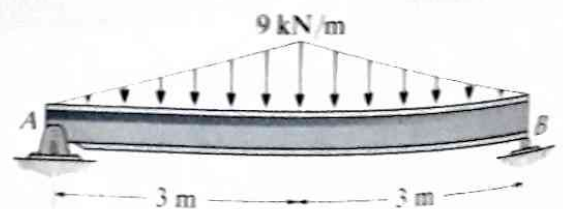
F7-17

15. Draw the shear and moment diagrams for the beam.



F7-15

F7-18. Draw the shear and moment diagrams for the beam.



F7-18